2:02 79

سیکٹر 5 پلاٹ نمبر 68 ایریا 5 کلیکشن سہ سائی ٹریکٹر کراچی (9) پلاٹ نمبر 49 سب حسینہ سینٹرل بیکاری کمپنی کراچی (10) سب حسینہ گلشن کراچی (7) تحصیل و مختیارکار ملیر کراچی (8) بحق آف ریونیو کیس آفس بلاک 79 پاک سیکریٹریٹ بالمقابل فائر MPA ہاؤس جنرک بی کمپنی سندھ ہائیکورٹ بعدالت علیہان درخواست گذار تنویر احمد ایڈووکیٹ کلیکشن ایجنسی ایڈمنسٹریٹر پروبیشن کیلئے دائر کیا ہے۔ مورخہ 28-2-2026 کو 830 بجے دن خود حاضر ہوں۔ مورخہ 63228 کو جاری ہوا بحکم سرشتہ دار 11346981

عدالتوں میں روزانہ بڑی مقدار میں کاغذی کارروائی ہوتی ہے جس کے باعث وقت کے ساتھ بہت سے ایسے پرانے یا غیر ضروری کاغذات جمع ہو جاتے ہیں جو ریکارڈ کا حصہ نہیں رہتے۔ بیچ شریڈر مشین کے ذریعے ایسے کاغذات کو ٹکڑوں میں تبدیل کر کے تلف کیا جائے گا جس سے حساس معلومات کے محفوظ کو بھی یقینی بنایا جا سکے گا۔ انھوں نے مزید کہا کہ جدید دفتری سہولتیں فراہم کرنے سے عدالتوں کی کارکردگی میں بہتری آئے گی۔

کاغذات کو محفوظ اور مؤثر طریقے سے تلف کرنے کے لیے مشینوں کی تنصیب کر دی گئی۔ ڈسٹرکٹ اینڈ سیشن جج بدین عبدالقدوس میمن کی جانب سے عدالتوں کی کارکردگی کو مزید بہتر بنانے اور غیر ضروری سرکاری دستاویزات کو محفوظ اور ماحول دوست طریقے سے تلف کرنے کے لیے ایک اہم اقدام اٹھایا گیا ہے۔ اس سلسلے میں ڈسٹرکٹ اینڈ سیشن جج بدین نے ضلع کی تمام عدالتوں کے ریڈرز میں بیچ شریڈر مشینیں تقسیم کی ہیں۔ اس موقع پر ڈسٹرکٹ اینڈ سیشن جج بدین عبدالقدوس میمن نے کہا کہ یہ مشینیں سپریم کورٹ

طریقے سے تلف کیا جائے۔ انھوں نے کہا کہ

جناح سندھ میڈیکل یونیورسٹی، کراچی
پروکیورمنٹ ڈیپارٹمنٹ

چھٹی منزل، ڈینٹل بلڈنگ JSMU، فون: 021-99205185 ایکسٹینشن (3009 اور 3012)

Ref No. JSMU/PROC/NIT/2026/288 Dated: 05-03-2026

ٹینڈر طلبی نوٹس

متعلقہ ٹیکس اتھارٹیز (NTN اور SRB) کے ساتھ رجسٹرڈ اور فعال ٹیکس گزار اور متعلقہ بولی دستاویز کے مطابق تجربہ اور قابلیت کی حامل معروف فرموں سے ای-پروکیورمنٹ ذریعے آن لائن جمع کرانے کے لیے ایک مرحلے پر دو لفافی طریقہ کار کے تحت سربمہر بولیاں مطلوب ہیں۔ صرف شعبہ نمبر 02 کے لیے، فرم (فرموں) کا PEC (پاکستان انجینئرنگ کونسل) میں مخصوص کیٹیگری اور مہارت کے ساتھ کارآمد لائسنس یافتہ ہونا، نیز متعلقہ بولی دستاویزات میں بیان کردہ تجربہ اور مطلوبہ صلاحیتیں رکھنا لازمی ہے، ورنہ بولی (بولیاں) مسترد کر دی جائیں گی۔

شعبہ نمبر	پروکیورمنٹ / کام کی تفصیل	زرِ بیعانہ / بڈ سیکیورٹی (کلٹ)	ٹینڈر فیس	مدتِ تکمیل	ٹینڈر کا طریقہ کار
1	JSMU کے مختلف شعبوں میں سی سی ٹی وی اور سروِیلنس ورکس	-/400,000 روپے	-/5000 روپے	02 ماہ	ایک مرحلے پر دو لفافی
2	جناح سندھ میڈیکل یونیورسٹی کراچی کی بجلری اپ گریڈیشن (پیکیج-01)	80 (ملین) روپے	-/5000 روپے	24 ماہ	

آن لائن بولی جمع کرانے / آن لائن ٹینڈر کھولنے کا شیڈول

شعبہ نمبر	پروکیورمنٹ / کام کا نام	درخواست کی وصولی اور ٹینڈر دستاویزات کا اجراء	ٹینڈر دستاویزات جمع کرانے کی آخری تاریخ (EPADs پر)	ٹینڈر کھولنے کا وقت (EPADs پر)
01	JSMU کے مختلف شعبوں میں سی سی ٹی وی اور سروِیلنس ورکس	11-03-2026 سے 27-03-2026 تک	28-03-2026 کو صبح 10:30 بجے تک	28-03-2026 کو صبح 11:00 بجے تک
02	جناح سندھ میڈیکل یونیورسٹی کراچی کی بجلری اپ گریڈیشن (پیکیج-01)	09-03-2026 سے 24-03-2026 تک	25-03-2026 کو صبح 09:30 بجے تک	25-03-2026 کو صبح 10:00 بجے تک

بمقام: آفس آف دی پروکیورمنٹ آفیسر، ڈیپارٹمنٹ، چھٹی منزل، JSMU

ٹینڈر دستاویزات، ٹینڈر دستاویزات کی فیس -/5,000 روپے (ہر ایک کے لیے) (ناقابلِ واپسی اور ناقابلِ منتقلی) جناح سندھ میڈیکل یونیورسٹی کے حق میں پے آرڈر کی صورت دفتری اوقات کے دوران جمع کرانے کے بعد پروکیورمنٹ آفیسر، چھٹی منزل، JSMU کے دفتر سے حاصل کیے جا سکتے ہیں یا جناح سندھ میڈیکل یونیورسٹی کی آفیشل ویب سائٹ (www.jsmu.edu.pk) یا سندھ پبلک پروکیورمنٹ ریگولیٹری اتھارٹی (SPPRA) کی آفیشل ویب سائٹ (www.eprocure.gov.pk) سے ڈاؤن لوڈ کیے جا سکتے ہیں۔

(a) ٹینڈر پروکیورمنٹ کمیٹی کی جانب سے شرکت کے خواہشمند بولی دہندگان یا ان کے مجاز نمائندوں کی موجودگی میں ای-پروکیورمنٹ کے قواعد کے مطابق کھولا جائے گا۔

(b) چھٹی یا کسی بھی وجہ سے کھلنے کی صورت میں، ٹینڈر زائد کے کام کے دن مقررہ شیڈول کے مطابق دستاویز اور اصل / جمع کیے کھولے جائیں گے۔

(c) تمام بولی دہندگان کو جائز NTN اور SRB سرٹیفکیٹس، اور بولی دستاویزات کے مطابق مطلوبہ دستاویزات ٹیکنیکل پروپوزل کے ساتھ منسلک کرنا لازمی ہے۔ مکمل ٹیکنیکل اور خام نمونہ جات پروپوزل کا ضروری حصہ ہوں گے، بصورت دیگر بولی مسترد کر دی جائے گی۔

(d) وفاقی، صوبائی یا مقامی حکومت کے تحت تمام لاگو ٹیکسز بولی دہندہ / سپلائر کی ذمہ داری ہوں گے۔

(e) مذکورہ بالا ٹینڈر طریقہ کار SPPRA رولز 2010 (2025 تک ترمیم شدہ) کے مطابق پروکیورمنٹ کے لیے اپنایا جائے گا۔

(f) ٹیکنیکل پروپوزل اور خام نمونہ جات پروپوزل الگ الگ EPADS ویب سائٹ پر بڈنگ دستاویزات میں بیان کردہ کے مطابق اپلوڈ کیے جانے چاہئیں۔ سربمہر بولیوں کی ایک ہارڈ کاپی، اصل زرِ بیعانہ اور ٹینڈر فیس (اگر لاگو ہو) کی صورت میں بھی ٹینڈر کے لیے الگ الگ سربمہر لفافے میں ٹینڈر جمع کرانے کی حتمی اور وقت (لازمی) پر / اس سے پہلے جمع کرانا ضروری ہے۔ زرِ بیعانہ صرف پے آرڈر / پیمنٹ گارنٹی کی صورت میں قابلِ قبول ہوگی۔

(g) بولی دہندہ کو -/500 روپے کے جوڈیشل اسٹامپ پیپر پر ایک حلف نامہ آن لائن بولی میں شامل کرنا ہوگا کہ فرم کو پاکستان بھر میں کسی بھی سرکاری، نیم سرکاری یا نجی شعبے سے کبھی بلیک لسٹ نہیں کیا گیا۔ اگر کسی بھی مرحلے پر فرم بلیک لسٹ پائی گئی تو بولی مسترد کر دی جائے گی۔ کسی بھی قانونی پڑتال / جانچ کی صورت میں، فرم کو قانونی پڑتال / جانچ کی تفصیلات اور اختیار تفویض میں موجودہ حیثیت کا اظہار کرنا ہوگا۔

(h) پروکیورمنٹ ایجنسی SPPRA رولز 2010 (2025 تک ترمیم شدہ) کی متعلقہ دفعات کے تحت تمام یا کسی بھی بولی کو مسترد کر سکتی ہے۔ EPADS/SPPRA کے تمام شرائط و ضوابط لاگو ہوں گے۔

پروکیورمنٹ آفیسر
جناح سندھ میڈیکل یونیورسٹی

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GENDER SPECIALIST	Development, or a related field. **Experience:** • A minimum of seven (07) years of demonstrated post-qualification professional experience in gender mainstreaming and women's empowerment, preferably within large-scale, international development or humanitarian projects. • Proven experience in conducting gender analysis, developing Gender Action Plans (GAPs), and overseeing their implementation across multiple operational components. • In-depth familiarity and proven application of the gender requirements of the World Bank Environmental and Social Framework (ESF), including the risks of Gender-Based Violence (GBV). • Experience in community-driven development projects and working under conditions similar to those in Balochistan, including knowledge of local languages is a highly desirable advantage.

The **FPMU-IFRAP**, now invites eligible individuals to indicate their interest in providing the specified services. Interested consultants must submit detailed CVs demonstrating their qualifications to perform the services, as per the criteria defined in the **"Terms of Reference (TORs)"**. The TORs can be downloaded through the following link: **https://ifrap.org.pk/procurements-ifrap/**.

The **Expression of Interest (EOI)** must be submitted through the online portal within 15 days of the publication of this advertisement via the following link: **https://ifrap.org.pk/procurements-ifrap/**. Qualified female candidates are strongly encouraged to apply.

The attention of interested consultants is drawn to **Section III, paragraphs 3.14, 3.16, and 3.17** of the World Bank's "Procurement Regulations for IPF Borrowers" (February 2025), which set forth the World Bank's policy on conflict of interest.

Consultants will be selected in accordance with the procedures set out in the **World Bank Procurement Regulations for IPF Borrowers (February 2025)**.

In case of any query, please email Procurement Officer at khurram@ifrap.org.pk

PID(I)7215/25

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI

PROCUREMENT DEPARTMENT

6th Floor Dental Building JSMU, 021-99205185 Ext (3012 & 3009)

Ref No. JSMU/PROC/NIT/2026/288 Date: 05-03-2026

NOTICE INVITING TENDER

Sealed Bids are invited on SINGLE STAGE TWO ENVELOPE PROCEDURE through E-procurement online submission from Reputable Firms who must be registered and active tax payer with applicable Tax authorities (NTN, & SRB) and having relevant experience and capabilities as per relevant bidding document. Only for Serial #02, the firm(s) must be registered in PEC with valid license in specified category & specialties as well as relevant experience and required capabilities as stated in the relevant bidding documents of the tender else bid(s) shall be rejected.

S/N	Procurement / Work Description	Earnest Money/ Bid Security (Fixed)	Tender Fee	Completion Period	Tender Procedure
01.	CCTV & SURVEILLANCE WORK AT VARIOUS DEPARTMENTS OF JSMU	Rs. 400,000/-	Rs.5,000/-	02-Months	SINGLE STAGE TWO ENVELOPE
02.	STRENGTHENING/UPGRADATION OF JINNAH SINDH MEDICAL UNIVERSITY KARACHI (PACKAGE-01)	Rs. 80 (M)	Rs.5,000/-	24-Months	

SCHEDULE FOR ONLINE BID SUBMISSION/ONLINE OPENING OF TENDER

S/N	Name of Procurement/Work	Receiving application & Issuance of Tender documents	Submission of Tender Documents (on EPADS)	Opening of Tender (on EPADS)
01.	CCTV & SURVEILLANCE WORK AT VARIOUS DEPARTMENTS OF JSMU	From 11/03/2026 to 27/03/2026	Till 28/03/2026 up to 10:30 AM	Till 28/03/2026 up to 11:00 AM
02.	STRENGTHENING/UPGRADATION OF JINNAH SINDH MEDICAL UNIVERSITY KARACHI (PACKAGE-01)	From 09/03/2026 to 24/03/2026	Till 25/03/2026 up to 09:30 AM	Till 25/03/2026 up to 10.00 AM

VENUE: OFFICE OF THE PROCUREMENT OFFICER DEPARTMENT, 6th FLOOR, JSMU

Tender Documents can be obtained during office hours on payment of Tender Documents fees of Rs. 5,000/- (Each) (Non Refundable & Non Transferable) in shape of pay order in favor of JINNAH SINDH MEDICAL UNIVERSITY from the office of the Procurement Officer, 6th Floor, JSMU or can be downloaded from Jinnah Sindh Medical University official website www.jsmu.edu.pk or Sindh Public Procurement Regulatory Authority (SPPRA) official EPADS www.eprocure.gov.pk

(a)	The Tender shall be opened by the Procurement Committee in presence of the bidders or their authorized representative who wish to attend as per rules of E-procurement.
(b)	In case of holiday or any incident, tenders will be obtained/submitted/opened on the next working day as per given schedule.
(c)	All bidder must submit latest Certificates of NTN & SRB Certificate, along with required documents as per biding documents duly attached with Technical proposal. Complete technical & financial bids must stamped & signed else bid(s) shall be rejected.
(d)	All prescribed taxes applicable under Federal/Provincial/local Government shall be borne by Bidder/Supplier.
(e)	Above mentioned specified tender procedure shall be adopted for the procurement as per SPPRA Rules 2010 (Amended 2025).
(f)	**Technical Proposal & Financial proposal** shall be separately uploaded online on EPADS website as specified in the bidding documents. Separate copy of sealed bids in hardcopy, original Bid security & tender fees (in case of download) must be submitted on/before tender submission time & date ***(mandatory)*** at above mentioned address in sealed envelope for each tender separately. Bid security shall be furnished in favor of JINNAH SINDH MEDICAL UNIVERSITY. ***The bid Security shall be only acceptable in shape of Pay order/Bank draft only.***
(g)	The firm/bidder must enclose in online bid an affidavit on judicial stamp paper of **Rs. 500/-** that the firm / bidder has never been blacklisted from any Government/semi Government/Private or Public Sector all over the Pakistan. If at any stage firm /bidder found blacklisted the bid shall be rejected & not be considered further. In case of any litigation, the firm must mentioned the litigation details & current status in the undertaking.
(h)	Procurement agency may reject all or any Bid subject to the relevant provision of SPPRA Rules 2010 (Amended 2025). All Terms & Conditions of SPPRA/EPADS shall be applicable.

PROCUREMENT OFFICER
Jinnah Sindh Medical University

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international peace and security."

Advocating a change of course, he said, the upsurge has generated new geopolitical and geo-economic pressures. "If not managed responsibly, competition over natural resources can affect supply chains, aggravate tensions, undermine sovereignty, and contribute to instability."

In this regard, the Pakistani envoy underscored that shared water resources are indispensable for sustaining life, and for sustainable development and prosperity.

"We reject the weaponization of water to choke this lifeline for lower riparians, also threatening regional peace, security and stability," Ambassador Asim Ahmad said.

Pakistan, he said, is itself confronted with water terrorism by India that has resorted to unilateral and unlawful action of putting in abeyance the 1960 Indus Waters Treaty in violations of international law and the provisions of that Treaty.

"The international community must impress upon India to return to full compliance with the Indus Waters Treaty, which remains valid and in-force as per the August 2025 award of the Court of Arbitration."

United States Secretary of Energy Chris Wright chaired the meeting, as US holds the presidency of the Security Council for the month of March.

"Where mineral wealth intersects with weak governance, entrenched poverty and external interference, the risks of instability

"Efforts to secure s
must not devolve into
politics, economic coerci
exclusionary arrangem
thereby ensuring that s
chain diversification doe
become a tool for geopol
containment. Fragment
of global markets
undermine both e
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collective security."

In this era
technological transform
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critical minerals must re
firmly anchored in the
Charter and internationa
Managed in accordance
these principles,
resources could
sustainable development
shared global prosperity.

"Mismanaged
exploited, they risk deep
inequalities and intensi
geopolitical tensions,"
added.

Opening the de
Rosemary DiCarlo, U
Nations Under-Secre
General for Political
Peacebuilding Affairs,
the Security Council
critical minerals are
"among the main drive
the twenty-first-ce
economy", essential
everything from smartph
to electric vehicles

Nepal's vote count puts ex-rapper's party ahead in two-thirds of seats

The party of Nepali rapper-turned-politician Balendra Shah was ahead on Friday in more than two-thirds of seats where leads were available in general elections, outpacing rivals, including the former prime minister ousted in last year's uprising.

Shah, 35, the former mayor of Kathmandu, the capital, has dominated the race to become prime minister during the campaign, gaining near-rockstar like fame on social media across the Himalayan nation in the wake of the youth-led uprising.

"I voted for Rastriya Swatantra Party because Balen is there," said Deepak Adhikari, 33, after voting for Shah's party in Kathmandu on Thursday, referring to the youthful leader by his popular name. "I believe he will become prime minister and make the country prosperous."

By noon on Friday, his centrist Rastriya Swatantra Party, founded three years ago, was leading in 52 of the 65 seats for which leads were available.

Vote counting was underway for 165 seats filled by direct election from a total of 275 in Nepal's lower house of parliament, while the rest are to be decided by a system of proportional

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10	Heavy Duty Gen

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6. Alternatively, the Bidding
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Address: Room N

Telephone No. +9

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI

STRENGTHENING / UPGRADATION OF JINNAH SINDH MEDICAL UNIVERSITY KARACHI (PACKAGE-01)

CONSTRUCTION OF ACADEMIC & ADMIN BUILDING

(ADP# 807 / 2025-26)

BIDDING & CONTRACT DOCUMENTS

VOLUME – I

(To be submitted as Financial Bid)

INVITATION FOR BIDS
INSTRUCTIONS TO BIDDERS & BIDDING DATA
SCHEDULES TO BID
CONDITIONS OF CONTRACT
STANDARD FORMS

MARCH 2026

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NOTICE INVITING TENDER

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INSTRUCTIONS TO BIDDERS

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INSTRUCTIONS TO BIDDERS

(Note: These Instructions to Bidders along with Bidding Data will not be part of the Contract and will cease to have effect once the contract is signed.)

A. GENERAL IB.1

Scope of Bid

1.1 The Procuring Agency as defined in the Bidding Data hereinafter called "the Procuring Agency" wishes to receive bids for the construction and completion of works as described in these Bidding Documents, and summarized in the Bidding Data hereinafter referred to as the "Works".

1.2 The successful bidder will be expected to complete the Works within the time specified in Appendix-A to Bid.

IB.2 Source of Funds

2.1 The project is an ADP scheme funded from Government of Sindh (ADP # 807/2025-26) as indicated in the bidding data towards the cost of the project /scheme specified in the bidding data, and it is intended that part of the proceeds of this grant/funds will be applied to eligible payments under the Contract for which these Bidding Documents are issued.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all interested bidders who are eligible under provision of Sindh Public Procurement Rules as mentioned below and the Criteria given in the Notice Inviting Tender & Bidding Document Contractor Firms/ Companies registered with Pakistan Engineering Council (PEC) in relevant category/specialty code of work and are eligible as stipulated in Bidding Data. ***Bid(s) not accompanied with required criteria &requisite supporting documentary evidences as stated in the Bidding Data shall be rejected***.

Firms and individuals, national or international, may be allowed to bid for any project where international competitive bidding is feasible. Any conditions for participation shall be limited to those that are essential to ensure the bidder's capability to fulfill the contract in question

a) Bidders may be excluded if;

(i) as a matter of law or official regulations, commercial relations are prohibited with the bidder's country by the federal government in case of ICB, or

(ii) a firm is blacklisted/ debarred by the procuring agency and the matter has been reported to the Authority, subject to Rule 30 of Sindh Public Procurement Rules 2010.

b) Government-owned enterprises or institutions may participate only if they can establish that they are:

(i) legally and financially autonomous, and
(ii) operate under commercial law.

Provided that where government-owned universities or research centers in the country are of a unique and exceptional nature, and their participation is critical to project implementation, they may be allowed to participate; and;

Bidders shall include all those contractors who are registered or incorporated in Pakistan, irrespective of the nationality of their owners and professional staff.

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IB.4 One Bid per Bidder

4.1 Each bidder shall submit only one bid either by himself, ***joint venture shall not be acceptable***. A bidder who submits or participates in more than one bid (alternate bid or joint venture participation) will be disqualified.

IB.5 Cost of Bidding

5.1 The bidders shall bear all costs associated with the preparation and submission of their respective bids and the Procuring Agency will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

IB.6 Site Visit

6.1 The bidders are advised to visit and examine the Site of Works and its surroundings during office hours (9:00 am to 3:00pm - Monday to Saturday) and obtain for themselves on their own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. All cost in this respect shall be at the bidder's own expense.

6.2 The bidders and any of their personnel or agents will be granted permission by the Procuring Agency to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the bidders, their personnel and agents, will release and indemnify the Procuring Agency, his personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of such inspection.

B. BIDDING DOCUMENTS

IB.7 Contents of Bidding Documents (SSP RULE 21)

7.1 The Bidding Documents, in addition to invitation for bids, are those stated below and should be read in conjunction with any Addenda issued in accordance with Clause IB.9:

a. Instructions to Bidders
b. Bidding Data.
c. General Conditions of Contract, Part-I (GCC).
d. Special Conditions of Contract, Part-II (SCC).
e. Technical Specifications (Vol-II).
f. Form of Bid & Appendices to Bid.
g. Bill of Quantities (Appendix-D to Bid).
h. Form of Bid Security
i. Form of Contract Agreement
j. Forms of Performance Security, Mobilization Advance Guarantee, Integrity Pact and Indenture Bond for Secured Advance
k. Drawings.

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7.2 The bidders are expected to examine carefully the contents of all the above documents. Failure to comply with the requirements of bid submission will be at the Bidder's own risk. Pursuant to Clause IB.26, bids which are not substantially responsive to the requirements of the Bidding Documents will be rejected.

IB.8 Clarification of Bidding Documents (SSP RULE 23(1))

8.1 Any interested bidder requiring any clarification (s) in respect of the Bidding Documents may notify the Procuring Agency in writing at the Procuring Agency's address indicated in the Invitation for Bids/NIT and no. of days before Pre-Bid meeting as indicated in Bidding Data. The Procuring Agency will respond to any request for clarification provided they are received at least Five calendar days prior to the date of opening of bids.

Provided that any clarification in response to query by any bidder; shall be communicated to all parties who have obtained bidding documents, but without identifying its source.

IB.9 Amendment of Bidding Documents

9.1 At any time prior to the deadline for submission of bids, the Procuring Agency may, for any reason, whether at his own initiative or in response to a clarification requested by a interested bidder, modify the Bidding Documents by issuing addendum.

9.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to Sub-Clause 7.1 hereof and shall be communicated in writing to all the bidders. Interested bidders shall acknowledge receipt of each addendum in writing to the Procuring Agency.

9.3 To afford bidders reasonable time in which to take an addendum into account in preparing their bids, the Procuring Agency may extend the deadline for submission of bids in accordance with Clause IB.20

C. PREPARATION OF BIDS IB.10

Language of Bid

10.1 The bid and all correspondence and documents related to the bid exchanged by a bidder and the Procuring Agency shall be in the language stipulated in the Bidding Data and Special Conditions of Contract. Supporting documents and printed literature furnished by the bidders may be in any other language provided the same are accompanied by an accurate translation of the relevant parts in the bid language, in which case, for purposes of evaluation of the bid, the translation in bid language shall prevail.

IB.11 Documents Accompanying the Bid

11.1 All bidders shall:

(a) Submit a written power of attorney authorizing the signatory of the bid to act for and on behalf of the bidder;

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(b) updated information as indicated/ or listed in Bidding Data & previously submitted along with the application for prequalification (if applicable), in order to continue meeting with the minimum criteria set out in the prequalification documents.

(c) Furnish & submit their updated Company Profile taking into account the various Appendices to Bid specially the following:

Appendix-E to Bid	Proposed Construction Schedule
Appendix-F to Bid	Method of Performing the Work
Appendix-G to Bid	List of Major Equipment
Appendix-K to Bid	Organization Chart for Supervisory Staff and

other pertinent information such as mobilization program etc;

11.2 Bids submitted by a joint venture of two (2) or more firms shall comply with the following requirements:

(a) one of the joint venture partners shall be nominated as being in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners;

(b) the bid and in case of a successful bid, the Form of Contract Agreement shall be signed so as to be legally binding on all partners;

(c) the partner-in-charge shall always be duly authorized to deal with the Procuring Agency regarding all matters related with and/or incidental to the execution of Works as per the terms and Conditions of Contract and in this regard to incur any and all liabilities, receive instructions, give binding undertakings and receive payments on behalf of the joint venture;

(d) all partners of the joint venture shall at all times and under all circumstances be liable jointly and severally for the execution of the Contract in accordance with the Contract terms and a statement to this effect shall be included in the authorization mentioned under Sub-Para (a) above as well as in the Form of Bid and in the Form of Contract Agreement (in case of successful bid); and

(e) a copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the person authorized to represent and obligate it and which persons will be directly responsible for due performance of the Contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partners without prior written consent of the Procuring Agency.

(f) submission of an alternative Letter of Intent to execute a Joint Venture Agreement shall be mandatory.

11.3 Bidders shall also submit proposals of work methods and schedule, in sufficient detail to demonstrate the adequacy of the Bidders' proposals to meet the technical specifications and the completion time referred to in Sub-Clause 1.2 hereof.

JOINT VENTURE NOT APPLICABLE

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IB.12 Bid Prices

12.1 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole of the Works as described in Sub-Clause 1.1 hereof, based on the unit rates and / or prices submitted by the bidder or percentage quoted above or below on the rates of Composite Schedule of Rates (CSR), as the case may be.

12.2 The bidders shall fill in rates and prices for all items of the works described in the Bill of Quantities. Items against which no rate or price is entered by a bidder will not be paid for by the Procuring Agency when executed and shall be deemed covered by rates and prices for other items in the Bill of Quantities. In case of Composite Schedule of Rates, if the bidder fails to mention the percentage above or below, it shall be deemed to be at par with the rates of Composite Schedule of Rates.

12.3 Bidders are required to submit, Rate Analysis of all the major items of works described in the Bill of Quantities. All government taxes including SSt/GST should also be mentioned & highlighted separately in Rate Analysis.

12.4 The bid price submitted by the contractor shall include all rates and prices including taxes. All duties, taxes (GST/SST) and other levies payable by the contractor under the contract, or for any other cause during the currency of the execution of the work or otherwise specified in the contract as on the date seven days prior to the deadline for submission of bids.

Additional/reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 13.7 of the General Conditions of Contract Part-I.

12.5 The rates and prices quoted by the bidders are subject to adjustment during the performance of the Contract in accordance with the provisions of Clause 13.7 of the Conditions of Contract. The bidders shall furnish the prescribed information for the price adjustment formulae in Appendix-C to Bid, and shall submit with their bids such other supporting information as required under the said Clause. Adjustment in prices quoted by bidders shall be allowed as per Instructions to Bidders , Sub- Para 4(ii) of Section C, and Bidding Data.

IB.13 Currencies of Bid and Payment

13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Procuring Agency's country (referred to as the "Foreign Currency Requirements") shall indicate the same in Appendix-B to Bid. The proportion of the Bid Price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the Bidder's home country or, (ii) at the bidder's option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in the bid.

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13.2 The rates of exchange to be used by the bidder for currency conversion shall be the selling rates published and authorized by the State Bank of Pakistan prevailing on the date, 07 (seven) days prior to the deadline for submission of bids. For the purpose of payments, the exchange rates used in bid preparation shall apply for the duration of the contract. Foreign Currency rates are only applicable if the BOQ specified with rates/Unit in foreign currency else only Unit Rates in Pak Rupees shall be acceptable.

IB.14 Bid Validity

14.1 Bids shall remain valid for the period stipulated in the Bidding Data after the Date of Bid Opening specified in Clause IB.23.

14.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Procuring Agency may request that the bidders extend the period of validity for a specified additional period which shall in no case be more than the original bid validity period. The request and the responses thereto shall be made in writing. A bidder may refuse the request without forfeiting his Bid Security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his Bid Security for the period of the extension, and in compliance with Clause IB.15 in all respects.

IB.15 Bid Security

15.1 Each bidder shall furnish, as part of his bid, a Bid Security in the amount stipulated in the Bidding Data in Pak Rupees or an equivalent amount in a freely convertible currency.

15.2 ***The Bid Security shall be acceptable only in shape of Pay order/Bank Draft in favor of the procuring agency.***

15.3 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Procuring Agency as non-responsive.

15.4 Bid security shall be released to the unsuccessful bidders once the contract has been signed with the successful bidder or the validity period has expired.

15.5 The Bid Security of the successful bidder will be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.

15.6 The Bid Security may be forfeited:

(a) if the bidder withdraws his bid except as provided in Sub-Clause 22.1;

(b) if the bidder does not accept the correction of his Bid Price pursuant to Sub-Clause 27.2 hereof; or

(c) In the case of successful bidder, if he fails within the specified time limit to:

(i) furnish the required Performance Security; or
(ii) sign the Contract Agreement.

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IB.16 Alternate Proposals by Bidder

16.1 Each bidder shall submit only one bid either by himself, or as a member of a joint venture, until and unless they have been requested or permitted for alternative bid, then he has to purchase separate bidding documents and alternate bid shall be treated as separate bid.

16.2 Alternate proposals are allowed only for procurement of works where technical complexity is involved and more than one designs or technical solutions are being offered. Two stage two envelope bidding procedure will be appropriate when alternate proposal is required.

16.3 Alternate bid(s) shall contain (a) relevant design calculations; (b) technical specifications; (c) proposed construction methodology; and (d) any other relevant details / conditions, provided that the total sum entered on the Form of Bid shall be that which represents complete compliance with the bidding documents.

IB.17 Pre-Bid Meeting

17.1 The Procuring Agency may, on his own motion or at the request of any bidder(s), hold a pre-bid meeting to clarify issues and to answer any questions on matters related to the Bidding Documents. The date, time and venue of pre-bid meeting, if convened, shall be communicated to all bidders. All bidders or their authorized representatives shall be invited to attend such a pre-bid meeting at their own expense.

17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Procuring Agency not later than three (05) days before the date of proposed pre-bid meeting.

17.3 Minutes of the pre-bid meeting, including the text of the questions raised and the replies given, will be transmitted without delay to all purchasers of the Bidding Documents. Any modification of the Bidding Documents listed in Sub-Clause 7.1 hereof which may become necessary as a result of the pre-bid meeting shall be made by the Procuring Agency exclusively through the issue of an Addendum pursuant to Clause IB.9 and not only through the minutes of the pre-bid meeting.

17.4 Absence at the pre-bid meeting will not be a cause for disqualification of a bidder.

IB.18 Format and Signing of Bid

18.1 Bidders are particularly directed that the amount entered on the Form of Bid shall be for performing the Contract strictly in accordance with the Bidding Documents.

18.2 All appendices to Bid are to be properly completed and signed.

18.3 Alteration is not to be made in the Form of Bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.

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18.4 Each bidder shall prepare by filling out the forms without alterations and shall provide an original copy along with photocopies as per the requirement of the procuring agency specified in the bidding data. The original as well as copies of the document shall be clearly marked as "ORIGINAL" and "COPY", as the case may be. If there is any discrepancy between original and copy / copies then the original shall prevail.

18.5 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person or persons duly authorized to sign on behalf of the bidder pursuant to Sub-Clause 11.1(a) hereof. All pages of the bid shall be initialed and stamped by the person or persons signing the bid.

18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Procuring Agency, or as are necessary to correct errors made by the bidder. Such corrections shall be initialed by the person (s) signing the bid.

18.7 Bidders shall indicate in the space provided in the Form of Bid their full and proper addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the Contract is to be sent.

18.8 Bidders should retain a copy of the Bidding Documents as their file copy.

D. SUBMISSION OF BIDS

IB.19 Sealing and Marking of Bids through EPADs (Procedure as stated & directed by the SPPRA for E-Procurement)

19.1 Each bidder shall submit his bid as under:

(a) ***ORIGINALLY scanned technical & financial Bids with complete tender documents (Stamped & signed on each page) shall be separately uploaded on SPPRA EPADS portal along with scanned copy of tender fee & Bid Security.***

(b) ***Additionally a separate of technical & financial Bids in separate sealed envelope with basic info of the bidder shall be submitted on / before tender opening schedule as stated in the NIT.***

(b) ***Original Pay order(s) of Bid security & tender fees (separately in sealed envelopes) in favor of procuring agency shall be submitted on / before tender opening schedule as stated in the NIT***

19.2 The inner and outer envelopes (For Bid Copies) shall:

(a) be addressed to the Procuring Agency at the address provided in the Bidding Data;

(b) bear the name and identification number of the contract as defined in the Bidding Data; and

(b) provide a warning not to open before the time and date for bid opening, as specified in the Bidding Data.

19.3 In addition to the identification required in Sub- Clause 19.2 hereof, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to Clause IB.21

19.4 If the outer envelope is not sealed and marked as above, the Procuring Agency will assume no responsibility

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* Note: See Bidding Data

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IB.20 Deadline for Submission of Bids

20.1 (a) Bids must be received by the Procuring Agency at the address specified no later than the time and date stipulated in the Bidding Data else rejected.

(b) Bids with charges payable will not be accepted, nor will arrangements be undertaken to collect the bids from any delivery point other than that specified above. Bidders shall bear all expenses incurred in the preparation and delivery of bids. No claims will be entertained for refund of such expenses.

(c) Where delivery of a bid is by mail and the bidder wishes to receive an acknowledgment of receipt of such bid, he shall make a request for such acknowledgment in a separate letter attached to but not included in the sealed bid package.

(d) Upon request, acknowledgment of receipt of bids will be provided to those making delivery in person or by messenger.

20.2 The Procuring Agency may, at his discretion, extend the deadline for submission of bids by issuing an amendment in accordance with Clause IB.9, in which case all rights and obligations of the Procuring Agency and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

IB.21 Late Bids

(a) Any bid received by the Procuring Agency after the deadline for submission of bids prescribed in Clause IB.20 will be returned unopened to such bidder.

(b) Delays in the mail, delays of person in transit, or delivery of a bid to the wrong office shall not be accepted as an excuse for failure to deliver a bid at the proper place and time. It shall be the bidder's responsibility to submit the bid in time.

IB.22 Modification, Substitution and Withdrawal of Bids

22.1 Any bidder may modify, substitute or withdraw his bid after bid submission provided that the modification, substitution or written notice of withdrawal is received by the Procuring Agency prior to the deadline for submission of bids.

22.2 The modification, substitution, or notice for withdrawal of any bid shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause IB.19 with the outer and inner envelopes additionally marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" as appropriate.

22.3 No bid may be modified by a bidder after the deadline for submission of bids except in accordance with Sub-Clauses 22.1 and 27.2.

22.4 Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the Bid Security in pursuance to Clause IB.15.

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E. BID OPENING AND EVALUATION IB.23

Bid Opening

23.1 The Procuring Agency will open the bids through EPADS Portal, including withdrawals, substitution and modifications made pursuant to Clause IB.22, in the presence of bidders' representatives who choose to attend, at the time, date and location stipulated in the Bidding Data. The bidders or their representatives who are present shall sign an attendance sheet.

23.2 Envelopes marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause IB.22 shall not be opened.

23.3 Procuring agency shall read aloud the name of the bidder, total bid price and price of any alternate proposal(s), if any, discounts, bid modifications, substitution and withdrawals, the presence or absence of bid security, and such other details as the procuring agency may consider appropriate, and total amount of each bid, and of any alternative bids if they have been requested or permitted, shall be read aloud and recorded when opened.

23.4 Procuring Agency shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with the sub-clause IB.23.3.

IB.24 Process to be Confidential (SPP Rule 53)

24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such process before the announcement of bid evaluation report in accordance with the requirements of Rule 45, which states that Procuring Agencies shall announce the results of bid evaluation in the form of a report giving reasons for acceptance or rejection of bids. The report shall be hoisted on website of authority and that of procuring agency if it website exists and intimated to all bidders at least seven (7) days prior to the award of contract The announcement to all bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the procuring agency's processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas, any bidder feeling aggrieved, may lodge a written complaint as per Rule 31; however, mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification of Bids (SPP Rule 43)

25.1 To assist in the examination, evaluation and comparison of bids, the Procuring Agency may, at its discretion, ask any bidder for clarification of the bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Procuring Agency in the evaluation of the bids in accordance with Clause IB.28.

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IB.26 Examination of Bids and Determination of Responsiveness

26.1 Prior to the detailed evaluation of bids, the procuring agency will determine whether the bidder fulfills all codal requirements of eligibility criteria given in bidding documents such as registration with tax authorities, registration with PEC (where applicable), turnover statement, experience statement, and any other condition mentioned in the NIT and bidding documents. If the bidder does not fulfill any of these conditions, it shall not be evaluated further.

26.2 Once found to be fulfilling the eligibility criteria, as mentioned in sub- clause 26.1, the bids of eligible bidders will be evaluated for technical responsiveness as per specification and criteria given in the bidding documents. Technical and financial evaluations may be carried out in accordance with single stage-single one envelope, single stage-two envelopes, two stage or two stage-two envelopes bidding procedures, depending on the selection procedure adopted by the procuring agency.

26.3 A bid will be considered technically responsive if it (i) has been properly signed; (ii) is accompanied by the required bid security; and (iii) conforms to all the terms, conditions, criteria and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the procuring agency's rights or the bidder's obligations under the contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

26.4 If a bid has major deviations to the commercial requirements and technical specifications will be considered technically non responsive. As a general rule, major deviations are those that if accepted, would not fulfill the purposes for which the bid is requested, or would prevent a fair comparison or affect the ranking of the bids that are compliant with the bidding documents.

(A). Major (material) Deviations include:-

(i) has not been properly signed;
(ii) is not accompanied by the bid security of required amount and manner;
(iii) stipulating price adjustment when fixed price bids were called for;
(iv) failing to respond to specifications;
(v) failing to comply with Mile-stones/Critical dates provided in Bidding Documents;
(v) sub-contracting contrary to the Conditions of Contract specified in Bidding Documents;
(vii) refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage;
(viii) taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures;
(ix) a material deviation or reservation is one :

(a) which affect in any substantial way the scope, quality or performance of the works;
(b) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

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(B) Minor Deviations

Bids that offer deviations acceptable to the Procuring Agency and which can be assigned a monetary value may be considered substantially responsive at least as to the issue of fairness. This value would however be added as an adjustment for evaluation purposes only during the detailed evaluation process.

26.5 If a bid is not substantially responsive, it will be rejected by the procuring agency, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

IB.27 Correction of Errors

27.1 Bids determined to be substantially responsive will be checked by the Procuring Agency for any arithmetic errors. Errors will be corrected by the Procuring Agency as follows:

(a) where there is a discrepancy between the amounts in figures and in words, the amount in words will govern; and

(b) where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the Procuring Agency there is an obviously gross misplacement of the decimal point in the unit rate, in which case the line item total as quoted will govern and the unit rate will be corrected.

27.2 The amount stated in the Form of Bid will be adjusted by the Procuring Agency in accordance with the above procedure for the correction of errors and with the concurrence of the bidders. The amount thus corrected shall be considered as binding upon the bidder. If the bidder does not accept the corrected bid price, his bid will be rejected, and the bid security shall be forfeited in accordance with sub-clause IB 15.6(b) hereof.

IB.28 Evaluation and Comparison of Bids

28.1 The Procuring Agency will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause IB.26.

28.2 In evaluating the Bids, the Procuring Agency will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:

(a) making any correction for errors pursuant to Clause IB.27;
(b) excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including competitively priced Daywork; and
(c) making an appropriate adjustment for any other acceptable variation or deviation.

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28.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

28.4 If the bid of the successful bidder is seriously unbalanced in relation to the procuring agency's estimate of the cost of work to be performed under the contract, the procuring agency may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the procuring agency may require that the amount of the Performance Security set forth in clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the procuring agency against financial loss in the event of default of the successful bidder under the contract.

28.5 Bidders may be excluded if involved in **"Corrupt and Fraudulent Practices"** means either one or any combination of the practices given below SPP Rule2(q);

(i) "**Coercive Practice**" means any impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence the actions of a party to achieve a wrongful gain or to cause a wrongful loss to another party;

(ii) "**Collusive Practice**" means any arrangement between two or more parties to the procurement process or contract execution, designed to achieve with or without the knowledge of the procuring agency to establish prices at artificial, noncompetitive levels for any wrongful gain;

(ii) **"Corrupt Practice"** means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the acts of another party for wrongful gain;

(iv) **" Fraudulent Practice"** means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(v) **"Obstructive Practice"** means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in a procurement process, or affect the execution of a contract or deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements before investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or acts intended to materially impede the exercise of inspection and audit rights provided for under the Rules.

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28.6 Evaluation Report (SPP Rule 45)

After the completion of evaluation process, as described in clauses IB 27 and IB 28, the procuring agency shall announce the results of bid evaluation in the form of report (available on the website of the authority) giving reasons for acceptance and rejection of bid. The report shall be hoisted on website of the authority and that of procuring agencies if its website exists and intimated to all bidders at least seven (7) days prior to the award of contract.

F. AWARD OF CONTRACT IB.29

Award (SPP Rule 49)

29.1 Subject to Clauses IB.30 and IB.34, the Procuring Agency shall award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the **most advantageous bid;** but not necessarily the lowest submitted price, within the original or extended period of bid validity. Provided that such bidder has been determined to be eligible in accordance with the provisions of clause IB 03 and qualify pursuant to sub-clause IB 29.2.

29.2 The Procuring Agency, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any deficiency/ies in supplier's or contractor's capacities, may require the suppliers or contractors to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not for the said project.

Provided, that such qualification shall only be laid down after recording reasons therefore in writing. They shall form part of the records of that bid evaluation report.

IB.30 Procuring Agency's Right to reject all Bids or Annul/Cancellation the Bidding Process (SPP Rule 25)

30.1 Notwithstanding clause IB.29, and provision of the rule: (1) A procuring agency reserves the right to cancel the bidding process at any time prior to the acceptance of a bid or proposal; (2) The procuring agency shall incur no liability towards bidders solely by virtue of its invoking sub–rule (1); (3) Intimation of the cancellation of bidding process shall be given promptly to all bidders and bid security shall be returned along with such intimation; (4) The procuring agency shall, upon request by any of the bidders, communicate to such bidder, grounds for cancellation of the bidding process, but is not required to justify such grounds.

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IB.31 Notification of Award (SPP Rule 25)

31.1 Prior to expiry of the period of bid validity, including extension, prescribed by the procuring agency, the procuring agency shall notify the successful bidder in writing ("Letter of Acceptance") that his bid has been accepted. This letter shall mention the sum which the procuring agency will pay to the contractor in consideration of the execution and completion of the works by the contractor as prescribed by the contract (hereinafter and in the conditions of contract called the "Contract Price").

31.2 No negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted, however, procuring agency may hold meetings to clarify any item in the bid evaluation report.

31.3 The notification of award and its acceptance by the bidder will constitute the formation of the contract, binding the procuring agency and the bidder till signing of the formal Contract Agreement.

31.4 Upon furnishing by the successful bidder of a Performance Security and signing of the contract, the procuring agency will promptly notify the name of the successful bidder to all bidders and return their bid securities accordingly.

31.5 Within seven days of the award of contract, procuring agency shall publish on the website of the Authority and on its own website, if such a website exists, the results of the bidding process, identify the bid through procurement identifying numbers, and the following information:
(1) Evaluation report;
(2) Form of Contract and letter of Award;
(3) Bill of Quantities or Schedule of Requirement.

31.6 Debriefing (SPP Rule 51).

(a) A bidder may ask the procuring agency for reasons for non-acceptance of his bid and may request for a debriefing meeting and procuring agency shall give him the reasons for such non acceptance, either in writing or by holding a debriefing meeting with such a bidder.

(b) The requesting bidder shall bear all the costs of attending such a debriefing.

31.7 Redressal of Grievances (SPP Rule 31)

A bidder may being aggrieved by the decision of the procuring agency regarding disqualification may seek relief through the mechanism of grievance redressal as provided under SPP Rule 31 (Refer SPP Rules 2010)

IB.32 Performance Security (SPP Rule 39)

32.1 The successful bidder shall furnish to the Procuring Agency a Performance Security in the form pay order or demand draft or bank guarantee, and the amount stipulated in the Bidding Data and the Conditions of Contract within a period of 14 days after the receipt of Letter of Acceptance.

32.2 Failure of the successful bidder to comply with the requirements of Sub-clause IB.32.1 or Clauses IB.33 or IB.35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

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32.3 Validity of performance security shall extend at least ninety days beyond the date of completion of contract, or as mentioned in the bidding data to cover defects liability period or maintenance period subject to final acceptance by the procuring agency.

IB.33 Signing of Contract Agreement (SPP Rule 55)

33.1 Within 14 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Procuring Agency will send the successful bidder the Contract Agreement in the form provided in the Bidding Documents, incorporating all agreements between the parties.

33.2 The formal Agreement between the Procuring Agency and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the Procuring Agency.

33.3 A procurement contract shall come into force when the signatures of both the procuring agency and the successful bidder are affixed to the written Contract Agreement. Such affixing of signatures shall take place within the time specified in the Bidding Data.

Provided that the procuring agency may reduce the maximum time limit for signing of contract, as and when required, and shall be notified to successful bidder.

33.4 **Stamp Duty:**

The formal Agreement between the Procuring Agency and the successful bidder shall be duly stamped at rate of 0.35% of bid price or updated from time to time stated in Letter of Acceptance

IB.34 General Performance of the Bidders

Procuring agency may in case of consistent poor performance of the contractor and his failure to remedy the underperforming contract may take such action as may be deemed appropriate under the circumstances of the case including the rescinding the contract and/or black listing of such contractor and debarring him from participation in future bidding process.

IB.35 Integrity Pact (SPP Rule 89)

The Bidder shall sign and stamp the Integrity Pact provided at Appendix-L to Bid in the Bidding Documents for all Provincial/Local Government procurement contracts exceeding Rupees ten million. Failure to provide such Integrity Pact shall make the bidder non-responsive.

IB.36 Instructions not Part of Contract

Bids shall be prepared and submitted in accordance with these Instructions which are provided to assist bidders in preparing their bids, and do not constitute part of the Bid or the Contract Documents.

IB.37 Arbitration (SPP Rule 34)

Any dispute that is not amicably resolved shall be finally settled, unless otherwise specified in the Contract, under the Arbitration Act 1940 updated from time to time and would be held anywhere in the Province of Sindh at the discretion of procuring agency

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

BIDDING
DATA

National Engineering Services Pakistan Ltd.
A & P
DIVISION
Karachi

BD-1

Bidding Data

1.1 Name and Address of the Procuring Agency:

The Project Director (ADP Scheme – JSMU)
Jinnah Sindh Medical University,
Rafiqui, H.J, Iqbal Shaheed Road, Karachi, Pakistan
Telephone No : 021-99205185 (Ext - 3009)

1.1 Name of the Project & Summary of the Works:

STRENGTHENING / UPGRADATION OF JINNAH SINDH MEDICAL UNIVERSITY KARACHI (PACKAGE-01) *(Construction of Academic & Administration Building)*

Construction of new RCC high-rise Building with (02) Basements + Ground + 9 Floors + Roof Top amenities Complete civil works including structural, architectural, shoring, plumbing, water supply, Firefighting, Sewerage network and related all electrical (LT + HT) & mechanical works as described in the drawings and Bill of Quantities in detail.

2.1 Name of the Borrower/Source of Financing/Funding Agency:

ADP Scheme funded by Government of Sindh through under ***ADP # 807/2025-26,***
Sector Universities & Boards, Govt of Sindh

2.1 Amount and type of financing:
ADP Scheme, Government of Sindh (ADP Scheme No. 807/2025-26)

3.1 Eligible Bidders

This Invitation for Bids is open to all interested Construction firms/ companies registered with Pakistan Engineering Council (PEC - valid up to June 2026) in Category ***C-1*** *& above with specialization codes CE09, CE10, CE09, BC03, EE01, EE02, EE04, EE07 & ME02 and having relevant experience in Building Works. The bidders must also be registered with relevant Government Departments and Taxation Authorities (FBR & SRB). The eligible bidders must successfully pass the evaluation criteria stated in Bidding Data.*

7.1 The Bidding Documents, in addition to invitation for bids, are those stated below and should be read in conjunction with any Addenda issued in accordance with Clause IB.9:

1. **Volume-I : Bidding & Contract Documents**
   - Instructions to Bidders & Bidding Data.
   - Evaluation Criteria (stated in Bidding Data) for preparing Technical Bid
   - Appendices to Bid [App A to K].
   - Form of Bid & Appendix-D to Bid (Bill of Quantities)
   - Sample Forms:
     - Bid Security (Pay Order/Demand Draft)
     - Performance Security
     - Contract Agreement
     - Mobilization Advance Guarantee/Bond
     - Indenture Bond for Secured Advance
   - General Conditions of Contract, Part-I (GCC).
   - Particular Conditions of Contract, Part-II (PCC).
2. **Volume-II : Specifications – Special & Technical Provisions.**
3. **Volume-III : Tender Drawings.**

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8.1 Time limit for clarification:
Bidders may seek clarification regarding Bidding Documents by sending their queries in writing at least five (05) days before last date of Bid Submission.

10.1 Bid language:
English

11.1 (c) Furnish –Technical Bid:
Bidders are advised to carefully read the Evaluation Criteria stated in the bidding data IB 19.1 and submit the required information as ***Technical Bid*** *by filling required information, attach acceptable documentary evidence regarding their technical capability to perform the Project in a separate Envelope marked as* ***Technical Bid****. Other Volume of Bids shall be submitted in separate envelope as* ***Financial Bid****.*

11.2 Bids submitted by a Joint Venture:
JV for this Project is not allowed. Similarly, past experience of firms in any JV shall not be considered.

13.1 *Bidders to quote entirely in Pak. Rupees only.*

14.1 Period of Bid Validity:
90 days from the date of Bid Opening.

15.1 Amount of Bid Security:

Bid Security of fixed amount of ***Rs. 80 Million*** *in the form of Call Deposit, Pay Order or a Demand Draft only issued by a scheduled Bank of Pakistan in favor of* ***JINNAH SINDH MEDICAL UNIVERSITY*** *on account of (Name of firm), should be attached with the "Technical Proposals / Bids", otherwise such tenders/bids will not be accepted. Original bid security pay order(s)/Bank draft shall be submitted in separate sealed envelope on/before tender opening.*

Bid Security of successful bidder shall be retained/adjusted as Performance Security

17.1 Venue, time, and date of the pre-Bid meeting:
Venue: *As notified in Notice Inviting Tender (NIT).*
Time and date: *As notified in Notice Inviting Tenders (NIT)*

18.4 Number of copies of the Bid to be completed and returned:
(01) Copy of both Financial & Technical Bids. Originally scanned complete tender documents with technical proposal & Financial Bid along with Bid Security (all stamped & signed by the bidder) must be uploaded on EPADS Portal on / before tender submission schedule as stated in NIT.

19.1 Sealing and Marking of Bids
Text of sub-clause 19.1 is replaced as under

19.1 Single stage – Two Envelope Procedure (SPP Rule 46 (2)

1. All Bids shall be uploaded, opened and evaluated to ascertain the eligibility **through SPPRA EPADS Portal.**
   a. Documentary evidence containing all information as required above shall be submitted & uploaded in a Separate Envelope marked as **"Technical Bid"** along with original Bid Security.
   b. Other Documents shall be uploaded & submitted in another separate sealed envelope

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marked as "**Financial Bid**".

The above envelopes to be submitted in a single envelope marked as the Bid. one (01) copy of Bid shall be separately sealed and put in separate envelopes & marked as such.

c. Original Pay order(s) of Bid Security & tender fee shall be submitted in sealed envelope on/before tender submission schedule as stated in the NIT.

2. Following Criteria is mandatory to be fulfilled by the Bidders(s) failing to which shall lead to non-responsiveness. Evaluation Criteria, Sub-Criteria, for the evaluation of full Technical Proposals is based on Yes/No. If a bidder fails to obtain "Yes" in any criteria or sub-criteria, then he/ it shall not be qualified for financial bid opening.

3. **Technical Bid shall comprise of information as under to ascertain bidder's eligibility.**

Mandatory Eligibility Criteria:

The bidder must full fill the following criteria, else bid(s) shall be rejected

a) Valid Registration with Pakistan Engineering Council (PEC) in Category ***C-1*** *& above with specialization codes CE09, CE10, CE09, BC03, EE01, EE02, EE04, EE07 & ME02.*

b) Valid Electrical License (Karachi Region) from Inspectorate of Electrical Licenses Sindh & ISO Certified in relevant specialty.

c) Registered & Active Tax Payer with Federal Board of Revenue (FBR) for Income Tax & Sales Tax and Sindh Revenue Board (SRB) for Sales Tax on Services and Active Filer on both the agencies. Failing any of the two, the bidder shall not be eligible to take part in bid and summarily be rejected.

d) Relevant Experience

Sub-Contract/Joint venture experience / Sister concerned firm experience shall not be acceptable. Partial completion shall not be acceptable

i. **At least 02 works completed in similar nature i.e Construction of G+10th storey building or above completed during last 03-years, each work amounting to Rs. 1500 Million & above in any Government, Semi-government or any private / public sector taxpayer organization/department/company.** *(Attach copy of Work order + Completion Certificate + Contract Agreement on judicial stamp paper & proof of final bill payment with tax deduction in technical proposal for verification).*

ii. **At least 01 on-going work in-hand of similar nature i.e Construction of G+10th storey building or above in hand, amounting to Rs. 1500 Million & above, in any Government, Semi-government or any private / public sector taxpayer organization/department/company.** *(Attach copy of Work order & Contract Agreement on judicial in technical proposal for verification).*

iii. ***At least 01 completed building project with Basement floor completed during last 05-years in any Government, Semi-government or any private / public sector taxpayer organization/department/company.*** *(Attach copy of Work order, Contract Agreement & completion certificate on judicial in technical proposal for verification).*

e) Financial Capability

i. Average Annual Financial Turn-over must be equal or above PKR 3000M during the last (03) Three financial *years. (Turnover will be evaluated from Annual FBR Returns and Audit Reports. Annual Audited Reports of last 03 years from (ICAP) registered audit firm. Audit report issued by Registered Audit firms other than (ICAP) will not be accepted. Income Tax returns of last 03 years also to be submitted)*

ii. *The firm must have Bank credit line limit of 800M or Above*
(Attach Bank Letter for verification)

f) **Team/Staff**
Details of all engineering and technical staff currently working with the firm, including at least two Bachelor of Engineering (Civil) graduates, one Bachelor of Engineering (Electrical) graduate, one Bachelor of Engineering (Mechanical) graduate, and one Diploma of Associate Engineer (Civil).
(For each individual, the submission must include a detailed Curriculum Vitae (CV) outlining academic qualifications, professional experience, and current designation within the firm and the names of these engineers must be reflected in the valid Pakistan Engineering Council (PEC) Certificate of the firm & Proof of employment with salary slip)

g) List of Machinery and Equipment in line with the scope of work, with documentary evidence of its ownership, rental, or lease agreement.

h) Undertaking on Stamp Paper of Rs.500/- stating that:-
- Firm is not involved in Departmental rift, abandoned or unnecessary delay in completion of any work in the Government and as well as in Private Organizations.
- Affidavit to the effect that the contractors / companies / firms is not currently on the list of blacklisted suppliers by any government / donor agency.
- List of procurement related litigation (if any) their nature and status / outcomes against or in favor of the firm; otherwise, enclose an affidavit on stamp paper stating that the firm is not involved in any type of procurement related litigation.
- Affidavits to the effect that all documents / particulars / information furnished are true and correct. In case of Bogus /Tempered or false information / certificates provided by the company / firm shall be liable to be black listed at any stage.

i) Each page of Bid must be paginated signed and stamped by the bidder.

19.2(a) Procuring Agency's address for the purpose of Bid submission:
Bids shall be submitted sickly as per procedure stated for E-Procurements on EPADs as prescribed by SPPRA

Tender fess, Bid Security & Copy of Sealed Bids shall be submitted at
Procurement Office
6th Floor Dental OPD Building
Jinnah Sindh Medical University,
Rafiqui H.J. Shaheed Road,
Karachi.
Postal Code# 75510
Tel: 99205185 Ext. 3009, www.jsmu.edu.pk

19.2(b) Name and Number of the Contract: _____

20.1(a) Deadline for submission of bids:
As notified in Notice Inviting Tenders NIT

23.1 Venue, time, and date of Bid opening:
Venue: *Same as submission of Bid/As notified in NIT*
Date: *As notified in NIT*
Time for opening of bids: *As notified in NIT*

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26 Examination of Bids and Determination of Responsiveness:

26.1 Technical Bids will be evaluated as per eligibility / evaluation criteria stated above.

26.2 Once found to be fulfilling the eligibility / evaluation criteria, as stated in Bidding Data IB 19.1, Technical and Financial Bids shall be evaluated in accordance with **SPP Rule 46(2) - Single Stage-Two Envelopes bidding procedure through E-Procurement SPPRA EPADS** as under;

a) bid shall comprise a single package containing two separate envelopes. each envelope shall contain separately the financial proposal and the technical proposal & shall be uploaded & submitted;

b) Copy of "FINANCIAL PROPOSAL" and "TECHNICAL PROPOSAL" in bold and legible letters to avoid confusion & Original Scanned Copy of Bids must be uploaded

c) initially, only the envelope marked "TECHNICAL PROPOSAL" shall be downloaded & opened through EPADS;

d) envelope marked as "FINANCIAL PROPOSAL" shall be retained in the custody of the procuring agency without being opened;

e) procuring agency shall evaluate the technical proposal in a manner prescribed in advance, without reference to the price and reject any proposal which does not conform to the specified requirements;

f) no amendments in the technical proposal shall be permitted during the technical evaluation;

g) financial proposals of technically qualified bids shall be opened publicly at a time, date and venue announced and communicated to the bidders in advance;

h) financial proposal of bids found technically non-responsive shall be returned un-opened to the respective bidders; and

i) bid found to be the lowest evaluated or best evaluated bid shall be accepted.

32.1 Standard form & amount of Performance Security acceptable to the Procuring Agency:

Bid Security of successful bidder shall be retained as Performance Security or separately submitted by the successful bidder.

32.3 Validity of Performance Security:

Performance Security shall be released at the completion of Defects Liability Period.

33.3 Signing of Contract Agreement:

Within Fourteen (14) days from the date of Award of Work/Letter of Acceptance. The successful bidder shall bring Contract Agreement (as per format given in Tender Documents) on stamp paper of the value as per Stamp Duty Act- latest version, signed and stamped by him for Procuring Agency's signature and stamp with FIDIC Conditions of Contract 2006 (Red Book).

33.4 Stamp duty

Stamp duty on contract agreement or other papers shall be paid by the successful bidder/contractor as per percentage given in Stamp Duty Act of Government of Sindh-latest version. The updated schedule can be obtained from the office of Chief Inspector of Stamps, Sindh Board of Revenue, opposite MPA hostel, High Court Road, Karachi.

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Academic & Admin Building

5) The Inspector General of Police, Sindh, Karachi.
6) The Managing Director, Sindh Public Procurement Regulatory Authority (SPPRA), Karachi.
7) The Superintendent Engineer (Police Works), Sindh, Karachi.
8) The Deputy Secretary (Admn), Home Department Sindh, Karachi.
9) PS to Additional Chief Secretary, Home Department Sindh, Karachi.
10) PS to Special Secretary (Home), Home Department, Sindh, Karachi.
11) PS to Additional Secretary (Admn), Home Department, Sindh, Karachi.

SECTION OFFICER (AI
HOME DEPARTMENT, SI

National Engineering Services Pakistan (Pvt.) Ltd.
A & P DIVISION
Karachi

FORM OF BID
AND
APPENDICES TO BID

FB-1

FORM OF BID

To:

Project Director (ADP Scheme - JSMU,
JSMU, Rafiqui H.J., Iqbal Shaheed Road,
Karachi, Pakistan
Telephone No : 021-99205185 (Ext – 3009)

1. Having examined the Bidding Documents including Instructions to Bidders, Bidding Data, Conditions of Contract. Specifications, Drawings and Bill of Quantities and Addenda Nos. _____for the execution of the above-named Works, we, the undersigned, offer to execute and complete such Works and remedy any defects therein in conformity with the Conditions of Contract. Specifications, Drawings, Bill of Quantities and Addenda for the sum of Rs. _____ (Rupees _____ _____) or such other sum as may be ascertained in accordance with the said conditions.

2. We understand that all the Appendices attached hereto form part of this Bid.

3. As security for due performance of the undertakings and obligations of this Bid, we submit herewith a Bid Security in the amount of (Rs. _____), Rupees _____ _____ drawn in your favour or made payable to you and valid for a period of _____days beginning from the date Bids are opened.

4. We/I undertake, if our Bid is accepted, to commence the Works and to complete the whole of the Works comprised in the Contract within time stated in Appendix-A to Bid.

5. We/I agree to abide by this Bid for the period of _____ days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

6. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

7. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.

8. We understand that you are not bound to accept the lowest or any Bid you may receive.

9. We undertake, if our/my bid is accepted, to execute the Performance Security referred to in Clause 4.2 of Conditions of Contract for the due performance of the Contract.

in the capacity of _____duly authorized to sign Bids for and on behalf of

Dated this _____day of_____20_____

Signature: _____

in the capacity of _____duly authorized to sign Bids for and on behalf of

_____

(Name of Bidder in Block Capitals)

(Seal)

Address:_____

_____

_____

Witness:

Signature: _____

Name: _____

Address. _____

_____

Occupation

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

SPECIAL STIPULATIONS

Appendix-A to Bid
BA-1

Clause in Conditions of Contract

S. No	Description	*Ref	Summary
1.	Engineer's Authority to issue Variation in emergency	3.1	2% of the Contract Price stated in the Letter of Acceptance.
2.	Amount of Performance Security	4.2	5% of Contract Price.
3.	Time for Furnishing Program	8.3	Within 14 days from the date of receipt of Letter of Acceptance.
4.	Minimum amount of Third Party Liability Insurance	18.3	Rs. 500,000/- for property damage & Rs. 500,000/- for personnel injury/death per occurrence with number of occurrences unlimited.
5.	Time for Commencement	8.1	Within 07 days from the date of receipt of Engineer's Notice to Commence, which shall be issued within Seven (7) days after signing of Contract Agreement.
6.	Time for Completion	8.2	**24 Calendar Months** from the date of receipt of Engineer's Notice to Commence.
7.	Amount of Liquidated Damages/ Delay Damages/ Penalties (LD)	8.7	The amount of liquidated damages for each day of delay in completion of whole of the works or if applicable for any section thereof shall be sum equal to 8% of the awarded cost of stated in the Letter of Acceptance or cost of works of the respective project Site divided by one-furth of the number of days specified in completion time. Formula: LD/Day = 10% of Awarded Cost / (0.25 x Time for completion (days))
8.	Defects Liability Period	11.1	12 Calendar Months from the effective date of Substantial Completion/Taking Over of Project.
9.	Percentage of Retention Money to be deducted from IPCs	14.2	5% of the amount of each Interim Payment Certificate IPC
10.	Minimum amount of Monthly Interim Payment Certificates	14.6	5% of Contract Price, however it's the Engineer's discretion to approve any amount considering the project & site conditions
11.	Time of Payment from delivery of IPC to the Procuring Agency by the Engineer.	14.7	28 working days for issuance date of Interim Payment Certificate (IPC) certified by the Engineer & availability of released funds. The Engineer shall certify the IPC within 14 working days of its receipt. Partial Progressive payment is applicable as verified by the engineer.
12.	Mobilization Advance (Interest Free)	*14.2	**Not Applicable.**
13.	Secured Advance	*14.2	Applicable subject to the given condition of contract & SPPRA rules.

*Note: For complete text please Refer related clause in Conditions of Contract

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BB-1
Appendix-B to Bid

FOREIGN CURRENCY REQUIREMENTS

1. The Bidder may indicate here in below his requirements of foreign currency (if any), with reference to various inputs to the Works.

2. Foreign Currency Requirement as percentage of the Bid Price excluding Provisional Sums _____%.

3. Table of Exchange Rates

Unit of Currency	Equivalent in Pak. Rupees
Australian Dollar	----------
Euro	----------
Japanese Yen	----------
U.K. Pound	----------
U.S. Dollars	----------
----------	----------
----------	----------

Not Applicable

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BC-1
Appendix-C To Bid

PRICE ADJUSTMENT UNDER CLAUSE 70/13.80 OF CONDITIONS OF CONTRACT

The source of indices and the weightages or coefficients for use in the adjustment formula under Clause 13.80 shall be as follows:

Cost Element	Description	Weightages	Applicable index
(1)	(2)	(3)	(4)
(i)	Fixed Portion	-	
(ii)	Cement – in bags	-	Government of Pakistan (GoP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin (Inter-City Consumer Prices).
(iii)	Reinforcing Steel	-	" "
(iv)	Labour	-	" "
(v)	POL	-	As announced by OGRA/PSO"
	Total		

Not Applicable

Notes:

1) Indices for "(ii)", "(iii)" & "(iv)" are taken from the Government of Pakistan Federal Bureau of Statistics, Monthly Statistical Bulletin. For steel reinforcement, the prices of ½" dia bar shall be referred as representative to all diameters. For Cement, prices of Ordinary Portland Cement (OPC) shall be referred as representative to all types of cements used in the project for escalation purposes. The base cost indices or prices shall be those applying 28 days prior to the latest day for submission of bids. Current indices or prices shall be those applying 28 days prior to the last day of the monthly billing period.

2) Any fluctuation in the indices or prices of materials other than those given above shall not be subject to adjustment of the Contract Price.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

BD-1

Appendix-D to Bid

BILL OF QUANTITIES

Preamble

1. The Bill of Quantities shall be read in conjunction with the Conditions of Contract, Specifications and Drawings.

2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work executed and measured by the Contractor and verified by the Engineer and valued at the rates and prices entered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix as per the Contract (in case of item not mentioned in Bill of Quantities).

3. The rates and prices entered in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the contract include all costs of contractor's plant, labour, supervision, materials, execution, insurance, profit, taxes (GST/SST) and duties, together with all general risks, liabilities and obligations set out or implied in the contract. Furthermore all duties, taxes and other levies payable by the contractor under the contract, or for any other cause, as on the date 14 days prior to deadline for submission of Bids in case of ICB/NCB respectively, shall be included in the rates and prices and the total bid price submitted by the bidder.

4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of items against which the contractor will have failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities and shall not be paid separately.

5. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the works.

6. General directions and description of work and materials are not necessarily repeated nor summarised in the Bill of Quantities. References to the relevant sections of the bidding documents shall be made before entering prices against each item in the priced Bill of Quantities.

7. Provisional sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with sub-clause 13.5 of Part I, General Conditions of Contract.

National Engineering Services Pakistan Ltd. A&P Division Karachi

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI

CONSTRUCTION OF ACADEMIC AND ADMIN BUILDING AT JSMU, KARACHI

SUMMARY OF BID PRICE

Sr. No.	DESCRIPTION	AMOUNT (Rupees)
1	Cost of Civil Works (Schedule Items)	
2	Cost of Civil Works (Non-Schedule Items)	
3	Cost of Plumbing (Schedule Items)	
4	Cost of Plumbing Works (Non-Schedule Items)	
5	Cost of Fire Fighting Works (Non-Schedule Items)	
6	Cost of Electrical Works (Schedule Items)	
7	Cost of Electrical Works (Non-Schedule Items)	
	A) Extra Electrical Work (Energization of the Building, additional power for AC & Medical Equipments)	
	B) Substation Works	
8	Cost of Telecommuncation Works (Non-Schedule Items)	
9	Cost of Mechanical Natural Gas Piping (Non-Schedule Items)	
	Total Bid Price *(including all applicable Taxes)* **Rs.**	

Bid Price in Words (_____)

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

PRICED BILL OF QUANTITES

(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	Part-I	**C. CIVIL WORKS**				
		CHAPTER NO. 1 **EXCAVATION AND EMBANKMENT**				
01-1C	Page No. 17, Sr .No. 18 (b)	**Excavation in foundation** of Building Bridges and other structures including dagbelling dressing, refilling around structure with excavated earth Watering and ramming lead upto 5 ft. , lead upto one chain (30 meter) and lift upto 5 ft. (1.5 meter).				
		(b) In hard soil	P.Cft.	522880	11.88	6,211,814.40
01-2C	Page No. 17, Sr .No. 20	Extra for excavation requiring **shoring**.	P.Cft.	522880	2.30	1,202,624.00
01-3C	Page No. 17, Sr .No. 22	**Filling,** watering and ramming earth under floor. with new earth (Excavated from outside) lift upto 5 ft and lead upto 10 miles including cost of earth.	P.Cft.	66424	47.02	3,123,256.48
		CHAPTER NO. 4 **CONCRETE**				
01-4C	Page No. 25, Sr. No. 5 ('h) & ('i)	Cement concrete plain including placing, compacting, finishing and curing, complete (including screening and washing at stone aggregate without shuttering.				
		(h) Ratio. 1: 3 : 6 (Blinding/lean Concrete in two layer for raft)	P.Cft.	9098	388.67	3,536,119.66
01-5C	Page No. 25, Sr. No. 7(i)	P/Applying **Hi Bond (Sealer)** water proofing polymer Modified cementations slurries (WPMCS) to be used as water proofing, anticorrosion, weater resistance or curing membrane for fresh concrete having thickness upto 2mm in two coats upto 20' height textured or trowel finish grey or coloured i/c preparing the surface for application as directed by Engineer Inchare.	P. Sft.	1502	56.71	85,178.42
01-6C	Page No. 26, Sr. No. 9	Precast cement concrete solid or face block (1 : 2 : 4) including cost of templates. (for window sill	P. Cft.	191	483.54	92,356.14
01-7C	Page No. 27, Sr. No. 22	Providing and laying 1:3:6 **cement concrete solid block masonry** set in 1:6 cement sand mortar in plinth and foundation including raking out joints and curing etc. complete. (Basement-1 & 2 Super Structure)	P.Cft.	672	481.95	323,870.40
01-8C	Page No. 27, Sr. No. 23	Providing and laying 1:3:6 Cement concrete solid **Block masonry wall above 6" in thickness** set in 1:6 cement mortar in G.F ground floor superstructure including raking out joints & curing etc, complete. (Ground to roof floor Super Structure)	P.Cft.	110135	493.79	54,383,561.65
01-9C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 1st floor	P.Cft.	13679	11.88	162,506.52
01-10C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 2nd floor	P.Cft.	11288	23.76	268,202.88
01-11C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 3rd floor	P.Cft.	11288	35.65	402,417.20

Engineering Services Pakistan A&P DIVISION Karachi

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-12C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 4th floor	P.Cft.	11288	47.53	536,518.64
01-13C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 5th floor	P.Cft.	11288	47.53	536,518.64
01-14C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 6th floor	P.Cft.	11288	47.53	536,518.64
01-15C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 7th floor	P.Cft.	11288	47.53	536,518.64
01-16C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 8th floor	P.Cft.	11288	47.53	536,518.64
01-17C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in 9th floor	P.Cft.	11288	47.53	536,518.64
01-18C	Page No. 28, Sr. No. 32	Add extra Labour for Block Masonry in Roof floor	P.Cft.	924	47.53	43,917.72
		CHAPTER NO. 8 **FLOORING**				
01-19C	Page No. 45, Sr. No. 16(d)	Providing and laying 1" thick topping of cement concrete (1:2:4) including Surface finishing and dividing into panels: (d.) 3" thick	P.Sft.	38086	145.00	5,522,470.00
01-20C	Page No. 46, Sr. No. 28 (vii)	Providing & Laying **Full Body Porcelain Tile in Flooring or Facing** of Approved Design Set in Gray Cement Motor 1:2 or of 3/4" Thickens I/C Washing & Joints With White Cement Slurry Using Colour Pigment for matching complete as per Specification.				
		(ix) 24"x24"x5/16" (Flooring + Skirting + Dado) or 12"x24"x5/16" (Flooring + Skirting + Dado)	P.Sft.	149846	439.57	65,867,806.22
01-21C	Page No. 47, Sr. No. 36(a)	Providing grey cement skirting or dado 3/8" thick including rounding of corner and straightening of top edge and finishing to smooth surface after plastering. (a) 1:2 cement sand mortar	P.Sft.	3617	73.64	266,355.88
01-22C	Page No. 50, Sr. No. 67	Providing & fixing cement **paving blocks flooring having size of 197 x 97 x 60 (mm)** of city /quddra / cobble shape **with natural colours**, having strength b/w 5000 PSI to 8500 PSI i/c filling the joints with hill sand over a bed of 2" thick hill sand or stone dust and laying and compacting in specified manner/pattern and design etc complete.	P.Sft.	756	325.40	246,002.40
01-23C	Page No. 50, Sr. No. 68	Providing & fixing cement **paving blocks flooring having size of 197 x 97 x 60 (mm)** of city /quddra /cobble shape **with pigmented,** having strength b/w 5000 psi to 8500 psi i/c filling the joints with hill sand over a bed of 2" thick hill sand or stone dust and laying and compacting in specified manner/ pattern and design etc complete.(Pigmented) (PSI 5000 to 8500e / Tameer Works or Equivalent manufacturer)	P.Sft.	84	325.40	27,333.60

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CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-24C	Page No. 50, Sr. No. 69	Providing & fixing cement **paving blocks flooring having size of 197 x 97 x 80 (mm)** of city /quddra /cobble shape **with natural colours,** having strength b/w 5000 psi to 8500 psi i/c filling the joints with hill sand over a bed of 2" thick hill sand or stone dust and laying and compacting in specified manner/pattern and design etc complete.(PSI 5000 to 8500e /Tameer Works or Equivalent manufacturer)	P.Sft.	2197	325.40	714,871.26
01-25C	Page No. 50, Sr. No. 70	Providing & fixing cement **paving blocks flooring having size of 197 x 97 x 80 (mm)** of city /quddra /cobble shape **with pigment,** having strength b/w 5000 PSI to 8500 PSI i/c filling the joints with hill sand over a bed of 2" thick hill sand or stone dust and laying and compacting in specified manner/pattern and design etc complete.	P.Sft.	244	325.40	79,430.14
		CHAPTER NO. 9 **SURFACE RENDERING**				
01-26C	Page No. 52, Sr.No.11 (b)	Cement plaster 1:4 on **specified Interior** upto 12' height. 1/2" thick (Ceiling & walls).	P.Sft	485621	39.83	19,342,284.43
01-27C	Page No. 53, Sr. No. 29	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (First floor)	P.Sft	38753	5.15	199,577.95
01-28C	Page No. 53, Sr. No. 29x2	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Second floor)	P.Sft	48079	10.30	495,213.70
01-29C	Page No. 53, Sr. No. 29x3	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Third floor)	P.Sft	48911	15.45	755,674.95
01-30C	Page No. 53, Sr. No. 29x4	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Fourth floor)	P.Sft	48911	20.60	1,007,566.60
01-31C	Page No. 53, Sr. No. 29x5	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Fifth floor)	P.Sft	48079	25.75	1,238,034.25
01-32C	Page No. 53, Sr. No. 29x6	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Sixth floor)	P.Sft	48079	30.90	1,485,641.10
01-33C	Page No. 53, Sr. No. 29x7	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Seventh floor)	P.Sft	48079	36.05	1,733,247.95
01-34C	Page No. 53, Sr. No. 29x8	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Eighth floor)	P.Sft	43092	41.20	1,775,390.40

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-35C	Page No. 53, Sr. No. 29x9	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Ninth floor)	P.Sft	42979	46.35	1,992,076.65
01-36C	Page No. 53, Sr. No. 29x11	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Roof floor)	P.Sft	11608	56.65	657,593.20
01-37C	Page No. 52, Sr.No.11 (c)	Cement plaster 1:4 on **specified Exterior surfaces** upto 12' height. 3/4" thick exterior surface	P.Sft	97366	53.82	5,240,238.12
01-38C	Page No. 53, Sr. No. 29	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (First floor)	P.Sft	13121	5.15	67,573.15
01-39C	Page No. 53, Sr. No. 29x2	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Second floor)	P.Sft	8265	10.30	85,129.50
01-40C	Page No. 53, Sr. No. 29x3	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Third floor)	P.Sft	8265	15.45	127,694.25
01-41C	Page No. 53, Sr. No. 29x4	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Fourth floor)	P.Sft	8265	20.60	170,259.00
01-42C	Page No. 53, Sr. No. 29x5	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Fifth floor)	P.Sft	8265	25.75	212,823.75
01-43C	Page No. 53, Sr. No. 29x6	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Sixth floor)	P.Sft	8265	30.90	255,388.50
01-44C	Page No. 53, Sr. No. 29x7	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Seventh floor)	P.Sft	8265	36.05	297,953.25
01-45C	Page No. 53, Sr. No. 29x8	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Eighth floor)	P.Sft	8265	41.20	340,518.00
01-46C	Page No. 53, Sr. No. 29x9	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Ninth floor)	P.Sft	8265	46.35	383,082.75
01-47C	Page No. 53, Sr. No. 29x11	Extra for lime mud or cement plaster and pointing from 12' and above (for each additional 10' height). (Roof floor)	P.Sft	2528	56.65	143,211.20
01-48C	Page No. 53, Sr.No.23 + 24(c)	Distempering with priming coat of chalk distemper **(sample and shade approved by the Architect / Engineer).**	P.Sft	152060	20.82	3,165,889.20
01-49C	Page No. 54, Sr.No.36.A & 36.B	Preparation the surface and painting with matt finish i/c rubbing the surface with Bathy (silicon carbide rubbing brick) filling the voids with zink/chalk/plaster of paris mixture, applying first coat premix, making the surface smooth and then painting 3 coats with matt finish of approved make etc. complete. (new surface). **sample and shade approved by the Architect / Engineer**	P.Sft	326326	100.83	32,903,450.58

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-50C	Page No. 54, Sr.No.38.A + 38.B	Preparation the surface and painting with weather coat i/c rubbing the surface with rubbing brick / sand paper, filling the voids with chalk / plaster of paris and then painting with weather coat of approved make. **(sample and shade approved by the Architect / Engineer).**	P.Sft	97365	86.58	8,429,861.70
01-51C	Page No. 55, Sr.No. 44	Providing & fixing colour crete to wall surface to provide, durable crust and aesthetics having thickness upto 3/4" with specified colour having water, fire and temite resistance (upto 20' -0 height).	P.Sft	41485	117.32	4,867,020.20
		CHAPTER NO. 17 **IRON WORK**				
01-52C	Page No. 75, Sr.No. 2 + 3	Fabrication of heavy steel work with angles, tees, flat iron, round iron and sheet iron for making trusses, girders, tands etc. including cutting, tanks etc. including cutting, drilling riveting, handling assembling and fixing but excluding erection in position. + Erection and fitting in position of iron trusses staging of water tanks etc. *(for Emergence Staircase+SD1 & SD2)*	P. Cwt	340	21,191.30	7,205,042.00
01-53C	Page No. 76, Sr.No. 23	Making & fixing steel grated doors complete with locking arrangement angle iron frame 2" x 2" 3/8"and 3/4" sq: bars 4" centre to center.	P. Sft	509	2,345.40	1,193,808.60
01-54C	Page No. 76, Sr.No. 26	Supplying & fixing in position iron/steel grill of 3/4" x 1/4" size flat iron of approved design including painting 3 coats etc. complete (weight not to be less than 3.7 Lbs./Sq. . Foot of finished grill).	P. Sft	8062	1,124.10	9,062,494.20
01-55C	Page No. 77, Sr.No. 32	Providing and fixing iron collapsible gate with channel framing of section 3/4" x 5/16" at 4" I/c revitted with 3/4" x 1/8" flat iron patti placed diagonally and provided with top & bottom T- section 1" x 1" 1/8" along with rollers also I/c locking arrangement and fixing in floor/ceiling or wall etc: completed.	P. Sft	435	1,956.05	850,881.75
		CHAPTER NO. 18 **MISCELLANEOUS**				
01-56C	Page No. 83, Sr.No. 84(b)	Supplying & fixing in position **Aluminum channels framing for sliding windows & ventilators** of made with 5 mm thick tinted glass glazing (Belgium) & Aluminum fly screen I/c handles stoppers & locking arrangement etc. complete. (b) Deluxe model (Bronze).	P.Sft	8062	2,386.73	19,241,817.26
01-57C	Page No. 84, Sr.No.92A	Providing Anti - termite treatment by spraying / sprinkling/spreading Neptachlar 0.5% Emulsion as an overall pre-construction treatment in slab type construction under the slab and along attached perches or entrances etc. complete as per direction of Engineer In charge. **(ground floor area will be measured for payment).**	P.Sft.	18299	11.46	209,706.54

National Engineering Services Pakistan (Pvt) Ltd. A&P DIVISION Karachi

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		BUILDING ITEMS				
01-58C	Page No. 85, Sr.No. 98(iv)	Placing, compacting, finishing and curing of concrete using ordinary Portland Cement/ Sulphate resistant cement / Slag cement as may be required: including screening, washing of aggregates and mixing of constituents using batching plant, transportation by transit mixer, pouring with pump in the required portion to achieve a cylindrical strength in the field as per ACI 214, with the specified consistency i/c the cost of shuttering, compaction with compactor, excluding the cost of admixture, as approved and directed by the Engineer In charge. **(iv) 4000 PSI** (All Structural Elements)	Per Cft.	306967	900.31	276,365,459.77
01-59C	Page No. 86, Sr.No. 105	Supply and installation of **mineral fiber acoustic ceiling** (non-directional) perforated pattern size 2'-0"x2-0"x1/2' thick and imported Aluminum trudged section in natural anodized finish 10-12 microns coating comprising of main tee runner and edge trim. Suspension shall be made by mean of adjustable suspender of 8 SWG galvanized steel wire and cadmium plated spring clip supported at 4'-0" center to center, suspender shall by fixed to slab beam soffits with nylon anchor 1-1/2 No. 12 round headed steel screws and washer	Per Sft.	6426	318.69	2,047,901.94
01-60C	Page No. 86, Sr.No. 110	Providing and fixing **stainless steel nickel coated staircase railing** of 3-1/2" consisting of horizontal 2-1/2"x21/2" at bottom and 1-1/2"x1-1/2" vertical tube 12" center to center and 3" steel tube with round ball as directed by engineer / in charge.	Per Rft.	664	315.13	209,246.32
01-61C	Page No. 86, Sr.No. 112	Providing and fixing in position **UPVC channels framing for Door** of Unplasticized polyvinyl chloride (UPVC) with fly screen in/c handles stoppers looking arrangement etc complete Deluxe model etc complete as per direction Engineer / In charge. (in Pantry, Electric Room, Toilets)	Per Sft.	3127	315.13	985,411.51
01-62C	Page No. 221, Sr.No. 13	Pavement marking in **Reflective Tharmo Plastic Paint** for Lines of 6" Width.	P. Rft.	2445	86.10	210,514.50
01-63C	Page No. 221, Sr.No. 14	Providing & fixing Precast Edge Block 3750 PSI Industrial Made Size 6 inches thick x 12 inches long x 18 inches high including the cost of Cartage, excavation, form Work for haunching, 1450 PSI lean concrete, 2250 PSI concrete for haunching, 1:4 cement sand mortor.	P. Rft.	210	678.38	142,459.80

Amount of Schedule Items Civil Works (Part-I) Rs.	550,876,345.33
Add / Deduct _____ Premium on Civil Works Schedule Items Rs.	
Total Amount of Civil Works (Part-I) Rs.	**550,876,345.33**

National Engineering Services Pakistan Ltd. A & E DIVISION Karachi

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	Part-II	**CHAPTER NO. 4** **CONCRETE**				
01-64C	Page No.17, Sr No. 8 (a-i)	Fabrication of deformed steel reinforcement for cement concrete including cutting, bending, laying in position, making joints and fastenings including cost of binding wire (also includes removal of rust from bars.) a) Deformed bar i) Grade-60	Per Cwt	27458.58	18,934.02	519,901,302.89
01-65C	Page No. 28, Sr. No. 29	Extra labour for lifting of steel above first floor for every additional floor. (Second Floor)	Cwt.	1168.44	792.15	925,579.75
01-66C	Page No. 28, Sr. No. 29x2	Extra labour for lifting of steel above first floor for every additional floor. (Third Floor)	Cwt.	1168.44	1,584.30	1,851,159.49
01-67C	Page No. 28, Sr. No. 29x3	Extra labour for lifting of steel above first floor for every additional floor. (Fourth Floor)	Cwt.	1168.44	2,376.45	2,776,739.24
01-68C	Page No. 28, Sr. No. 29x4	Extra labour for lifting of steel above first floor for every additional floor. (Fifth Floor)	Cwt.	1168.44	3,168.60	3,702,318.98
01-69C	Page No. 28, Sr. No. 29x5	Extra labour for lifting of steel above first floor for every additional floor. (Sixth Floor)	Cwt.	1168.44	3,960.75	4,627,898.73
01-70C	Page No. 28, Sr. No. 29x6	Extra labour for lifting of steel above first floor for every additional floor. (Seventh Floor)	Cwt.	1168.44	4,752.90	5,553,478.48
01-71C	Page No. 28, Sr. No. 29x7	Extra labour for lifting of steel above first floor for every additional floor. (Eighth Floor)	Cwt.	1168.44	5,545.05	6,479,058.22
01-72C	Page No. 28, Sr. No. 29x8	Extra labour for lifting of steel above first floor for every additional floor. (Ninth Floor)	Cwt.	1168.44	6,337.20	7,404,637.97
01-73C	Page No. 28, Sr. No. 29x10	Extra labour for lifting of steel above first floor for every additional floor. (Roof Floor)	Cwt.	577.07	7,921.50	4,571,259.28

Amount of Schedule Items Civil Works (Part-II) Rs. 557,793,433.03

Add / Deduct _____ Premium on Civil Works Schedule Items Rs. _____

Total Amount of Civil Works (Part-II) Rs. _____

Total Amount of Civil Works Schedule (Part-I+II) Rs.

carried over to Summary _____

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		NON - SCHEDULE ITEMS				
		DEWATERING Ref. Spec. No. 1200				
01-74C	NSR	Designing, providing, installing, operating and maintaining a **dewatering system** and protective sheeting (for all project) complete including mobilization & demobilization of equipment, materials and personnel for this work and stand by arrangements for keeping the water table to specified limit as to enable the construction of office building to proceed and keep the construction area dry.	L.S.	1		
		STONE SOLING Ref. Spec. No. 1330				
01-75C	NSR	Providing & Laying compacted stone soling.				
		a) 6 inch thick	Sft	17848		
		STAINLESS STEEL MATERIAL & FINISHES Ref. Spec. No. 3010				
01-76C	NSR	Providing, fabricating and fixing **stainless steel (SS) Staircase hand railing** of the following types complete in all respects as shown on drawings / details and/or as directed by the Architect / Engineer.**(sample approved by the Architect/Engineer).**				
	(a)	Wall Mounted	Rft.	1130		
		CARPENTRY & JOINERY WORK Ref. Spec. No. 4600 & 6700				
01-77C	NSR	Providing and fixing wooden **Engineered doors with vision panel of the following type** consisting of Metal Chowkat/frame 16 SWG and door shutter solid core commercial ply wood with 3mm thick approved veneer on both side with groove shutters consists of 2" thick 4" wide frame of Red Meranti wood filling with MDF approved quality including vision panel (5mm thick clear glass), hold fast, hinges, mortice lock (approved quality) + striking plates s.s. finish, door closer tower bolts, 10 mm Lipping and beading/architrave, painting / polishing and Kick plate/wired glass view panel and etc. complete in all respects as shown on drawings / specifications and/or as directed by the Architect / Engineer *(sample approved by the Architect / Engineer)*.				
	(a)	Double Swing Door	Sft.	1764		
	(b)	Single Leaf Door	Sft.	1197		
01-78C	NSR	Providing making and fixing **Kitchen/Pantry cabinets** comprising 3/4" thick polished granite, 1/16" drip, 3/16" wide 1/16" deep groove, under counter cabinet shutter 3/4" thick light stained beech veneered MDF on 2 Nos. proprietary concealed hinges, brushed stainless steel long handle, 6" high ceramic tiles skirting, concrete base, 4" highX1" thick polished black galaxy granite back splash, 3/4" MDF impregnated white board on both side and roil lipping to all exposed edges and 3/4" thick moisture resistant MDF impregnated white board base unit etc. complete in all respects as shown on drawings and or as directed by the Engineer.				
		a) Floor Mounted	Rft.	159		

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CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		b) Wall Mounted	Rft.	269		
01-79C	NSR	Providing and fixing 4" **Thick foldable partioning systems** comprising of solid patal wood framing, 1/2" thick lamininated MDF sheet both sides with Oak lipping allaround, 3mm thick veneer middle bands/boarder with lacquare polishng, hings (heavy duty), channels, handles, all other fixing accessories and hardwares etc. complete in all respects as shown on drawings / details and/or as directed by the Architect / Engineer *(sample approved by the Architect / Engineer).*	Sft	1562		
		ALIMINUM WORKS				
		Ref. Spec. No. 6220 & 6250				
01-80C	NSR	Providing and fixing fully glazed **anodized aluminum doors** of approved manufacturer using **2mm thick** 4" wide extruded sections, glazed with distortion free 12mm thick tempered glass including Floor machine, SS Handles, all other fixing accessories, hardware's, PVC / rubber gasket and sealant complete as per schedule & specifications and/or as directed by the Architect / Engineer **(sample as approved by the Architects/Engineer).**				
		(a) Main Entrance Door with fixed glazing	Sft.	269		
		WATER PROOFING & BULIT-UP ROOFING				
		Ref. Spec. No. 2300 & 6411				
01-81C	NSR	Water proofing treatment of retaining wall & raft complete in all respects as shown on drawings/details as per approved manufacturer's to the entire stratification of the Engineer.				
		a) Under raft	Sft	17848		
		b) Outside retaining wall outside retaining wall including protection block masonry (4" Thick) & flashing etc.	Sft	19548		
		c) Inside retaining wall	Sft	15994		
01-82C	NSR	**Roof treatment** over roof / chajja comprising of surface preparation, removal of loose concrete, primer ASO - UNIGRUND - P @ 0.2 lit./Sq.m, Two (02) coats AUAFIN - 2C @ 1.75 Kg./Sq.m per coat, 3" thick Class - "C" (1:2:4) cement concrete screed laid in slope & panel including making gola/chamfering on edges all-around parapet, foundations (any type) and curing etc. complete in all respect and / or as directed by the Architect / Engineer.	Sft.	16445		
01-83C	NSR	**Water proof plaster inside,** 3/4" thick 1:4 cement sand plaster after applying sika seal 105-N A+B, 4 coats @ 2kg / Sq.m or as per manufacturer's instructions / recommendations complete in all respects and/or as directed by the Architect / Engineer (inside O.H. water tanks).	Sft.	2240		
01-84C	NSR	**Water proof plaster outside,** 3/4" thick 1:4 cement sand plaster complete in all respects and/or as directed by the Architect / Engineer (outside O.H. W. Tank).	Sft.	2136		
01-85C	NSR	Providing & fixing **8" wide PVC water stopper** with fixing claps, as per manufacture recommendation complete in all respects and/or as directed by the Engineer.	Rft.	750		

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Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		FALSE CEILING Ref. Spec. No. 6500				
01-86C	NSR	Providing and fixing **Gypsum tile** (Moisture resistant) **false ceiling** of the following (DFB or approved equivalent) including suspension system, cutting of opening for light fixtures/fans/ diffusers, making light pelmet & bulk-head, Two (02) coats of lead free non-yellowing alkyd enamel paint finish (approved quality colour/shade), making access panel etc., complete in all respects as shown on drawings/details and/or as directed by the Architect/Engineer. *(Clear Surface area will be measured for payment)*				
		a) 24" x 24" x 1/2" Thick	Sft.	26363		
		b) 24" x 96" x 1/2" Thick	Sft.	17576		
01-87C	NSR	Providing and fixing **DAMPA non-perforated false ceiling** 600X600X0.7mm Thick with suspension system of approved quality, colour & pattern including all other accessories & hardware's making light fixing provisions etc. complete in all respects as shown drawings/details and/or as directed by the Engineer.	Sft.	8610		
		FLOOR AND WALL FINISHING Ref. Spec. No. 2300, 6521, 6531, 6600, 6610 & 7510				
01-88C	NSR	Providing and laying **3/4" thick granite stone one piece on trade and risers** of approved quality / colour / shade i/c non slip carboarded inserts, Tiles laying over base of Class - "C" (1:2:4) cement concrete , setting tile in dry bond (SIKA Ceram 90 VOC less Or Equivalent), SIKA Tile grouting with matching colour, torch flaming, grinding, polishing, washing, cleaning and curing etc. complete in all respects as per drawings, specifications and/or as directed by the Architect / Engineer **(sample and shade/colour approved by the Architect / Engineer).**				
		a) One Piece on Trades & Risers	Sft.	4505		
		b) on landing (approved size)	Sft.	1449		
		c) Door Threshold	Sft.	780		
01-89C	NSR	Providing and laying **3/4" thick Granite stone in Dado in specified area** of approved quality / colour / shade over base of Class - "C" (1:2:4) cement concrete , setting tile in dry bond (SIKA Ceram 90 VOC less Or Equivalent), SIKA Tile grouting with matching colour, torch flaming, grinding, polishing, washing, cleaning and curing etc. complete in all respects as per drawings, specifications and/or as directed by the Architect / Engineer **(sample and shade/colour approved by the Architect / Engineer).**				
	(a)	3/4" thick 12" x 24" Granite tiles upto 8'-0" high (Typical all lift Well walls)	Sft.	3426		

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CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-90C	NSR	Providing and laying **3/4" thick Granite vanity counter, Labs counter and Information top** of approved colour / shade over base of Class - "C" (1:2:4) cement concrete , setting tile in cement slurry, filling the joint with matching colour, cleaning and curing etc. complete in all respects as per drawings, specifications and/or as directed by the Architect / Engineer (sample and shade/colour approved by the Architect / Engineer).	Sft.	836		
01-91C	NSR	Providing & fixing **Anti static Flooring** comprising compact vinyl-Forbo Sphrera element 2.0mm in rolls (Holland by Forbo flooring system, F-CUBE or Approved), welded with machine grooving and heat welding process to provide seamless surface, 3mm level top self leveling complete in all respects and/or as directed by the Engineer.	Sft.	1195		
01-92C	NSR	Providing and laying SIKAFLOOR-5 Chapdur Paymix (PK) non-metallic (@ of 6 Kg/Sqm.) **floor hardener** or approved equivalent complete in all respects as per manufacturer's recommendations, and/or as directed by the Architect / Engineer.	Kg	17631		
		MISCELLANEOUS WORKS				
01-93C	NSR	Providing & fixing Fire rated Door (2hrs) as per NFPA standard including all other accessories, hardware's & painting as per manufacture recommendation, complete in all respects and/or as directed by the Engineer.	No	13		
01-94C	NSR	Providing, fabricating and fixing 2"x2"x1/4" thick up to 5'-0" high Mild steel (MS) Guard rail for Edges of Columns, including enamel paint with anti-corrosive priming coat complete in all respects as shown on drawings / details and/or as directed by the Architect / Engineer.(sample approved by the Architect/Engineer).				
		(a) Guard Rail	Kg	550		
01-95C	NSR	Providing & fixing **Solid wooden flooring for stage**, 6" wide x ¾" thick mahogany solid wooden flooring fixed over CC stage platform making all good proper rigid carpentry joint including French polishing etc. complete in all respects and/or as directed by the Engineer.	Sft.	1176		
01-96C	NSR	Providing & fixing **lasani wooden cladding** fabricated with front 18mm high gloss/tactile lasani wooden sheet (Wilsonart or equivalent) both side machine pressed lamination of approved design & pattern fixed over base of 18mm MDF sheet all fixed over 2" thick anti termite partal wood having (@ 2' x 4' spacing) entire sheet edges protected with 2mm thick PVC lipping entire wooden work must be treated with anti-termite spray complete in all respects and/or as directed by the Engineer.	Sft.	9514		

CIVIL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-97C	NSR	Providing & fixing **Red Oak** 2mm ply pasted 18mm lasani sheet as per approved design fixed over base of 18mm MDF sheet all fixed over 2" thick anti- termite partal wood having (@ 2' x 4' spacing) entire sheet edges protected with red-oak lipping entire wooden work must be treated with anti-termite spray including French polishing etc. complete in all respects and/or as directed by the Engineer.	Sft.	9514		
01-98C	NSR	Providing & fixing **WPVC Wall paneling ribs** wooden design on existing wall/dry partition as per approved design complete in all respects and/or as directed by the Engineer.	Sft.	9514		

Amount of Non - Schedule Items Civil Works Rs. _____

carried over to Summary _____

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION

LIST OF APPROVED MANUFACTURERS/BRANDS OF MATERIALS/EQUIPMENT

Civil & Architectural Items

Sr. No.	Materials	Manufactures
1.	Crushed Stone Aggregate	Source as approval by the Engineer
2.	Reinforcement Steel	(i) Sheikhoo steel (ii) A1 steel, Karachi (iii) Amrelli, (iv) Magna Steel (v) Faizan Steel or approved equivalent
3.	Sand	Source as approved by the Engineer
4.	Cement	(i) Pakland (ii) Falcon, (iii) Power (iv) Lucky, (v) D.G. Cement or approved equivalent
5.	Porcelain Tiles	**Local** (i) Master Tiles, ii) Shabbir Tiles or equivalent
6.	Ceramic Tiles	**Local** (i) Master Tiles, ii) Shabbir Tiles or approved equivalent
7.	Paints & Varnish	(i) ICI, (ii) Berger, (iii) Jotun, (iv) Kansai, (v) Brighto, (vi) Nippon or approved equivalent
8.	Aluminum profile Windows / Ventilator	(i) Al Fatah (ii) ALCOP (iii) Chawla Aluminum (iv) Prime Aluminum or approved equivalent
9.	Hardware Stays, Hinges, Handles & Door Locks	(i) JB Saeed or approved equivalent
10.	Concrete Floor Tiles/Pavers/Curbstone	(i) Tuff Pavers (ii) Izhar (iii) Envicrete (iv) Magna Crete (v) Hub Crete or approved equivalent
11.	Concrete Blocks	As approved by the Engineer
12.	MDF	(i) Pakistan Chipboard (ii) Al-Noor or approved equivalent
13.	Lamination Boards/ Veneer Boards	(i) Formite, (ii) Al-Noor or approved equivalent
14.	Formica	(i) Formite (Tuff), (ii) Al-Noor or approved equivalent
15.	Glass, Tinted glass / Double Glasses Tempered/ Reflective/ Wired Glasses Mirror Glass	(i) Gunj Glass, (ii) Ghani Glass (iii) Pakistan Safety Glass or approved equivalent
16.	False Ceiling & Suspension System	Source as approved by Engineer.
17.	Board Gypsum False Ceiling including Suspension System	(i) Boral, (ii) DFB, (iii) Elephant make or approved equivalent
18.	Marble / Granite	Source as approved by Engineer.
19.	**Termite Proofing** For Soil For Wood	 (i) Fiprokill (ii) Biflex (ii) Merage or approved equivalent (i) Bio Wood, (ii) Power Max (iii) Solignum (iv) Biflies or approved equivalent
20.	Construction Chemicals	(i) Aquafin Pakistan (ii) FOSPAK, (iii) SIKA or approved equivalent
21.	Wooden Flooring	(i) Source as approved by Engineer
22.	Furniture	(i) Source as approved by Engineer

National Engineering Services Pakistan Pvt. Ltd. A & P DIVISION Karachi

PRICED BILL OF QUANTITES
(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		P. PLUMBING WORKS				
01		**SCHEDULE ITEMS**				
		Vol III, Part III				
		CHAPTER NO. 1: SANITARY FITTINGS				
01-1P	Vol III, Part III, Ch. 1, Sr. No. 3(b)	Providing and fixing orisa type white or colour glazed earthen ware w.c pan with cost of low level plastic flush tank of 3 gallons capacity of approved quality i/c making requisite number of holes in wall, plainth & floor and making good in cement concrete 1:2:4. (ii) With 4" dia earthen ware trap and plastic thumble.	Each.	40		
01-2P	Vol III, Part III, Ch. 1, Sr. No. 5	Providing & fixing European white glazed earthen ware wash down w.c pan complete with & I/c the cost of white/black plastic seat (Best Quality) and lid with C.P brass hinges and buffers, 3 gallons white glazed earthen earthen ware low level flushing cistern with siphon fitting 1-1/2" dia white porcelain enameled flush bend 3/4" dia and making requisite number of holes in walls, plinth and floor for pipe connections and making good in cement concrete 1:2:4. (Foreign Quality) (ICL or equivalent).	Each.	54		
01-3P	Vol III, Part III, Ch. 1, Sr. No. 10	Providing & fixing 24" x 18" lavatory basin in white glazed earthen ware complete with & I/c the cost of W.I or C.I cantilever brackets 6 inches built into wall, painted white in two coat after a primary coat of red lead paint, a pair of 1/2" dia rubber plug & chrome plate brass chain 1-1/4" dia malleable iron or c.P brass traps malleable iron or brass unions and making requisite number of holes in walls, plinth & floor for pipe connection and making good in cement concrete 1:2:4 (Foreign or Equivalent).	Each.	94		
01-4P	Vol III, Part III, Ch. 1, Sr. No. 11	Add extra for providing & fixing of earthen ware pedestal white or colored glazed(Foreign or Equivalent.)	Each.	94		
01-5P	Vol III, Part III, Ch. 1, Sr. No. 19	Providing & fixing steel sinks stainless local make complete with cast iron or wraught iron brackets 6 inches built in wall, 1-1/2" c.p bubber plug chrome plated brass chain, 1-1/2" c.p brass waste, with 1-1/2" P.V.C. waste pipe & making requisite number of holes in wall & plinth & floor for pipe connection & making good in cement concrete 1 : 2: 4.				
		c) Steel sink stainless sized 33" x 18" local make (Standard Pattern.)	Nos.	43		

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		CHAPTER NO.2: TOILETS				
01-6P	Vol III, Part III, Ch. 2, Sr. No. 2	Providing & fixing c.p brass toilet paper holder of standard size with chrome plated brass brackets complete (Similar to twyfords design No. 1108).				
		b) Superior Quality.	Nos.	105		
01-7P	Vol III, Part III, Ch. 2, Sr. No. 3	Providing & fixing 24" x 18" bavelled edge mirror of belgium glass complete with 1/8" thick hard board and c.p screws fixed to wooden pleat..				
		b) Superior Quality.	Nos.	104		
01-8P	Vol III, Part III, Ch. 2, Sr. No. 5	Supplying & fixing soap tray of superior quality and design with fine finishing with C.P. screws etc. complete.	Each	52		
		CHAPTER NO. 6: C.P BRASS BIB COCK AND STOP COCK				
01-9P	Vol III, Part III, Ch. 6, Sr. No. 12(b)	(b) S/Fixing concealed tee-stop cock of superior quality with c.p head 1/2" dia.	Each	313		
01-10P	Vol III, Part III, Ch. 6, Sr. No. 14(b)	(b) S/Fixing wash basin mixer of superior quality with c.p head 1/2" dia.	Each	94		
01-11P	Vol III, Part III, Ch. 6, Sr. No. 19(a)	(a) S/Fixing C.P Muslim Shower with double Bib Cock & ring Pipe etc. complete.	Each	105		
		Vol III, Part II, CHAPTER NO. II: EXTERNAL WATER SUPPLY SYSTEM				
		EXTERNAL SEWERAGE SYSTEM **U-PVC PIPES WITH 'Z' JOINTs.**				
01-12P	Vol III, Part II, Ch. II, Sr. No. D-2	Providing, Laying uPVC Pressure Pipes of Class 'C' (equivalent make) fixing in trench i/c cutting, fitting and jointing with 'Z' joint with one rubber ring i/c testing with water to a head 91.5 meter or 300 ft.				
	g)	8" dia 200 mm	Rft.	100		
					Amount of Schedule Items Plumbing Works Rs.	
					Add / Deduct_____Premium on Plumbing Works Schedule Items Rs.	
					Total Amount of Plumbing Works Schedule Rs.	
		NON - SCHEDULE ITEMS				
02		**WATER SUPPLY**				
		Ref: Spec. No.5100, 5180, & 5220				
02-1P	N.S	Supply, installation, testing, and remedy of defects and damages during defect liability period of PPR cold and hot water pipes (S-2.5, SDR-6, PN-20) conforming to ISO 15874, DIN 8077 & DIN 8078 & fittings (PN25) conforming to DIN 16962 of following nominal outside diameters, complete in all respects, as shown on the drawings and as specified (for unexposed piping).				
		a) O.D. 25mm	Rft	3,300		
		b) O.D. 32mm	Rft	1,738		

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Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		c) O.D. 40mm	Rft	760		
		d) O.D. 50mm	Rft	370		
		e) O.D. 63mm	Rft	60		
		f) O.D. 75mm	Rft	230		
02-2P	N.S	Supply, installation, testing, and remedy of defects and damages during defect liability period of HDPE pipes (SDR-17, PE-100, PN-10), conforming to ISO 4427, including tees, bends, flange adapters, and all types of fittings conforming to ISO 4427, of following nominal outside diameters, complete in all respects, as shown on the drawings and as specified (for unexposed & exposed piping).				
		a) O.D. 90mm	Rft	230		
		Gate Valves Ref: Spec. No. 5100, 5220 & 5180				
02-3P	N.S	Supply, installation, testing, and remedy of defects and damages during defect liability period of threaded Bronze Gate Valves, full bore, non-rising stem, PN 16 or Class 150, of the following nominal diameters, conforming to MSS SP-80 or equivalent, complete in all respects, installed as shown on the drawings and in accordance with the specifications.				
		a) 25 mm (1")	Nos.	114		
		b) 32 mm (1-1/4")	Nos.	56		
		c) 40 mm (1-1/2")	Nos.	29		
		c) 50 mm (2")	Nos.	2		
02-4P	N.S	Supply, installation, testing, and remedy of defects and damages during defect liability period of flange-type Gate Valves, full bore, non-rising stem, PN 16, of the following nominal diameters, conforming to BS 5163 or equivalent, complete in all respects, installed as shown on the drawings and in accordance with the specifications.				
		a) 80 mm	Nos.	2		
		b) 100 mm	Nos.	2		
03		**PUMPING MACHINERY AND ACCESSORIES** Ref.Spec. 5240				
03-1P	N.S	Supply, installation, testing, commisioning and remedy of defects and damages during defect liability period of Non-Clogging Submersible Drainage Pump of approved type, of the following capacity & pressure, including motor, variable level control, integrated check valve, overload protection and all other accessories required for complete installation & operation, complete in all respects, as shown on the drawings and as specified.				
		Q = 50-55 US gpm, H = 60-65 ft	Nos.	2		

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Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
04		**ROOF TANK ACCESSORIES** Ref. Spec. No. 5100, 5180 & 5220				
04-1P	N.S	Supply, installation, testing, and remedy of defects and damages during defect liability period of threaded brass / bronze float valve, piston type, full-bore, PN 16 or Class 150, of the following specified nominal diameter(s), conforming to BS 1212-1 or approved equivalent, including copper float (ball), complete in all respects, and installed in accordance with the drawings and specifications.				
		a) 50 mm (2")	Nos.	1		
04-2P	N.S	Supply, installation, and remedy of defects and damages during defect liability period of overhead tank manhole cover (light-duty) with frame (C.I./D.I.), size 2' × 2', as approved, complete in all respects, and installed in accordance with the drawings and specifications.	Nos.	2		
04-3P	N.S	Supply, installation, and remedy of defects and damages during defect liability period of Goose Neck (Hot Dip Galvanized), Schedule 40 at Overhead Tank, of the following nominal diameters, including wire mesh, complete in all respects, and installed in accordance with the drawings and specifications.				
		a) 100 mm (4")	Nos.	1		
04-4P	N.S	Supply, installation, and remedy of defects and damages during defect liability period of Puddle Flanges (Hot Dip Galvanized), Schedule 40 for Overhead Tank, of the following nominal diameters, complete in all respects, and installed in accordance with the drawings and specifications.				
		a) 100 mm (4")	Nos.	4		
05		**PLUMBING FIXTURES** Ref: Spec. No. 5100 & 5180				
05-1P	N.S	Supply, installation, and remedy of defects and damages during defect liability period of European water closet (coupled / single-body type) for disable with dual-flush push button cistern, including all necessary accessories, complete in all respects, as shown on the drawings and as specified.	Nos.	11		
05-2P	N.S	Supply, installation, and remedy of defects and damages during defect liability period of pedestal-type wash basin for disable with C.P. brass basin mixer, including all other accessories as specified and required for installation, and as shown on the drawings.	Nos.	11		
05-3P	N.S	Supply, installation, testing, commissioning and remedy of defects and damages during defect liability period of electric storage-type water heater, of the following capacities, including stop cocks/angle valves at supply and discharge, power cable, and all other accessories, complete in all respects, as shown on the drawings and as specified.				
		a) 30 Liter	Nos.	2		

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Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		b) 45 Liter	Nos.	21		
05-4P	N.S	Supply, installation, testing, commissioning and remedy of defects and damages during defect liability period of Electric water cooler, of the following capacities, including 3-stage filters (of approved make & type), stop cock/angle valve, power cable, and all other accessories, complete in all respects, as shown on the drawings and as specified.				
		a) 100 Liter/hour	Nos.	5		
05-5P	N.S	Supply, installation, and remedy of defects and damages during defect liability period of stainless steel SS316 coat hook of approved shape and size, complete in all respects, as shown on the drawings and/or as specified.	Nos.	105		
05-6P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of stainless steel SS316 kitchen sink with single bowl and single drainboard, including SS316 sink mixer and all other accessories, complete in all respects, as shown on the drawings and as specified.	Nos.	2		
05-7P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of Janitor sink, including SS316 sink mixer and all other accessories, complete in all respects, as shown on the drawings and as specified.	Nos.	11		
06		**SANITARY DRAINAGE** Ref: Spec. No. 5100, 5180, 5225 & 5233				
06-1P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of PVC soil, waste, and vent pipes conforming to ASTM D-1785, Schedule 40, with fittings conforming to ASTM D-2466, Schedule 40, of the following nominal pipe diameters, complete in all respects, as shown on the drawings and as specified.				
		a) NPS 1-1/2"	Rft	200		
		b) NPS 2"	Rft	3,014		
		c) NPS 3"	Rft	1,550		
		d) NPS 4"	Rft	1,475		
06-2P	N.S	Supply and installation of uPVC drainage pipes and fittings, conforming to BS 3505 or PS 3051 and BS 4346, Class 'C', of the following nominal pipe diameters, for below-ground installation, complete in all respects, as shown on the drawings and as specified.				
		a) NPS 4"	Rft	100		
		b) NPS 6"	Rft	400		

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
06-3P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of floor drains with stainless steel grating & cover, and PVC P-trap, of the following nominal diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 3"	Nos.	67		
06-4P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of floor trap with stainless steel grating and cover, and PVC P-trap, of the following diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 3"	Nos.	67		
06-5P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of floor cleanout with SS316 cover, of the following diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 3"	Nos.	1		
		b) 4"	Nos.	1		
06-6P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of cleanout plug, of the following diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 3"	Nos.	62		
		b) 4"	Nos.	80		
06-7P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of uPVC vent cowl for soil/waste pipe, of the following diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 4"	Nos.	3		
		b) 3"	Nos.	1		
06-8P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of CI / DI grating (Class B125) for ramp drain on basement floors, 2" thickness and of sizes as shown on the drawing, complete in all respects, and as specified.	Rft	60		
06-9P	N.S	Catch Pits of the following sizes, including earthworks, concrete works, steel reinforcement, and C.I./D.I. grating with frame (Class B125), complete in all respects, as shown on the drawings and as specified.				
		a) 1 ft x 1 ft	Nos.	16		
06-10P	N.S	C.I./D.I. grating with frame (Class B125) for sump pit, complete in all respects, as shown on the drawings and as specified.				
		a) 1.5 ft x 1.5 ft	Nos.	9		

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Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
06-11P	N.S	C.I./D.I. grating with frame (Class B125) for sump pit, complete in all respects, as shown on the drawings and as specified.				
		a) 2 ft x 2 ft	Nos.	1		
06-12P	N.S	Hot-dip galvanized mild steel (MS) ladder rungs of 20 mm diameter for sump pit, including embedding in wall, complete in all respects, as shown on the drawings and as specified.	Nos.	5		
		Valves Ref: Spec. No. 5220				
06-13P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of ductile iron gate valve, full-bore, non-rising stem, PN16 or Class 150, conforming to B.S. 5163, of the following nominal diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 75 mm	Nos.	2		
06-14P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of Check valve, full-bore, PN16 or Class 150, of the following nominal diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 75 mm	Nos.	2		
		Gate Valve Chamber Ref: Spec. No. 5225				
06-15P	N.S	Gate valve chamber of the following size, including earthworks, concrete works, steel reinforcement, and C.I./D.I. cover with frame (Class B125), complete in all respects, as shown on the drawings and as specified.				
		a) 1.5 ft x 1.5 ft	Nos	1		
07		**RAIN WATER PIPING:** Ref. Spec. No. 5100 & 5180				
07-1P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of cast iron rain water pipe, conforming to BS 416, of the following diameters, including fittings, complete in all respects, as shown on the drawings and as specified.				
		a) 100 mm	Rft	850		
07-2P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of cast iron scupper drain / side-inlet type roof drain, of the following diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 4"	Nos.	10		
07-3P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of cast iron rainwater shoes, of the following diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 4"	Nos.	10		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
08		**EXTERNAL WATER SUPPLY SYSTEM**				
		Valves				
		Ref: Spec. No. 5220				
08-1P	N.S	Supply, installation, testing and remedy of defects and damages during defect liability period of ductile iron gate valve, full-bore, non-rising stem, PN16 or Class 150, conforming to B.S. 5163, of the following nominal diameters, complete in all respects, as shown on the drawings and as specified.				
		a) 100 mm	Nos.	1		
		Gate Valve Chamber				
		Ref: Spec. No. 5225				
08-2P	N.S	Gate valve chamber of the following size, including earthworks, concrete works, steel reinforcement, and C.I./D.I. cover with frame (Class B125), complete in all respects, as shown on the drawings and as specified.				
		a) 750 mm x 750 mm (Internal)	Nos	1		
		Service Connection				
		Ref. Sec. No. 5270				
08-3P	N.S	Service connection with existing/external water supply pipe, including forming of opening, saddle clamps, fittings, and all other accessories required for installation, complete in all respects and as approved by the Engineer.	Job	1		
09		**EXTERNAL SEWERAGE SYSTEM**				
		uPVC Pipe & Fitting (Sewerage)				
		Ref. Spec. No. 5218 & 5180				
09-1P	N.S	Excavation for pipeline in all types of sub-surface material up to the specified depth, including dewatering (if required) and disposal of surplus or rejected excavated material, with loading, unloading, and transportation to designated locations, as directed by the Engineer, complete in all respects.				
		a) From 0 to 5ft	Cu.ft	2,093		
09-2P	N.S	Bedding with fine dry sand fill, obtained from an approved outside source, as directed by the Engineer.	Cu.ft	860		
09-3P	N.S	Filling and backfilling with selected material obtained from excavation, including watering, compaction, complete in all respects, as shown on the drawings and in accordance with the specifications.	Cu.ft	1,163		
		Gully Trap				
		Ref. Spec. No. 5100 & 5233				
09-4P	N.S	Chamber with gully trap of the following size, including earthworks, concrete works, steel reinforcement, and C.I./D.I. cover with frame (Class B125), complete in all respects, as shown on the drawings and as specified.				
		a) 450 mm x 450 mm	Nos.	3		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		Manholes				
		Ref. Spec. No. 5225 & 5233				
09-5P	N.S	Manholes of the following sizes, including earthworks, concrete works, steel reinforcement, and C.I./D.I. cover with frame (Class A15), complete in all respects, as shown on the drawings and as specified.				
		a) 750 mm x 750 mm	Nos.	3		
		Service Connection				
		Ref. Spec. No. 5270				
09-6P	N.S	Service connection with existing/external manhole or septic tank, including forming of opening, placement of rebars, and concrete casting, complete in all respects and as approved by the Engineer.	Job	1		

Amount of Non-Schedule Items Plumbing Works Rs. _____

Total Cost of Plumbing Works (Schedule & Non-Schedule Items) Rs. _____
(carried over to Summary)

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI

CONSTRUCTION OF ACADEMIC AND ADMIN BUILDING AT JSMU, KARACHI

PRICED BILL OF QUANTITES

(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

Item. No.	DESCRIPTION	UNIT	QTY.	UNIT RATE (Rs.)	TOTAL AMOUNT (Rs.)
01-01	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of seamless or ERW black steel pipe, UL listed, conforming to ASTM A53 Schedule 40, Grade B, with fittings conforming to ASTM A234, of the following nominal diameters, epoxy coated, complete in all respects, as specified and/or directed by the Engineer.				
	i) Dia 6 inch	RFT	1,746		
	ii) Dia 4 inch	RFT	936		
	iii) Dia 3 inch	RFT	630		
	iv) Dia 2-1/2 inch	RFT	2,316		
	v) Dia 2 inch	RFT	3,984		
	vi) Dia 1-1/2 inch	RFT	3,312		
	vii) Dia 1-1/4 inch	RFT	1,500		
	viii) Dia 1 inch	RFT	8,950		
01-02	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of sprinklers of the following types, with electroless nickel PTFE plating, complete in all respects, FM approved and UL listed, in accordance with NFPA 13, as specified and/or directed by the Engineer.				
	i) Pendant type	Each	850		
	ii) Upright type	Each	200		
	ii) Horizontal sidewall Sprinkler type		50		
01-03	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of the internal Class III fire hose cabinet, including swing-type drum, 100 ft × 1" diameter high-pressure hose reel with brass nozzle, instantaneous coupling, 2.5" & 1" landing valves with PRVs, and all associated accessories, UL listed and FM approved, housed within red epoxy-finished cabinet with glass front, complete in all respects, in accordance with NFPA 14, as specified and/or directed by the Engineer.	Each	26		

Item. No.	DESCRIPTION	UNIT	QTY.	UNIT RATE (Rs.)	TOTAL AMOUNT (Rs.)
01-04	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of ductile iron flanged gate valves, PN 16, of the following diameters, complete in all respects, FM approved and UL listed, as specified and/or directed by the Engineer.				
	i) Dia 6 inch	Each	4		
	ii) Dia 4 inch	Each	4		
	iii) Dia 3 inch	Each	2		
01-05	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of the zone control valve assembly, including OS&Y gate valve with tamper switch, flow switch, pressure gauges, pressure reducing valve (PRV), test and drain valve with sight glass, supports/hangers, and all associated accessories, UL listed and FM approved, of the following sizes, complete in all respects, in accordance with NFPA 13 and as specified and/or directed by the Engineer.				
	i) Dia 4 inch	Each	13		
01-06	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of Automatic air release valve of required size, UL listed and FM approved, complete in all respects, in accordance with NFPA 13 & 14 and as specified and/or directed by the Engineer.	Each	2		
01-07	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of portable fire extinguishers of the following types, complete in all respects, Kitemark & LPCB approved or UL listed, as specified and/or directed by the Engineer.				
	i) Dry chemical powder 6 Kg.	Each	150		
	ii) Carbon dioxide 5 kg.	Each	150		
	iii) Wet Chemical 6 Ltr.	Each	12		
	iv) AFFF foam 6 Ltr.	Each	2		

Item. No.	DESCRIPTION	UNIT	QTY.	UNIT RATE (Rs.)	TOTAL AMOUNT (Rs.)
	v) Automatic ceiling mounted Dry Chemical Powder 6 kg Extinguisher	Each	20		
01-08	Supply and installation of Fire Blanket of Medium Size	Each	2		
01-09	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of Inspector test connection with drain assembly of 1" size, UL listed and FM approved, complete in all respects, in accordance with NFPA 13, as specified and/or directed by the Engineer.	Each	1		
01-10	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of Two Way Fire Department Connection or Breeching Inlet of required size, UL listed and FM approved, complete in all respects, in accordance with NFPA 13, as specified and/or directed by the Engineer	Each	2		
01-11	Supply, installation, testing, commissioning, and remedy of defects during the defect liability period of Check valve for Breeching Inlet of 6" size, UL listed and FM approved, complete in all respects, in accordance with NFPA 13, as specified and/or directed by the Engineer	Each	1		

FIREFIGHTING WORK TOTAL (PKR)

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI
CONSTRUCTION OF ACADEMIC AND ADMIN BUILDING AT JSMU, KARACHI

PRICED BILL OF QUANTITES
(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
EA.		**ELECTRICAL WORKS** The entire electrical installation/work shall be carried out by licensed Contractor, authorised to undertake such work under the provisions of the Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified upto date by the Government of Pakistan. The work includes supply, installation, testing, commissioning of the following Electrical work items (unless specifically stated otherwise). The specifications section 8001 and recommended list of manufacturer applicable to all BoQ items. The work includes all material, labour, tools, plant, storage, transportation, accessories, related civil works required for proper completion of each item. The Contractor is bound to provide submittals for the Engineer's approval with relevant standards, data sheets, catalog, brochures, manuals, shop drawings etc. Note: in case of any discrepancy found between BoQ, specifications and drawings, then BoQ/specifications will govern.				
		WIRING				
01-1EA	S # 24 Pg # 230	Providing & laying (wiring from DB to light point) PVC insulated with size 3-7/.029 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 49 ft and 3 inch average length)	R.ft.	17,000	684.64	11,638,880
01-2EA	S # 23 Pg # 230	Providing & laying (wiring from two way switchboard to switchboard including wiring between switches) PVC insulated with size 3-3/.036 (2L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 16 ft 5 inch average length)	R.ft.	7,500	548.72	4,115,400
01-3EA	S # 23 Pg # 230	Providing & laying (wiring from switchboard to switchboard including wiring between switches) PVC insulated with size 3-3/.036 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 16ft 5 inch average length)	R.ft.	4,000	411.54	1,646,160
01-4EA	S # 23 Pg # 230	Providing & laying (wiring from switch to light point) PVC insulated with size 3-3/.036 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 16 ft 5 inch average length)	R.ft.	8,000	411.54	3,292,320

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-5EA	S # 23 Pg # 230	Providing & laying (wiring from light point to light point) PVC insulated with size 3-3/.036 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 13 ft 1.5 inch average length)	R.ft.	34,000	411.54	13,992,360
01-6EA	S # 25 Pg # 230	Providing & laying (wiring from DB to socket outlet) PVC insulated with size 3-7/.036 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 49 ft 2.5 inch average length)	R.ft.	13,000	934.36	12,146,680
01-7EA	S # 24 Pg # 230	Providing & laying (wiring from socket outlet to outlet) PVC insulated with size 3-7/.029 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 16 ft 5inch average length)	R.ft.	14,500	684.64	9,927,280
01-8EA	S # 25 Pg # 230	Providing & laying (wiring from DB to LBS/15A Socket Outlet) PVC insulated with size 3-7/.036 (L+N+E) copper conductor in ¾" dia PVC conduit recessed in the wall or column as required (upto 49 ft 2.5 inch average length)	R.ft.	8,000	684.64	5,477,120
01-9EA	S # 26 Pg # 230	Providing & laying (wiring from DB to LBS/20A Socket Outlet) PVC insulated with size 3-7/.044 (L+N+E) copper conductor in 1" dia PVC conduit recessed in the wall or column as required (upto 49 ft 2.5 inch average length)	R.ft.	8,000	934.36	7,474,880
		WIRING ACCESSORIES				
01-10EA	S # 191 Pg # 244	Providing & fixing Bakelite ceiling rose with two terminals	No.	5,500	373.39	2,053,645
01-11EA	S # 188 Pg # 244	Providing & fixing one way SP 10 amp switch flush type	No.	5,500	468.19	2,575,045
01-12EA	S # 220 Pg # 244	Providing & fixing two way SP 5 amp switch flush type	No.		**NOT IN USED**	
01-13EA	S # 190 Pg # 244	Providing & fixing three pin (multi-socket) 10 amp plug & socket flush type	No.	1,184	677.36	801,994
01-14EA	S # 190 Pg # 244	Providing & fixing three pin 15 amp plug & socket flush type	No.	100	677.36	67,736
		MISCELLANEOUS ITEMS				
01-15EA	S # 195 Pg # 244	Providing & fixing Brass Ceiling fan 56" (good quality)	No.	477	14,869.21	7,092,613
01-16EA	S # 196 Pg # 244	Providing & fixing Brass Bracket fan 18" (good quality)	No.	36	11,606.88	417,848

Amount of Schedule Items Electrical Works Rs. 82,719,961

Add / Deduct _____Premium on Electrical Works Schedule Items Rs. _____

Total Amount of Electrical Works Schedule Rs. _____

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		EXTRA ELECTRICAL WORKS (ENERGIZATION OF THE BUILDING, ADDITIONAL POWER FOR AC & MEDICAL EQUIPMENT				
	Part-I	**LT CABLE**				
01-17EA	S # 84 Pg # 234	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheathed with 4 core copper conductor 600/1000 volts size 70mm2	R.ft.	200	6,668.83	1,333,766
01-18EA	S # 83 Pg # 234	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheathed with 4 core copper conductor 600/1000 volts size 50mm2	R.ft.	800	4,876.85	3,901,480
01-19EA	S # 82 Pg # 234	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheathed with 4 core copper conductor 600/1000 volts size 35mm2	R.ft.	500	3,241.44	1,620,720
01-20EA	S # 81 Pg # 234	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheathed with 4 core copper conductor 600/1000 volts size 25mm2	R.ft.	200	2,538.04	507,608
01-21EA	S # 80 Pg # 234	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheathed with 4 core copper conductor 600/1000 volts size 16mm2	R.ft.	2,000	1,937.18	3,874,360
					Amount of Schedule Items Electrical Work Works (Part-I) Rs.	11,237,934.00
					Add / Deduct _____ % Premium on Electrical Works Schedule Items Rs.	
					Total Amount of Electrical Works (Part-I) Rs.	
		EXTRA ELECTRICAL WORK				
	Part-II	**LT SWITCHBOARD**				
		Ref Spec Sec: 8132, 8212, 8240				
01-22EA	NSR	Following 14 SWG MS sheet, floor mounted LT switch boards (as per single line diagram shown on drawings) including electrical & mechanical components, electrolytic tinned copper busbars (Luvata), control wiring, related civil works, mounting framing (where required) with epoxy coating or galvanized + powder coating (as approved) and all related accessories, complete in all respect.				
		a) ATS Panel (Form 3b) (IP42, Dust-Proof, Floor Mounted)	Job.	1		
		b) EMPB (Form 3b) (IP42, Dust-Proof, Floor Mounted)	Job.	1		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		LT DISTRIBUTION BOARD Ref Spec Sec: 8133, 8212, 8240				
01-23EA		Following 16 SWG MS sheet LT Distribution Boards (as per single line diagram shown on drawings) including electrical & mechanical components, electrolytic tinned copper busbars (superior A1-grade quality), control wiring, related civil works etc. and all accessories, complete in all respect.				
	NSR	a) EDB-GF-LP (IP42) (recessed)	Job.	1		
	NSR	b) EDB-B1-LP (IP42) (recessed)	Job.	1		
	NSR	c) EDB- B2-LP (IP42) (recessed)	Job.	1		
	NSR	d) EDB-SS-LP (IP42) (recessed)	Job.	1		
	NSR	e) EACP-GF (IP42) (recessed)	Job.	1		
	NSR	f) ESMDB-MEZZ (14SWG) (IP42) (recessed)	Job.	1		
	NSR	g) ESMDB-MEZZ-LP (14SWG) (IP42) (recessed)	Job.	1		
	NSR	h) ESMDB-1F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	i) EDB-1F-LP (IP42) (recessed)	Job.	1		
	NSR	j) EDB-AUDITORIUM-1F (IP42) (recessed)	Job.	1		
	NSR	k) UDB-DR-1F (IP42) (recessed)	Job.	1		
	NSR	l) ESMDB-2F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	m) EDB-2F-LP (IP42) (recessed)	Job.	1		
	NSR	n) EDB-CONFERENCE-2F (IP42) (recessed)	Job.	1		
	NSR	o) EDB-STUDENT AFFAIRS-2F (IP42) (recessed)	Job.	1		
	NSR	p) ESMDB-3F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	q) EDB-3F-LP (ZONE-A) (IP42) (recessed)	Job.	1		
	NSR	r) EDB-3F-LP (ZONE-B) (IP42) (recessed)	Job.	1		
	NSR	s) ESMDB-4F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	t) EDB-4F-LP (IP42) (recessed)	Job.	1		
	NSR	u) EDB-LIBRARY-4F (IP42) (recessed)	Job.	1		
	NSR	v) ESMDB-5F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	w) EDB-5F-LP (IP42) (recessed)	Job.	1		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	x) EDB-LAB-5F (IP42) (recessed)	Job.	1		
	NSR	y) ESMDB-6F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	z) ESMDB-6F-LP (14SWG) (IP42) (recessed)	Job.	1		
	NSR	aa) ESMDB-LAB-6F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	ab) ESMDB-7F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	ac) EDB-7F-LP (IP42) (recessed)	Job.	1		
	NSR	ad) EDB-LAB-7F (IP42) (recessed)	Job.	1		
	NSR	ae) ESMDB-8F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	af) EDB-8F-LP (IP42) (recessed)	Job.	1		
	NSR	ag) EDB-LAB-8F (IP42) (recessed)	Job.	1		
	NSR	ah) ESMDB-9F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	ai) EDB-9F-LP (IP42) (recessed)	Job.	1		
	NSR	aj) EDB-LAB-9F (IP42) (recessed)	Job.	1		
	NSR	ak) ESMDB-RF (14SWG) (IP42) (recessed)	Job.	1		
	NSR	al) EDB-RF-LP (IP42) (recessed)	Job.	1		
	NSR	am) SMACP-MEZZ (14SWG) (IP42) (recessed)	Job.	1		
	NSR	an) EACP-MEZZ (Zone-A) (IP42) (recessed)	Job.	1		
	NSR	ao) SMADB-1F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	ap) EACP-AUDITORIUM-1F (IP42) (recessed)	Job.	1		
	NSR	aq) EACP-1F (IP42) (recessed)	Job.	1		
	NSR	ar) SMACP-2F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	as) EACP-2F (IP42) (recessed)	Job.	1		
	NSR	at) EACP-CONFERENCE-2F (IP42) (recessed)	Job.	1		
	NSR	au) EACP-STUDENT AFFAIR-2F (IP42) (recessed)	Job.	1		
	NSR	av) SMACP-3F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	aw) EACP-3F (ZONE-A) (IP42) (recessed)	Job.	1		
	NSR	ax) EACP-3F (ZONE-B) (IP42) (recessed)	Job.	1		

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	ay) SMACP-4F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	az) EACP-4F (IP42) (recessed)	Job.	1		
	NSR	ba) EACP-LIBRARY-4F (IP42) (recessed)	Job.	1		
	NSR	bb) SMACP-5F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	bc) EACP-5F (IP42) (recessed)	Job.	1		
	NSR	bd) EACP-LAB-5F (IP42) (recessed)	Job.	1		
	NSR	be) SMACP-6F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	bf) EACP-6F (IP42) (recessed)	Job.	1		
	NSR	bg) EACP-LAB-6F (IP42) (recessed)	Job.	1		
	NSR	bh) SMACP-7F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	bi) EACP-7F (IP42) (recessed)	Job.	1		
	NSR	bj) EACP-LAB-7F (IP42) (recessed)	Job.	1		
	NSR	bk) SMACP-8F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	bl) EACP-8F (IP42) (recessed)	Job.	1		
	NSR	bm) EACP-LAB-8F (IP42) (recessed)	Job.	1		
	NSR	bn) SMACP-9F (14SWG) (IP42) (recessed)	Job.	1		
	NSR	bo) EACP-9F (IP42) (recessed)	Job.	1		
	NSR	bp) EACP-LAB-9F (IP42) (recessed)	Job.	1		
	NSR	bq) ESMDB-RF-2 (14SWG) (IP42) (recessed)	Job.	1		
	NSR	br) EDB-LIFT (IP42) (recessed)	Job.	1		
	NSR	bs) MCCB BOX - BANK (IP42) (recessed)	Job.	1		
		MOTOR CONTROL CENTER (MCC)				
		Ref Spec Sec: 8133, 8135, 8212, 8240				
01-24EA		Following 14 SWG MS sheet, surface mounted on wall or floor mounted type MCC (as per single line diagram shown on drawings) including electrical & mechanical components, electrolytic tinned copper busbars, control wiring, related civil works and all accessories, complete in all respect.				
	NSR	a) MCC-B2-SUMP PIT	Job.	1		

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	b) Lockable Mushroom Switch including control cable all accessories complete in all respect.	no.	3		
		LT BUS TIE DUCT / BUS BAR TRUNKING Ref. Sec. 8132, 8212, 8240, 8134				
01-25E		Following rating LT Bus bur Trunking / Busway (IP-55), Aluminium conductor, 4(R, Y, B, N) + 1/2(E) conductors including flanges, bends, hangers, supports, flexible connections and all installation accessories etc, from LT Bushings of Power Transformer to ATS panel to LV Switchboard, complete in all respects:				
	NSR	a) 2500 A	Rft.	230		
01-26E		Following rating LT Bus bur Trunking / Busway (IP-55) , Aluminium conductor, 4(R, Y, B, N) + 1/2(E) conductors including flanges, bends, hangers and all installation accessories etc, complete in all respect:				
	NSR	a) 1250 A	Rft.	180		
	NSR	b) 600 A	Rft.	180		
01-27E		(TP + N + E) Plug-In units with Adjustable MCCB of the following ratings:				
	NSR	d) 32 Amps	no.	2		
	NSR	e) 40 Amps	no.	1		
	NSR	f) 60 Amps	no.	7		
	NSR	g) 80 Amps	no.	2		
	NSR	h) 125 Amps	no.	8		
	NSR	i) 150 Amps	no.	2		

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		LIGHT FIXTURES				
		Ref. Specs Sec. 8150, 8212, 8240				
01-28EA		Following LED light fixtures (Flicker Free) installed on surface or wall or floor or false ceiling or columns with lamps, holders, ballasts, starters, ignitors, capacitors, drivers as applicable, including mounting accessories, complete in all respect. The contractor shall be responsible for compatibility of light fixtures with false ceiling as proposed in architectural design. The light fixtures & components shall be certified by international accredited laboratory and complete test certificates and associated reports shall be submitted for approval. Make as per approved list in Vol-I.				
	NSR	a) Type - BH1 Wall mounted decorative double side (up & down beam) COB LED light fixture, 1800 lumens light output, 2x18 W or better system wattage, 4000 K color temperature, CRI Index 85+, SDCM<5, built-in LED output driver (PF>0.9), complete IP65 ingress protection, die-cast aluminum housing, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE or ENEC certified products	no.	25		
	NSR	b) Type - DL1 Surface mounted COB LED light fixture 100 mm dia, 1800 lumens light output, 20 W or better system wattage, 36 degree beam angle, 6500 K color temperature, CRI Index 85+, SDCM<5, separate LED output driver (PF>0.9), IP20 ingress protection, die-cast aluminum housing and heat sink, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE, or ENEC certified products	no.	426		
	NSR	c) Type - DL2 Recessed mounted COB LED light fixture 100 mm dia, 1320 lumens light output, 13 W or better system wattage, 100 degree beam angle, 6500 K color temperature, CRI Index 85+, SDCM<5, separate LED output driver (PF>0.9), IP20 ingress protection, die-cast aluminum housing and heat sink, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE or ENEC certified products	no.	252		
	NSR	d) Type - FL1 LED flood light fixture, 9000 lumens light output, 70 W or better system wattage, 80 degree beam angle, 6500 K color temperature, CRI Index 80, built-in LED output driver (PF>0.9), IP65 ingress protection, IK07 impact protection, Corosion resistant die cast aluminium housing, tempered safety glass, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE or ENEC certified products	no.	25		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	e) Type - PL1 Recessed mounted LED panel light fixture (back-lit Type) (600 mm x 600 mm) 4000 lumens light output, 50 W or better system wattage, 120 degree beam angle, 6500 K color temperature, CRI Index 85+, SDCM<5, LED output driver (PF > 0.9), IP20 panel protection, IP20 driver protection, extruded aluminum housing, metal frame, polystrene optics and cover material, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE or ENEC certified products	no.	1,200		
	NSR	f) Type - SP1 Recessed mounted COB LED spot light fixture 100 mm dia, 3000 lumens light output, 40 W or better system wattage, 24 degree beam angle, 4000 K color temperature, CRI Index 85+, SDCM<5, separate LED output driver (PF>0.9), IP20 ingress protection, die-cast aluminum housing and heat sink, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE or ENEC certified products	no.	45		
	NSR	g) Type - SP2 Recessed mounted COB LED spot light fixture 100 mm dia, 900 lumens light output, 12 W or better system wattage, 24 degree beam angle, 4000 K color temperature, CRI Index 85+, SDCM<5, separate LED output driver (PF>0.9), IP20 ingress protection, die-cast aluminum housing and heat sink, 50,000 hours life (L70/B50), fixture and driver shall be CB or CE or ENEC certified products	no.	30		
		EMERGENCY LIGHTING FIXTURE Ref. Specs Sec. 8150, 8212, 8240				
01-29EA		Following LED light fixtures (Flicker Free) installed on surface or wall or floor or false ceiling or columns with lamps, holders, ballasts, starters, ignitors, capacitors, drivers, battery backup unit as applicable, including mounting accessories, complete in all respect. The contractor shall be reponsible for compatibility of light fixtures with false ceiling as proposed in architectural design. The light fixtures & components shall be certified by international accredited laboratory and complete test certificates and associated reports shall be submitted for approval. Make as per approved list in Vol-I.				
	NSR	a) Type – EB1 Recessed mounted, non-maintained type double head emergency light fixture, 6.5 W, with ni-cd or LifePO4 or Lithium ion battery backup unit for 3 hours standby operation, over charge & discharge protection, 3 no. indication light for power, charging & fault, test button, IP65 ingress protection	no.	180		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	b) Type - EX (Single Side Visual Indication) Recessed mounted or Surface mounted or suspended including suspension system with base, non maintained type emergency exit light fixture with sign & direction pictograms, with ni-cd or LifePO4 or Lithium ion battery backup unit for 3 hours standby operation,over charge & discharge protection, 3 no. indication light for power, charging & fault, test button, IP20 ingress protection (Note: The light fixture quanity for surface mounted or suspended shall be evaluated by the contractor as per site conditions)	no.	54		
	NSR	c) Type - EX (Double Side Visual Indication) Recessed mounted or Surface mounted or suspended including suspension system with base, non maintained type emergency exit light fixture with sign & direction pictograms, with ni-cd or LifePO4 or Lithium ion battery backup unit for 3 hours standby operation,over charge & discharge protection, 3 no. indication light for power, charging & fault, test button, IP30 ingress protection (Note: The light fixture quanity for surface mounted or suspended shall be evaluated by the contractor as per site conditions)	no.	36		
		WIRING ACCESSORIES Ref. Specs Sec. 8220				
01-30EA		Following types of wiring accessories including all related sundries, complete in all respect.				
	NSR	a) 150W fan regulator (5 steps control)	no.	477		
	NSR	b) Concealed sheet steel back box with earth point for switches fan dimmer/regulator & socket outlets (3 inch by 3 inch)	no.	1,833		
	NSR	c) Concealed sheet steel back box with earth point for switches fan dimmer/regulator & socket outlets (6 inch by 3 inch)	no.	1,833		
	NSR	d) 16A/20A, 2 pole safety breaker with 16 SWG concealed G.I sheet back box etc.	No.	33		
		CONDUITS & PIPES Ref. Specs Sec. 8230				
01-31EA		Following sizes of uPVC conduit with bends, including laying excavation, backfilling, compaction, sand bedding with compaction, all accessories, complete in all respect of following sizes				
	NSR	a) 6" dia	Rft.	350		
	NSR	b) 4" dia	Rft.	300		

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	c) 2" dia	Rft.	325		
01-32EA		Following sizes of PVC conduit with bends, including laying excavation, backfilling, compaction, sand bedding with compaction, all accessories, complete in all respect of following sizes				
	NSR	a) 2" dia	Rft.	500		
	NSR	b) 1" dia	Rft.	500		
01-33EA	NSR	RCC Man Hole of size 600 mm (L) x 600 mm (W) x 900 mm (varies as per site condition) (D) with heavy duty cast iron cover of size 24" dia with double groove, including G.I cable support channels, excavation, backfilling, compaction, lean concrete (Class-E), plastering & water proofing of structure, steel shuttering and form work, water stopper, steel reinforcement, sulphate resistant concrete cement (Class-B), galvanazied mild steel ladder rungs etc., all accessories, complete in all respect. (The contractor shall prepare shop drawings including structural drawings for approval)	Job.	10		
01-34EA	NSR	RCC Man Hole of size 900 mm (L) x 900 mm (W) x 900 mm (varies as per site condition) (D) with heavy duty cast iron cover of size 24" dia with double groove, including G.I cable support channels, excavation, backfilling, compaction, lean concrete (Class-E), plastering & water proofing of structure, steel shuttering and form work, water stopper, steel reinforcement, sulphate resistant concrete cement (Class-B), galvanazied mild steel ladder rungs etc., all accessories, complete in all respect. (The contractor shall prepare shop drawings including structural drawings for approval)	Job.	10		
		EARTHING Ref. Specs Sec. 8212, 8240				
01-35EA	NSR	20 mm dia, 7 numbers 3 meters long copper bonded steel core rod connected in one shaft with threaded couplers, driving head and spike, including bronze clamp with nuts and bolts, R.C.C. inspection chamber (450mm x 450mm) with medium duty C.I cover, excavation, backfilling, filling manhole with stone gravel, 3 inch borehole drilling upto required depth, filling of bore hole with bentonite material or low resistance earthing compound and including all accessories, etc., as shown on the drawings, complete in all respects. Testing to be performed as specified in contract documents or relevant international applicable code.	no.	32		
01-36EA		Following sizes of single core PVC insulated copper conductor cable as earth continuity conductor (ECC) installed on surface or on already installed pipes / conduits / trenchs / cable tray etc., including tags, ties, lugs, termination kits, colour sleeves, cable glands, bushes etc., all related accessories, complete in all respect.				

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
	NSR	a) 70 mm^2	Rft	2,000		
	NSR	b) 50 mm^2	Rft	1,850		
	NSR	c) 25 mm^2	Rft	2,000		
	NSR	d) 35 mm^2	Rft	2,150		
	NSR	e) 16 mm^2	Rft	2,100		
	NSR	f) 10 mm^2	Rft	2,200		
01-37EA		Following sizes of tinned copper earth connecting point, including continuous mounting base all accessories, complete in all respect.				
	NSR	a) 6 ways (400 mm x 50mm x 6mm)	no.	30		
	NSR	a) 12 ways (750 mm x 50mm x 6mm)	no.	30		
		LIGHTNING PROTECTION Ref. Specs Sec. 8240, 8250				
01-38EA	NSR	2000 mm length, 20 mm dia tapered air termination rod including locknut tight system, compatible mounting brackets, base, saddles, all related accessories, complete in all respect.	no.	12		
01-39EA	NSR	25 mm x 3 mm bare aluminium tape conductor installed on surface or concealed in columns including mounting clips, brackets, clamps, hold fast, supports etc., all accessories, complete in all respect.	Rft.	6,000		
01-40EA	NSR	Earth Bonding point with 04 number holes gun metal body with 02 number 70 mm2 PVC insulated cable with clamps suitable for reinforcement bar, mounting clips, brackets, clamps, hold fast, supports etc., all accessories, complete in all respect.	no.	50		

Netgreen Engineering Services Pakistan Ltd. A&P DIVISION Karachi

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-41EA	NSR	120 mm^2 PVC insulated earth copper conductor laid direct in ground or in already laid conduit or on surface including clamps, all accessories, complete in all respect.	Rft.	400		
01-42EA	NSR	Test point for lightning system on down conductors including all accessories, complete in all respects.	no.	25		
01-43EA	NSR	Exothermic welding including all accessories, complete in all respect.	no.	25		
		MISCELLANEOUS ITEMS Ref. Specs Sec. 8290				
01-44EA	NSR	24 inch x 24 inch high quality ABS material False Ceiling Fan, with 18" sweep fan blade & motorized grill & remote control, including all mounting and related accessories, complete in all respect. (Make Voldam or approved equivalent imported fan)	no.	468		
01-45EA	NSR	Supply and install 12" (300 mm) sweep exhuast fan including plastic louvers.	No.	60		
01-46EA	NSR	250 x 250 x 100 mm underfloor box with 4 no. socket outlet frame, die cast aluminium alloy trap & frame 9 mm recess, in line surface finish without collar including all accessories, complete in all respect.	no.	50		
01-47EA		Following (2.0 mm) thick G.I sheet coated perforated cable tray with 1.5mm thick soild cover including proper manufactured flexible expansion coupler, elbows, risers, tees, crosses, internal & external bends and fittings, galvanized support structure, all accessories, compelete in all respects. (Note: Welded connection is not allowed and prohibited). Make as per approved list in Vol-I				
	NSR	a) 24" x 4"	Rft.	500		
	NSR	b) 18" x 4"	Rft.	500		
	NSR	c) 12" x 4"	Rft.	2,500		
01-48EA		Following sizes of junction box including connectors, railing etc., all accessories, complete in all respect.				
	NSR	a) 6" x 6" x 4" (depth varies) with front cover plate (recessed in slab)	no.	40		

Total Amount of Non Scheduled Items Electrical Works Part-II

Total Amount of Electrical Works Schedule (Part-I+II) Rs.

EXTRA ELECTRICAL WORK carried over to Summary

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI
CONSTRUCTION OF ACADEMIC AND ADMIN BUILDING AT JSMU, KARACHI

PRICED BILL OF QUANTITES
(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
EB.		**SUBSTATION WORKS** Ref Spec Sec: 8001, Approved List of Manufacturer's in Vol-I The entire electrical installation/work shall be carried out by licensed Contractor, authorised to undertake such work under the provisions of the Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified upto date by the Government of Pakistan. The work includes supply, installation, testing, commissioning of the following Electrical work items (unless specifically stated otherwise). The specifications section 8001 and recommended list of manufacturer applicable to all BoQ items. The work includes all material, labour, tools, plant, storage, transportation, accessories, related civil works required for proper completion of each item. The Contractor is bound to provide submittals for the Engineer's approval with relevant standards, data sheets, catalog, brochures, manuals, shop drawings etc. Note: in case of any discrepancy found between BoQ, specifications and drawings, then BoQ/specifications will govern.				
		INDOOR POWER TRANSFORMER Ref Spec Sec: 8121				
01-1EB	NSR	1500 kVA distribution transformer (indoor), 11/0.415 kV, including control wiring to HT/LT switchboard, cable mounting channels, related civil works and all accessories, complete in all respect, Make as per approved list in Vol-I. (Local authority or electricity service provider approvals shall be obtained by the contractor, HT panel manufacturer shall be approved in K-Electric (Necessary Documentary evidence shall be provided)				
		a) 1000 kVA	Job.	1		
01-2EB	NSR	Spare parts as per Appendix "V" Volume - 1 of bidding documents.	Job.	1		

ELECTRICAL WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		HT SWITCHBOARD				
		Ref Spec Sec: 8131				
01-3EB	NSR	HT In/Out switchboard (weatherproof, IP54) suitable for 11 kV, voltage rating, BIL 75 kV, including vaccum circuit breaker, protective relay, CT & PT, metering equipment, indications lamps, equipment, push buttions, control wiring, interlocking, lamp test and all accessories as shown in diagram, complete in all respect, Make as per approved list in Vol-I. (Local authority or electricity service provider approvals shall be obtained by the contractor, HT panel manufacturer shall be approved in K-Electric (Necessary Documentary evidence shall be provided)	Job.	3		
01-4EB	NSR	Rubber insulation mat, one meter wide, 6 mm thick for 11 kV panel including all accessories, complete in all respect in line with standards and specfications. , Make as per approved list in Vol-I.	Job.	3		
01-5EB	NSR	Danger board signs, wall mounted / panel front door mounted including all accessories, complete in all respect in line with standards and specfications, Make as per approved list in Vol-I.	Job.	3		
01-6EB	NSR	Spare parts as per Appendix "V" Volume - 1 of bidding documents.	Job.	3		
		HT CABLES				
		Ref. Specs Sec.8211				
01-7EB	NSR	3 core, 15/8.7 kV, aluminium conductor with PVC screen, XLPE insulation, PVC screen, copper shielding, PVC bedding, galvanized steel wire armoured, extruded PVC sheathed cable laid in already built cable trenches or PVC sleeves including tags, ties, color sleeves, cable glands, lugs, sleeves/pipes plugging all accessories, complete in all respect. (Note: Cable trenches & raceways is not included in this item)				
		a) 3 core 120 Sq.mm	Rft	500		
01-8EB		For item No. 0-1-7EB terminaiton kit with color sleeves including all accessories, complete in all respect installed at:				
	NSR	a) HT Switchboard	no.	16		
	NSR	b) Power Transformer including cable termination support	no.	5		

Total Amount of Non Scheduled Items Electrical Works

SUBSTATION WORK Carried Over to Summary Rs.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

PRICED BILL OF QUANTITES
(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

TELECOMMUNICATION WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
T.		**T. TELECOMMUNICATION WORKS** **Ref Spec Sec: 8001, 8002** Supply, installation, testing and commissioning of the following items of work (unless specifically stated otherwise) including all material, labour, tool, plant, accessories, related civil works etc required for proper completion of each item as per specifications (Section-8001 "General Specifications for Electrical Works" shall be applicable to all BOQ items). The contractor is bound to submit all relevent data, information, literature, drawings, submittals etc. as per specifications & recommended manufacturers list to (Specs Section-8020) The engineer for necessary approvals. Note: in case of any discrepancy found between BoQ, Specifications and drawings, then BoQ/Specifications will govern.				
		STRUCTURED CABLING NETWORK Ref Spec Sec: 8312				
01-1T	NSR	CAT-5e UTP RJ45 outlet including recessed sheet steel or surface mounted back box and face plate including all mounting accessories.	no.	600		
01-2T	NSR	CAT-5e UTP RJ45 outlet including face plate without sheet steel back box including all mounting accessories.	no.	50		
01-3T	NSR	CAT-5e UTP RJ45 duplex outlet including recessed sheet steel or surface mounted back box and face plate including all mounting accessories.	no.	50		
01-4T	NSR	CAT-5e UTP RJ45 duplex outlet including face plate without sheet steel back box including all mounting accessories.	no.	50		
01-5T	NSR	CAT-6A UTP RJ45 outlet including recessed sheet steel or surface mounted back box and face plate including all mounting accessories.	no.	600		
01-6T	NSR	CAT-6A UTP RJ45 outlet including face plate without sheet steel back box including all mounting accessories.	no.	50		
01-7T	NSR	CAT-6A UTP RJ45 duplex outlet including recessed sheet steel or surface mounted back box and face plate including all mounting accessories.	no.	50		
01-8T	NSR	CAT-6A UTP RJ45 duplex outlet including face plate without sheet steel back box including all mounting accessories.	no.	50		
01-9T	NSR	Following sizes of IDC rack mounted 110 base unit or enclosure type mounting with connecting blocks, channels including all components & accessories, complete in all respect.				
		a) 100 Pair Distribution Box	no.	12		
		b) 50 Pair Distribution Box	no.	12		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

TELECOMMUNICATION WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-10T	NSR	Following sizes of 16 SWG powder coated Telephone Distribution Frame with IDC connectors, channels including all components & accessories, complete in all respect.				
		a) 1200 pair	no.	1		
01-11T	NSR	24 port Cat-6A UTP 10 Giga Speed modular loaded (RJ45) jack patch panels compatible with 19" rack installed in floor/wall mounted cabinet including built-in rear cable management with all mounting accessories.	no.	25		
01-12T	NSR	12 port Duplex LC loaded multimode (OM4) module rack mountable fibre optic patch panel with pigtails and sliding splice trays including all installation accessories	no.	12		
01-13T	NSR	19" Rack mounted front cable management with all installation & mounting accessories, complete in all respect.	no.	25		
01-14T	NSR	Wiring from RJ45 outlet point to relevant Building / floor distributor with CAT-5e UTP cable already laid concealed conduit / already installed cable tray or cable trunking including all accessories complete in all respect.	Point	600		
01-15T	NSR	Wiring from RJ45 outlet point to relevant Building / floor distributor with CAT-6A UTP cable already laid concealed conduit / already installed cable tray or cable trunking including all accessories complete in all respect.	Point	600		
01-16T	NSR	Following type CAT-5e UTP patch cord with connectors at both ends (as mentioned below), including all accessories, complete in all respect.				
		a) 110 to 110 or RJ-45 Type - 3 metre (10 ft.) long	no.	300		
01-17T	NSR	Following type CAT-6A, UTP 10 Giga Speed patch cord with RJ45 connector at both ends, including all accessories, complete in all respect.				
		a) 1 metre (3 ft.) long	no.	600		
		b) 3 metre (10 ft.) long	no.	600		
01-18T	NSR	Following type of fibre optic duplex pach cord with required connector at both end, in all components and accessories, complete in all respect.				
		a) 1 meter (3 ft)	no.	600		
		b) 3 meter (10ft)	no.	600		
01-19T	NSR	Following sizes of Multipair Category 3 cable CMR (24 AWG) in already installed PVC conduit / cable trunking / cable tray, including connectors etc., including all mounting & installation accessories, complete in all respect.				
		a) 100 Pair	Rft	3000		
		b) 50 Pair	Rft	3000		
01-20T	NSR	Following type 50um / 125um Multimode (OM4) 10G optical fibre back bone cable in already installed PVC conduit / cable trav.				
		a) 12 Core	Rft	3000		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

TELECOMMUNICATION WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
01-21T	NSR	Following sizes 19" Rack with plexiglass door including hoops, perforated panels, side management, cable trays, 2/4 fans tray, required Power Distribution Units (PDU) and power sockets, power cabling with industrial connection socket in conduit or cable tray (as per site condition) from relevant connection point upto rack including all mounting and installation accessories complete in all respect.				
		a) 15U (600 mm width x 800 mm depth)	Job.	24		
01-22T	NSR	Power cabling for data rack single or three phase (as required) including industrial socket in already installed conduit or cable tray (as per site condition) from relevant connection point upto rack including all mounting and installation accessories complete in all respect.	Job.	24		
01-23T	NSR	Fluke Copper & OTDR Testing and Commissioning of all above network related items, termination and connectivity at both ends, including tagging/labeling and submission of detailed report with updated cable route drawings.	Job.	1		
		INTELLIGENT ADDRESSABLE FIRE ALARM SYSTEM				
		Ref Spec Sec: 8331				
01-24T	NSR	Intelligent Addressable Optical Smoke & Heat Multisensor (Vds / FM / UL certified system) with base, built-in isolator module including all installation accessories.	no.	300		
01-25T	NSR	Addressable Manual Call Station (Vds / FM / UL certified system)with all installation and mounting accessories, complete in all respect.	no.	30		
01-26T	NSR	Loop powered Addressable directional sounder with flasher (Vds / FM / UL certified system) including all installation accessories.	no.	30		
01-27T	NSR	Following type modules with all installation accessories.				
		a) Control / Relay Module (Vds / FM / UL certified system) with installation box enclosure	no.	5		
		b) Monitor Module (Vds / FM / UL certified system) with installation box	no.	5		
01-28T	NSR	Wiring of Fire Alarm Points with 2 core 1.5 mm2 LSZH, CWZ cable complying BS5839 and EN50200 laid in already installed conduit or tray or trunking etc., including all accessories, complete in all respect	Points	370		
01-29T	NSR	Four loop Fire Alarm Control Panel (FACP) (Vds / FM / UL certified system) including interfacing components for FACP to link with main building FACP, public address, access control system, Integrated Building Management System etc., including power supply, maintainance free batteries, battery charger, and all installation and mounting accessories, complete in all respect.	Job.	1		
01-30T	NSR	Fire Alarm Repeater Panel (FARP) (Vds / FM / UL certified system) including all installation and mounting accessories, complete in all respect. Make as per approved list in Vol-I	Job.	4		

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

TELECOMMUNICATION WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		CCTV SYSTEM Ref Spec Sec: 8335				
01-31T	NSR	4 inch x 4 inch x 3 inch 16 SWG G.I sheet steel recessed outlet back box with face plate of same material for camea installation provision to be installed in future including all components & accessories, complete in all respect.	no.	30		
01-32T	NSR	4 inch x 4 inch x 3 inch plastic junction box back box with face plate of same material for camea installation provision to be installed in future including all components & accessories, complete in all respect.	no.	30		
01-33T	NSR	Wiring from CCTV camera to relevant Building / floor distributor with CAT-6A UTP cable already laid concealed conduit / already installed cable tray or cable trunking including all accessories complete in all respect.	no.	40		
01-34T	NSR	Wiring from CCTV camera to relevant Building / floor distributor with CAT-6A UTP cable already laid concealed conduit / already installed cable tray or cable trunking including all accessories complete in all respect. (for cameras in future)	no.	30		
		CATV SYSTEM Ref Spec Sec: 8371				
01-35T	NSR	Co-axial TV outlet, including back box, all accessories, complete in all respect.	no.	95		
01-36T	NSR	Wiring from TV outlet to relevent building / floor TV box with RG-7 solid copper conductor, copper braid coaxial cable in already installed concealed conduit / trunking/tray, including all accessories, complete in all respect.	no.	95		
01-37T	NSR	RG-11 solid copper conductor, copper braid coaxial cable in already installed concealed conduit / trunking/tray, including all accessories, complete in all respect.	Rft	1000		
01-38T	NSR	Following type Tap-off with mounting accessories: a) 8-way	no.	10		
01-39T	NSR	TV splitter including all accessories, complete in all respect of following type; a) 6-way	no.	5		
01-40T	NSR	Appropriate size cabinet (recessed / surface mounted as per site condition) for housing amplifier, splitters and tap-off etc., including power distribution unit all components & accessories, complete in all respect.	no.	10		
01-41T	NSR	High speed HDMI to HDMI 4K (upto 15 meter length) cable with connectors on both end laid in already installed concealed conduit or trunking or cable tray, including all accessories, complete in all respect.	no.	10		
01-42T	NSR	VGA cable for 1080P resolution (upto 15 meter length) cable laid in already installed in already installed concealed conduit / trunking/tray, including all accessories, complete in all respect.	no.	10		

TELECOMMUNICATION WORKS

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		CONDUITS & PIPES Ref Spec Sec: 8371				
01-43T	NSR	Following sizes of PVC conduit / pipes installed on surface / concealed in wall, slab & floor including pull wire and all accessories as required etc., complete in all respects.				
		a) 2 inch dia	Rft	2500		
		b) 1-1/2 inch dia	Rft	2500		
		c) 1-1/4 inch dia	Rft	2500		
		d) 1 inch dia	Rft	65000		
		MISCELLANEOUS ITEMS Ref. Specs Sec. 8290				
01-44T		Following sizes 2.0 mm thick G.I sheet perforated cable tray with 1.5 mm thick soild cover including proper manufactured flexible expansion coupler, galvanized support structure, all accessories, compelete in all respects. (Note: Welded connection is not allowed and prohibited)				
	NSR	a) 12" x 4"	Rft.	500		
	NSR	b) 8" x 4"	Rft.	350		
	NSR	c) 6" x 4"	Rft.	2500		

Total Amount of (Electrical Works) Carried over to Summary

TELECOMMUNICATION WORK Carried Over to Summary Rs. _____

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

JINNAH SINDH MEDICAL UNIVERSITY ADMIN AND ACADEMIC BUILDING
APPENDIX – A TO BILL OF QUANTITIES
ELECTRICAL EQUIPMENT MANUFACTURERS
ON WHICH THE BID IS BASED
(To be filled in and signed by the Bidder)*

1. Qualifications of Manufacturers of Equipment and Material

The local and imported equipment offered by the Bidders shall be of reputed manufacturers who have at least 10 (ten) years of proven experience in the manufacturing of such equipment and have all testing facilities for testing of equipment strictly in accordance with the laid down standards, BoQ descriptions, contract specifications and Drawings instructions.

2. Brand Names

Equipment and materials specified with a Brand Name have been named in order to establish a standard of performance and do not necessarily indicate a preference for aparticular manufacturer or material.

3. List of Manufacturers Recommended and as Offered

The Material / Equipment required in the Bid should be selected from the following recommended / approved manufacturer's / supplier's. The Bidder shall procure the required materials and equipment's for this project from the following recommended / approved manufacturers / suppliers or their authorized dealers / agents. The Bidder shall also provide a valid letter of authorization to establish authenticity.

The names of manufacturers given below are to indicate the level of quality and performance anticipated by the Engineer / Employer. Other makes, under the head of approved equivalent, may also be accepted provided the quality and performance of such equipment in the sole opinion of the Engineer are at least equal to or better than the equipment offered by the recommended / approved manufacturer listed hereunder.

The Engineer has the right to reject any of the alternate manufacturer proposed by the bidder / contractor other than listed manufacturer, without assigning any reason thereof.

Just mentioning the name of manufacturer / supplier in this Appendix does not mean that the material, equipment, devices etc. which are to be supplied, installed, and tested under the Contract should be considered "Approved". Instead, comprehensive and proper material submittals meeting all the criteria are required to be submitted by the Bidder / Contractor, after the award of Contract, for Engineer's review and approval.

During post Contract award material submittals stage, if it is noted that any of the brand / manufacturer's name of equipment / material filled by the Bidder in the offered / proposed list does not meet the the laid down requirements of standards, BoQ descriptions, contract specifications and Drawings instructions or it is not equal to or better than the brand of equipment / material stated in the recommended / approved manufacturer list, the material submittal from that manufacturer shall be REJECTED & Bidder / Contractor shall be asked to supply the equipment / material from the recommended / approved manufacturers list.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
1.	H.T Switchboards (with Vacuum Circuit Breaker/ Triple Pole Earthing Switch from the same make) Type-tested in accordance with the latest editions of IEC-62271)	• PAK ELECTRIC LIMITED (PEL) • HUSSAIN & CO • OR APPROVED EQUIVALENT			
2.	Indoor Power Transformers (Oil Type)	• PAK ELECTRIC LIMITED (PEL) • OR APPROVED EQUIVALENT			
3.	Diesel Generator Set in weather and sound proof canopy. (Complete Build Unit)	• CATERPILLAR (USA) • CUMMINS (CPG SET) (EU) • REHLKO (USA) • MITSUBISHI (JAPAN) • TEKSAN (CUMMINS/PERKINS/STANFORD/LEROY SOMER) (TURKEY) • AKSA (CUMMINS/PERKINS/STANFORD/LEROY SOMER) (TURKEY) • OR APPROVED EQUIVALENT			
4.	Main L.T. Switch Board/ Motor Control Centre(MCC)/LT out door Distribution board, Feeder Pillar (FP) verifiable through Reference Design as per latest editions of IEC	• HUSSAIN AND CO. • SUNBEAM • KARIMI ELECTROMECH • HRA SWITCHGEAR • A to ZEE • OR APPROVED EQUIVALENT			

NOT TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
	61439)				
5.	L.T. Switch Boards / Manual Transfer Switch (MTS) /ATS Automatic Transfer Switch L.T. Distribution boards	• HUSSAIN AND CO. • SUNBEAM • KARIMI ELECTROMECH • HRA SWITCHGEAR • A TO ZEE • OR APPROVED EQUIVALENT			
5.	Isolated Power Supply Panel	• HUSSAIN AND CO. • SUNBEAM • KARIMI ELECTROMECH • HRA SWITCHGEAR • A TO ZEE • OR APPROVED EQUIVALENT			
6.	Circuit breakers in weather proof enclosure	• HUSSAIN AND CO. • SUNBEAM • KARIMI ELECTROMECH • HRA SWITCHGEAR • A TO ZEE • OR APPROVED EQUIVALENT			
7.	Vaccuum Circuit Breakers(V.C.B)	• SCHNEIDER • ABB • SIEMENS • OR APPROVED EQUIVALENT			
8.	Air Circuit Breakers (ACB) / Molded Case Circuit Breakers. (M.C.C.B.) / Miniature Circuit Breakers. (M.C.B.)	• SIEMENS • SCHNEIDER ELECTRIC • ABB • OR APPROVED EQUIVALENT			
9.	Air Break Magnetic Contactors	• SIEMENS • SCHNEIDER ELECTRIC • ABB • OR APPROVED			

NO TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
		EQUIVALENT			
10.	Voltmeter / Ammeter	• REVALCO • SIFAM TINSLEY • SACI • LUMEL • OR APPROVED EQUIVALENT			
11.	C.T.(Current Transformer)	• REVALCO • FICO • CIRCUTOR • METELX • OR APPROVED EQUIVALENT			
12.	P.T.(Potential Transformer)	• REVALCO • FICO • CIRCUTOR • METELX • OR APPROVED EQUIVALENT			
13.	Auto-Off-Manual Selector Switchs. / A.S.S. / V.S.S	• BRETER • KRAUS & NAIMER • BREMAS • LUMEL • OR APPROVED EQUIVALENT			
14.	Protection Relays (Self – Powered)	• SIEMENS • SCHNEIDER ELECTRIC • ABB • OR APPROVED EQUIVALENT			
15.	Control Relays	• ZAHRA • FINDER • EMIRAL • OR APPROVED EQUIVALENT			
16.	H.R.C. (High Repturing Capacity) Fuses.	• DF ELECTRIC • KALEPORSELEN • ETI • OR APPROVED EQUIVALENT			
17.	Indication Lights. / ON. / OFF. Push	• SCHNEIDER ELECTRIC			

NOT TO BE FILLED

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
	Buttons. / Lockable Mushroom Switches.	• MARUYASU • LOVATO • OR APPROVED EQUIVALENT			
18.	Bus Bar Trunking System / Bus Tie Duct	• SCHNEIDER ELECTRIC • GERSON • SIEMENS • EAE • ABB • COMPAC • OR APPROVED EQUIVALENT			
19.	LED for Indoor / Outdoor Illumination light (Professional / Project Series)	• SIGNIFY • (Formerly PHILIPS) • EAE • NVC LIGHTING • LEDVANCE • OPPLE • OR APPROVED EQUIVALENT			
20.	Capacitor Trip Unit	• ELABS • OR APPROVED EQUIVALENT			
21.	Emergency Exit Signs	• CEAG (EATON) • TEKNOWARE • EPOWERTECH • OR APPROVED EQUIVALENT			
22.	Power Factor Controller	• NOKIAN • LOVATO • CIRCUTOR • SHIZUKI • OR APPROVED EQUIVALENT			
23.	H.T Cables	• PAKISTAN CABLES • FAST CABLES • NEWAGE CABLES • OR APPROVED EQUIVALENT			
24.	Single & Multi Core L.T. Cables	• PAKISTAN CABLES • FAST CABLES • NEWAGE CABLES			

NOT TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
		• PIONEER CABLES • COPPERGATE • UNIVERSAL CABLE • OR APPROVED EQUIVALENT • ALLIED CABLES			
25.	H.T. Termination Kits	• RAYCHEM • 3M • OR APPROVED EQUIVALENT			
26.	Light Control Switches. / Fan Dimmers. / Socket Outlets / Spur outlets	• SCHNEIDER ELECTRIC • MK • ORANGE ELECTRIC • PHILIPS • LEGRAND • OR APPROVED EQUIVALENT			
27.	Pull box/ Back Boxes / Fan Hook	• HUSSAIN & CO • ORANGE • OR APPROVED EQUIVALENT			
28.	PVC Conduits & Accessories / uPVC Pipes & accessories	• DADEX • GALCO • JEDDAH • OR APPROVED EQUIVALENT			
29.	Medium duty G.I. Conduits & Accessories	• INTERNATIONAL INDUSTRIES LIMITED • STEELEX • OR APPROVED EQUIVALENT			
30.	Earthing System	• FURSE • WALLIS • DEHN • OR APPROVED EQUIVALENT			
31.	HT/LT Surge Arrestors	• SCHNEIDER ELECTRIC • ABB			

NOT TO BE FILLED

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
		• SIEMENS • DEHN • OR APPROVED EQUIVALENT			
32.	Lightning Protection System	• FURSE • DEHN • WALLIS • INDELEC (EARLY STREAMER) • OR APPROVED EQUIVALENT			
33.	Ceiling Fans/ Wall Bracket Fans/ Exhaust Fans	• PAK FANS • ROYAL FANS • MILLAT FANS • GFC • OR APPROVED EQUIVALENT			
34.	Propeller Exahust Fan with impoted Motor	• AEROTECH PAKISTAN • SASA • SHAN INDUSTERIES • OR APPROVED EQUIVALENT			
35.	Connectors	• PHOENIX CONTACT • MOLEX • AMPHENOL • BJB • OR APPROVED EQUIVALENT			
36.	Automatic Time Switches	• PANASONIC • FUJI • OR APPROVED EQUIVALENT			
37.	Photo Cell / Day Light Switches.	• PANASONIC • SCHNEIDER ELECTRIC • OR APPROVED EQUIVALENT			
37.	UPS(Uninterruptable Power Supply	• APC • ABB			

NOT TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi A

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
		• EATON • OR APPROVED EQUIVALENT			
38.	Energy Meter	• SYED BHAIS • ABB • OR APPROVED EQUIVALENT			
39.	Cable Tray	• ASHRAF FEBRICATION AND ENGINEERING • OR APPROVED EQUIVALENT			
40.	ISO-12944, Corrosivity Category Medium Durability Paint	• JOTUN • AKZONOBEL • SPICO • OR APPROVED EQUIVALENT			
41.	Ethernet Switches	• HUAWEI CISCO OR APPROVED EQUIVALENT			
42.	Computers	• DELL • HP • LENOVO • OR APPROVED EQUIVALENT			
43.	PABX	• ALCATEL • HUAWEI • OR APPROVED EQUIVALENT			
44.	Structured Cabling Network	• 3M / CORNING • SCHNEIDER ELECTRIC • VIVANCO • OR APPROVED EQUIVALENT			
45.	Firewall	• FORTINET • OR APPROVED EQUIVALENT			
46	Wireless Controller / Wireless Access Point	• ALCATEL • CISCO • OR APPROVED			

NOT TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
		EQUIVALENT			
47.	Intelligent Addressable Fire Alarm System (Despite the mentioned Brands the Product shall be UL/FM/Vds Certified)	• MORLEY BY HONEY WELL • GENT BY HONEYWELL • HOCHIKI • ESSER • BOSCH SECURITY • OR APPROVED EQUIVALENT			
48.	Fire Resistance Cable	• PRYSMIAN • CAVICEL • RAMCRO • OR APPROVED EQUIVALENT			
49.	Closed Circuit Television (CCTV) System.	• HIK VISION (PRO/AI SERIES) • OR APPROVED EQUIVALENT			
50.	Public Address System.	• TOA • BOSCH • OR APPROVED EQUIVALENT			
51.	Speaker Cable	• PRYSMIAN • CAVICEL • BELDEN • RAMCRO • OR APPROVED EQUIVALENT			
52.	Microphone Cable	• PROCEL • CANARE • OR APPROVED EQUIVALENT			
53.	Passive CATV System	• WISI • OR APPROVED EQUIVALENT			
54.	Co-axial Cable	• WISI • OR APPROVED EQUIVALENT			
55.	Access Control System	• HIK VISION (PRO/AI SERIES)			

NOT TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

S #	EQUIPMENT / MATERIAL.	RECOMMENDED / APPROVED MANUFACTURER	OFFERED / PROPOSED MANUFACTURER (*)	COUNTRY OF ORIGIN(*)	COUNTRY OF MANUFACTURING (*)
		• OR APPROVED EQUIVALENT			
56.	Nurse Call System	• ZKR • ALCAD • C-TECH • OR APPROVED EQUIVALENT			
57.	Data Rack	• APC • EATON • VIVANCO • OR APPROVED EQUIVALENT			

NOT TO BE FILLED

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

Bidder's Seal and Signature

APPENDIX - B

DEVIATIONS FROM SPECIFICATION
(To be filled in by the Bidder)

The bid submitted contains the following deviations from the Specification of Electrical & Communication works. State specifically if the Tender does not contain any deviation.

SR. NO	REF. OF BOQ ITEM NO.(s)	DESCRIPTION OF DEVIATION(s)	REASON(s)

Bidder's Seal and Signature

Additional sheets to be attached if necessary. Each sheet to be signed and sealed.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

APPENDIX – C TO BILL OF QUANTITIES

SPECIAL TOOLS FOR ELECTRICAL & COMMUNICATION WORKS
(To be filled in by the Bidder) *

The following tools required in accordance with the Bid will be supplied. No separate payment will be made for this item of work.

SR. NO	NAME OF SPECIAL TOOLS	QUANTITY	MANUFACTURER
1.	0-1000 V Megger	1 No.	
2.	0-2500A Clamp on ammeter/Voltmeter	1 No.	
3.	AVO Meter	1 No.	
4.	Phase Sequence Meter	1 No.	
5.	Earth Resistance Tester	1 No.	
6.	Fuse pullers of all fuse sizes	1 Set	
7.	Lux Meter.	1 No.	
8.	Fluke Meter.	1 No.	
9.	OTDR.	1 No.	
10.	Any other tools recommended by the manufacturers of various equipment to be installed. ***		

Tenderer's Seal and Signature

*** Additional sheets to be attached if necessary. Each sheet to be signed and sealed.

APPENDIX – D TO BILL OF QUANTITIES

SPARE PARTS OF ELECTRICAL ITEMS

(To be filled in by the Bidder)

The following spare parts required in accordance with the Bid will be supplied. The Quantities of spare parts marked with aesterics (*) shall be as recommended by the equipment manufacturer and the Bidder shall enter here the actual recommended quantities in numbers.

Sr. No.	Name of Spare Parts	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1.	**Power Transformer** (1250kVA)				
2.1	Silica Gel in Sealed pack	kG	20		
2.2	Dial type thermometer	No.	2		
2.3	Pressure release safety valve	No.	2		
	Total amount carried over to "Rate" column of BOQ item No 01-7E.				
2.	**H.T Switch Board**				
3.1	Indication lamps of each type	No.	7		
3.2	Racking Crank for moving the Withdrawable Part	No.	7		
3.3	Hand Crank For charging of VCB Manually	No.	7		
3.4	Push Rod for operating VCB Mechanically	No.	7		
3.5	Operating Lever of Earthing switch	No.	7		
3.6	Service Truck for Withdrawable Parts	No.	7		
	Total amount carried over to "Rate" column of BOQ item No 01-11E.				

Bidder's Seal and Signature

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI
CONSTRUCTION OF ACADEMIC AND ADMIN BUILDING AT JSMU, KARACHI

PRICED BILL OF QUANTITES
(Based on Composite Schedule of Rates (CSR) 2024, Government of Sindh)

Item No.	C.S.R. 2024 Item No.	Description	Unit	Qty.	Unit Rate (Rs.)	Amount (Rs.)
		P. PLUMBING WORKS				
		INTERNAL NATURAL GAS PIPING WORKS Ref. Specification Sec. No. (8460) (Entire under mentioned work will be executed by SSGC or their approved Contractors only)				
01-1M	N.S	Supply, installation, testing, and commissioning of galvanized steel pipes, medium grade, conforming to BS 1387, of the following nominal diameters, including all required fittings, sockets, bends, tees, elbows, caps, and plugs, fixed to walls, ceilings, and floors as required, complete in all respects, as per the drawings and specifications.				
		i) DN 15mm (NPS 1/2")	Rft.	380		
		ii) DN 20mm (NPS 3/4")	Rft.	150		
		iii) DN 25mm (NPS 1")	Rft.	60		
		iv) DN 32mm (NPS 1 1/4")	Rft.	325		
01-2M	N.S	Supply and installation of brass/bronze ball valve, full-bore, PN 16 or Class 150, of the following nominal diameters, suitable for natural gas service, conforming to MSS SP-100 or equivalent, complete in all respects, as shown on the drawings and as specified.				
		a) NPS 1/2"	Nos.	22		

TOTAL AMOUNT OF MECHANICAL WORKS (Natural Gas piping) Rs. _____
carried over to Summary _____

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

BE-1

Appendix-E to Bid

PROPOSED CONSTRUCTION SCHEDULE

Pursuant to Sub-Clause 8.2 of the General Conditions of Contract, the Works shall be completed on or before the date stated in Appendix-A to Bid. The Bidder shall provide as Appendix-E to Bid, the Construction Schedule in the bar chart (CPM, PERT or any other to be specified herein) at least in form of latest MS Project or approved, showing the sequence of work items and the period of time during which he proposes to complete each work item in such a manner that his proposed program for completion of the whole of the Works and parts of the Works may meet Procuring Agency's overall completion targets in days noted below and counted from the date of receipt of Engineer's Notice to Commence. The bidders shall propose completion time for major milestones of the project to ensure effective monitoring:

The contractor shall submit work plan for each school and a comprehensive plan for complete project containing all school units.

Description	Time for Completion
Construction of Academic & Admin Building	24 Calendar Months from the date of issuance of Engineer's Notice to Commence

BF-1

Appendix-F to Bid

METHOD OF PERFORMING THE WORK

The Bidder is required to submit a narrative outlining the method of performing the Work. The narrative should indicate in detail and include but not be limited to:

1. Organization Chart indicating head office and field office personnel involved in management and supervision, engineering, equipment maintenance and purchasing.

2. Mobilization, the type of facilities including personnel accommodation, office accommodation, provision for maintenance and for storage, communications, security and other services to be used.

3. The method of executing the Works, the procedures for installation of equipment and machinery and transportation of equipment and materials to the site of each school and complete project containing all school units.

4. Arrangements for temporary school academic facilities.

BG-1

Appendix-G to Bid

LIST OF MAJOR EQUIPMENT – RELATED ITEMS

The Bidder will provide on Sheet 2 of this Appendix a list of all major equipment and related items, under separate heading for items owned, to be purchased or to be arranged on lease by him to carry out the works. The information shall include make, type, capacity, and anticipated period of utilization for all equipment which shall be in sufficient detail to demonstrate fully that the equipment will meet all requirements of the Specifications.

BG-2

Appendix-G to Bid

LIST OF MAJOR EQUIPMENT

Owned Purchased or Leased	Description of Unit (Make, Model, Year)	Capacity HP Rating	Condition	Present Location or Source	Date of Delivery at Site	Period of Work on Project
(1)	(2)	(3)	(4)	(5)	(6)	(7)
a. Owned						
b. To be Purchased						
c. To be arranged on Lease						

BI-1

Appendix-I to Bid

LIST OF SUBCONTRACTORS

I/We intend to subcontract the following parts of the Work to subcontractors. In my/our opinion, the subcontractors named hereunder are reliable and competent to perform that part of the work for which each is listed.

Enclosed are documentation outlining experience of subcontractors, the curriculum vitae and experience of their key personnel who will be assigned to the Contract, equipment to be supplied by them, size, location and type of contracts carried out in the past.

Part of Works (Give Details)	Subcontractor (With Complete Address)
(1)	(2)

BH-1

Appendix-H to Bid

CONSTRUCTION CAMP AND HOUSING FACILITIES

The Contractor in accordance with the Conditions of Contract shall provide description of his construction camp's facilities for complete project .

The Contractor shall be responsible for pumps, electrical power, water and electrical distribution systems, and sewerage system including all fittings, pipes and other items necessary for servicing the Contractor's construction camp.

The Bidder shall list or explain his plans for providing these facilities for the service of the Contract as follows:

1. Site Preparation (clearing, land preparation, etc.).

2. Provision of Services.

   a) Power (expected power load, etc.).
   b) Water (required amount and system proposed). c) Sanitation (sewage disposal system, etc.).

3. Construction of Facilities

   a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).
   b) Warehouses and Storage Areas (area required, type of construction and layout).
   c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).

4. Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).

5. Other Items Proposed (Security services, etc.).

BJ-1

Appendix-J to Bid

ESTIMATED PROGRESS PAYMENTS

Bidder's estimate of the value of work which would be executed by him during each of the periods stated below, based on his Programme of the Works and the Rates in the Bill of Quantities, expressed in thousands of Pakistani Rupees:

Quarter/ Year/ Period	Max. upto %age	Amounts (1,000 Rs.)
1st Quarter		
2nd Quarter		
3rd Quarter		
4th Quarter		
5th Quarter		
6th Quarter		
7th Quarter		
8th Quarter		
Bid Price	**100%**	

The Contractor shall submit to 'Project Manager / The Engineer a Cash Flow in 'S-Curve' and update regularly according to the progress payments.

BK-1

Appendix-K to Bid

ORGANIZATION CHART FOR THE SUPERVISORY STAFF AND LABOUR

(To be filled in by the bidder)

The Contractor should have team of reasonably skilled persons in the field of building construction led by a Project Manager (BE Civil) registered in PEC as Professional Engineer, having at least 20 years' experience in the relevant field. The Project Manager should be authorized to take instruction from the Engineer and direct contractor's crew to complete the works in accordance with the specifications.

The Contractor shall depute BE civil site engineers in appropriate number as per law and at least two experienced supervisor (DAE) at site to be directly responsible for the execution of works at site. The contractor must employee experienced lab technician in his laboratory to conduct required QA/QC testing at site / lab and to keep record of all tests.

BL-1
Appendix-L to Bid

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS CONTRACT

Contract No._____ Dated _____
Contract Value: _____
Contract Title: _____

..... [name of Contractor] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Sindh (GoS) or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoS) through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Contractor] represents and warrants that it has fully declared the brokerage, commission, fees etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder s fee or kickback, whether described as consultation fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from, from Procuring Agency (PA) except that which has been expressly declared pursuant hereto.

[name of Contractor] accepts full responsibility and strict liability that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with PA and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[name of Contractor] accepts full responsibility and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right, interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other rights and remedies available to PA under any law, contract or other instrument, be voidable at the option of PA.

Notwithstanding any rights and remedies exercised by PA in this regard, [name of Supplier/Contractor/Consultant] agrees to indemnify PA for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to PA in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder s fee or kickback given by [name of Contractor] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from PA.

Name of Buyer: .....

.....
[Seal]

Name of Seller/Supplier: ..... Signature:

Signature: .....
[Seal]

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

SAMPLE FORMS

BID SECURITY (Pay Order/Demand Draft)
PERFORMANCE SECURITY (Pay order)
CONTRACT AGREEMENT
MOBILIZATION ADVANCE GUARANTEE/BOND
INDENTURE BOND FOR SECURED ADVANCE

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

BS-1

BID SECURITY
(Pay Order/Demand Draft)

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

PS-1

PERFORMANCE SECURITY
(Pay Order/Demand Draft)

CA-1

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the _____ day of_____(month) 2014 between _____ (hereafter called the "Procuring Agency") of the one part and _____ (hereafter called the "Contractor") of the other part.

WHEREAS the Procuring Agency is desirous that certain Works, viz _____ should be executed by the Contractor and has accepted a Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

NOW this Agreement witnessed as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents after incorporating addenda, if any, except those parts relating to Instructions to Bidders shall be deemed to form and be read and construed as part of this Agreement, viz:

   (a) The Contract Agreement;
   (b) The Letter of Acceptance;
   (c) The completed Form of Bid;
   (d) Special Stipulations (Appendix-A to Bid);
   (e) The Particular Conditions of Contract – Part II;
   (f) The General Conditions – Part I;
   (g) The priced Bill of Quantities (Appendix-D to Bid);
   (h) The completed Appendices to Bid (B, C, E to L);
   (i) The Drawings;
   (j) The Specifications.
   (k) _____ (any other)

3. In consideration of the payments to be made by the Procuring Agency to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Agency to execute and complete the Works and remedy defects therein in conformity and in all respects with the provisions of the Contract.

4. The Procuring Agency hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works as per provisions of the Contract, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

CA-2

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed on the day, month and year first before written in accordance with their respective laws.

Signature of the Contactor

(Seal)

Signature of Procuring Agency

(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:

(Name, Title and Address)

Witness:

(Name, Title and Address)

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

MG-1

MOBILIZATION ADVANCE GUARANTEE
(Bank Guarantee)

Not Applicable

Guarantee No._____ Date _____

WHEREAS _____(hereinafter called the 'Procuring Agency') has entered into a Contract for _____
(Particulars of Contract)
with _____ (hereinafter called the "Contractor').

AND WHEREAS, the Procuring Agency has agreed to advance to the Contractor, at the Contractor's request, an amount of Rupees _____(Rs _____) which amount shall be advanced to the Contractor as per provisions of the said Contract.

AND WHEREAS, the Procuring Agency has agreed the Contractor to furnish Guarantee to secure the mobilization advance for the performance of his obligations under the said Contract.

AND WHEREAS, _____
(Scheduled Bank in Pakistan or Insurance Company acceptable to the Procuring Agency)
(hereinafter called the "Guarantor") at the request of the Contractor and in consideration of
theProcuring Agency agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

NOW, THEREFORE, the Guarantor hereby guarantees that the Contractor shall use the advance for the purpose of above mentioned Contract and if he fails and commits default in fulfilment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Procuring Agency for payment not exceeding the aforementioned amount.

Notice in writing of any default, of which the Procuring Agency shall be the sole and final judge, on the part of the Contractor, shall be given by the Procuring Agency to the Guarantor, and on such first written demand, payment shall be made by the Guarantor of all sums then due under this Guarantee without any reference to the Contractor and without any objection.

This Guarantee shall remain in force until the advance is fully adjusted against payments from the
Interim Payment Certificates of the Contractor or until _____
whichever is earlier.(Date)

The Guarantor's liability under this Guarantee shall not in any case exceed the sum of Rupees
_____(Rs _____).

This Guarantee shall remain valid up to the aforesaid date and shall be null and void after the aforesaid date or earlier if the advance made to the Contractor is fully adjusted against payments from Interim Payment Certificates of the Contractor provided that the Guarantor agrees that the aforesaid period of validity shall be deemed to be extended if on the above mentioned date the advance payment is not fully adjusted.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

MG-2

GUARANTOR

1. Signature_____
2. Name _____
3. Title _____

WITNESS

1. _____

Corporate Secretary (Seal)

2. _____

(Name Title & Address) Corporate Guarantor (Seal)

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

IB-1

INDENTURE FOR SECURED ADVANCES

(For use in cases in which is contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time).
This INDENTURE made the ..... day of .... 20..... BETWEEN (hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and THE GOVERNOR OF SINDH (hereinafter called "the Government" of the other part).

WHEREAS by an agreement, dated (hereinafter called the said agreement, the
contractor has agreed to perform the under-mentioned works (hereinafter referred to as the said work):- (Here enter (the description of the works). 1

AND WHEREAS the contractor has applied to the ....for an advance to him of Rupees ..... (Rs. .....) on the security of materials absolutely belonging to him and brought by him to the site of the said works the subject of the said agreement for use in the construction of such of the said works as he has under taken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charge) AND

WHEREAS the Government has agreed to advance to the Contractor the sum of Rupees, (Rs. .....) on the security of materials the quantities and other particulars of which are detailed in Part II of Running Account Bill (B) the said works signed by the contractor Fin R.Form.I7.A On ..... and on such covenants and conditions as are hereinafter contained and the Government has reserved to itself the option of marking any further advance or advances on the security of other materials brought by the
Contractor to the site of the said
works.

NOW THIS INDENTURE WTTNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees..... (Rs. .....) on or before the execution of these presents paid to the Contractor by the Government (the receipt whereof the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid (all of which advances are hereinafter collectively referred to as the said amount) the Contractor doth hereby assign unto the Government the said materials by way of security for the said amount And doth hereby covenant and agree with the Government and declare ay follow :-

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

(1) That the said sum of Rupees. ..... Rs.....) so advanced by the Government to the Contractor as aforesaid and all or any further sum or sums which may be advanced as aforesaid shall be employed by the contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Running Account Bill (B) which have been offered to and accepted by (he Government as security for the said amount are absolutely by the Contractors own property free from encumbrances of any kind and the Contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the contractor hereby agrees, at all times, to indemnify and save harmless the Government against all claims whatsoever to any materials in respect of which an advance has been made to him as aforesaid.

(3) That the said materials detailed in the said Running Account Bill (B) and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in *the* execution of the said works in accordance with the directions of the Divisional Officer (hereinafter called the Divisional Officer) and in the terms of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangement for the proper watch, safe custody and protection against all risks of the said material and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and at his own risk and on his own responsibility and shall at all times be open to inspection by (he Divisional Officer or any officer authorized by him. In the event of the said materials of any part (hereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due to reasonable use and wear thereof Contractor will forthwith replace the same with other materials of like qualify or repair and make good the same as required by the Divisional Officer and the materials so brought to replace the said materials so repaired and made good shall also be considered as security for the said amount.

(5) 'Hurt the said materials shall not on any account be removed from the site of the said works except with the written permission of the Divisional Officer or an officer authorized by him in that behalf

(6) That the said amount shall be payable in full when or before the Contractor receives payment, from the Government of the price payable to him for the said works under the terms and provisions of the said agreement PROVIDED THAT if any intermediate payments are made to the contractor on account of work done then on the occasion of each such payment the Government will be at liberty to make a recovery from the Contractors Bill for such payment by deducting there from in the value of the said materials (hen actually used in the construction and in respect of which recovery has not been made previously the value for this purpose being determined in respect of each description of material at (he rates at which the amount of the advances made under these presents were calculated.

(7) at if the Contractor shall at any time make any default in the performance or observation in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the Government shall immediately on the happening of such default be repayable by the Contractor to the Government together with interest thereon at twelve percent per annum from the date or respective dates of such advance or advances to the date or repayment and with all costs, charges, damages and expenses incurred by the Government in or for the recover y thereof or the enforcement of this security or otherwise by reason of (he default of the Contractor and any moneys so becoming due and payable shall constitute a debt due from the Contractor to the Government and the Contractor hereby covenants and agrees with the Government to repay and the same respectively to it accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the Government of the said sum of Rupees .....(Rs.....) and any further sum or sums which may be advanced as aforesaid and a l l costs charges damages and expenses payable under these present PROVIDED ALWAYS and it is hereby agreed and declared that not, withstanding anything in the said agreement and without prejudice to the powers contained therein if and whether the covenant for payment and repayment hereinbefore contained shall become enforceable and the money owing shall not be paid to accordingly. Once there with the Government may at any time thereafter adopt all or any of following courses as it may deem best ;-

(a) Seize and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay the same to the Government on demand.

(b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable to the Government under these presents and pay over the surplus (if any) to the Contractor.

(c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

(9) That except as is expressly provided by the presents interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been hereinbefore expressly provided for the same shall be referred to the Superintending Engineer/Executive District Officer/Officer one grade higher to officer signed the agreement Circle whose decision shall be final and the provisions of the Arbitration Act 1940 for the time being in force so far as they are applicable shall apply to any such reference.

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

1. Signature _____
2. Name _____
3. Title _____

WITNESS

1. _____ _____
(Name Title & Address) Corporate Secretary (Seal)

2. _____ _____
(Name Title & Address) Corporate Guarantor (Seal)

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

(GENERAL CONDITIONS OF CONTRACT PART-I)

Conditions of Contract
CONSTRUCTION for

FOR BUILDING AND ENGINEERING
WORKS DESIGNED BY THE PROCURING AGENCY

Multilateral Development Bank Harmonized Edition
March 2006
General Conditions

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FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS
INTERNATIONAL FEDERATION OF CONSULTING ENGINEERS
INTERNATIONALE VEREINIGUNG BERATENDER INGENIEURE FEDERACION
INTERNACIONAL DE INGENIEROS CONSULTORES

(It is presumed that all the bidders possess original copy of FIDIC for their reference while preparation of Bid and original of the same is also required to submit at the time of signing of Contract Agreement)

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PART II - SPECIAL /PARTICULAR CONDITIONS OF CONTRACT

1.1 Definitions

1.1.1.4 "Form of Bid" is synonymous with "Letter of Tender".

1.1.1.8 "Bid" is synonymous with "Tender".

1.1.1.10 "Bidding" is synonymous with "contract".

The following paragraph is added:

1.1.1.11 "Programme" means the program to be submitted by the contractor in accordance with Sub-Clause 8.3 and any approved revisions thereto.

1.1.2.4 The Engineer is **National Engineering Services Pakistan (Pvt) Ltd. (NESPAK),** 4th Floor NICL Building, Abbasi Shaheed Road, Karachi, or any other competent person appointed by the Procuring Agency, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineers is to formulate his certifications/recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure.

1.12.2 "Procuring Agency" is synonymous with "Procuring Agency"

1.1.2.9 "DAB" is synonymous with "Committee".

1.1.3.7 "Defects notification Period" is synonymous with "Defects liability Period".

1.4 Law and Language(s)

(a) The Contract Documents shall be drawn up in the English language.
(b) The Contract shall be subject to the Laws of Islamic Republic of Pakistan.

1.5 Priority of Contract Documents

Add following paragraph at the end of Sub-clause:

In case of discrepancies between drawings, those of larger scale shall govern unless they are superseded by a drawing of later date regardless of scale. All Drawings and Specifications shall be interpreted in conformity with the Contract and these Conditions. Addendum, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.

1.15 Inspections and Audit by the Procuring Agency

The Contractor shall give access to Procuring Agency or its representative to its record and audit to verify the funds of the project has been used for the purposes intended in the Tender documents.

3.1 Engineer's Duties and Authority.

The following paragraph is added after duties:

Procuring agency shall ensure that the Engineer's Representative/Staff is a professional Engineer as defined in the Pakistan Engineering Council Act 1975 (V of 1976)

The Engineer shall obtain the specific approval of the Procuring Agency before carrying out his duties in accordance with the following Clauses:

(i) Consenting to the sub-letting of any part of the Works under Sub Clause 4.4 "Subcontracting".

(ii) Certifying additional cost determined under Sub-Clause 4.12 "Not Foreseeable Physical Obstructions or Conditions".

(iii) Any action under Sub-Clause 4.2 "Performance Security" and Clause 18 "Insurance" of sorts.

(iv) Any action under Clause 16 "Suspension".

(v) Any action under Clause 8.4 "Extension of Time for Completion".

(vi) Any action under Clause 8.7 "Delay Damages" or Payment of Bonus for Early Completion of Works.

(vii) Issuance of "Taking-Over Certificate" under Clause 10.

(viii) Issuing a Variation Order under Clause 13,except:

a) in an emergency* situation, as stated here below, and

b) if such variation would increase the Contract Price by less than the amount stated in the Appendix-A to Bid.

(ix) Fixing rates or prices under Clause 13.3.

(x) Extra payment as a result of Contractor's claims under Clause 20.

(xi) Release of Retention Money to the Contractor under Sub-Clause 14.9 "Payment of Retention Money".

(xii) Issuance of "Final Payment Certificate" under Sub-Clause 14.11 & 14.13.

(xiii) Issuance of "Defect Liability Certificate" under Sub-Clause 11.

* (The Contractor shall notify the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the work, and if in the opinion of the Engineer an emergency occurs (whether notified by the Contractor or not) affecting the safety of life or of the Works or of adjoining property, the Engineer may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Procuring Agency.)

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The following sub-clause 3.6 is added in (GCC):

3.6 Engineer Not Liable

Approval, reviews and inspection by the Engineer of any part of the Works does not relieve the Contractor from his sole responsibility and liability for the supply of materials, plant and equipment for construction of the Works and their parts in accordance with the Contract and neither the Engineer's authority to act nor any decision made by him in good faith as provided for under the Contract whether to exercise or not to exercise such authority shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any of their representatives or employees or any other person performing any portion of the Works.

4.2 Performance Security

Delete and replace '28' days with '14' days wherever found in the sub-clause.
Add the following text at the end;

The Performance Security shall be binding irrespective of changes in the quantities or variations in the Works or Extensions in Time for Completion of the Works which are granted or agreed upon under the provisions of the Contract.

4.3 Contractor's Representative

The following text is to be added after first paragraph:

The contractor's authorized representative or Project Manager must be a graduate civil engineer i.e. BE or B.Sc. (Civil) registered with the Pakistan Engineering Council as Professional Engineer having at least 20 years' experience in the relevant field and should not be more than 50 years old. The Project Manager should be authorized to take instruction from the Engineer and direct contractor's team to complete the works in accordance with the specifications.

In case the Contractor fails to appoint his representative / PM and other staff, as stated above & as indicated in Appendix-K to bid, the Engineer may order to stop complete or appropriate portion of work at site until Contractor fulfills the requirement of staff employment.

Following are added after sub clause 4.24;

4.25 Vesting of Contractor's Plant, Equipment Temporary Works and Materials:

(a) **Definitions**

For the purpose of Sub-Clause 4.17.

(i) The expression "Construction Plant" shall be deemed to exclude vehicles engaged in transporting any labour equipment or materials to or from the site.

(ii) The expression "Essential Hired Plant" shall mean all Constructional Plant, Equipment Temporary Works and materials of Temporary Work the withdrawal of which in the event of termination under Sub-Clause 15.2 hereof might (having regard to the methods of construction employed prior to the termination) endanger the safety or stability of or result in serious disturbance to the execution of any part of the Works and which are held by the Contractor under any agreement for hire thereof.

(iii) The expression "Hired Plant" shall mean any Constructional Plant, Equipment, Temporary Works (other than essential hired plant) held by the Contractor under any agreement for hire thereof.

(iv) The expression "Agreement for Hire" shall be deemed not to include an agreement for hire purchase with an option to purchase or for conditional sale either of which is herein referred to as an "agreement for the purchase".

(v) The expression "Hire Purchase Plant" shall mean any Constructional Plant, Equipment, Temporary Works held by the Contractor under an agreement for hire purchase thereof.

(vi) The expression "owner" means the owner of the plant and equipment of any Hire Purchase Plant.

(b) Vesting of Certain Plant

All Constructional Plant, Equipment, Temporary Works and material owned by the Contractor or by any company in which the Contractor has a controlling interest shall when brought on to the site (or in the case of hire purchase plant upon becoming the property of the Contractor) and shall be deemed to become the property of the Procuring Agency.

(c) Conditions of Hire of Certain Plant

With a view to securing in the event of termination Sub-Clause 15.2 hereof the continued availability for the purpose of executing the Works of any essential hired plant and equipment the Contractor shall not bring on to the Site any essential hired plant unless the agreement for hire thereof contains a provision that the owner will on request in writing made by the Procuring Agency within 7 days after the date on which any such termination has become effective and on the Procuring Agency undertaking to pay all hire charges in respect thereof on the same terms in all respects as the same was hired to the contractor save that the Procuring Agency shall be entitled to permit the use thereof by any other contractor employed by it for the purposes of completing the works under the terms of Sub-Clause 15.2 hereof.

(d) Costs for purpose of Approval of Materials not implied

In the event of the Procuring Agency entering into any agreement for hire of essential hired plant pursuant to the contract provisions, all sums properly paid by the Procuring Agency under the provisions of any such agreement and all expenses incurred by it (including stamp duties) in entering into such agreement shall be deemed for the purpose of Sub-Clause 15.2 hereof to be part of the cost of completing the Works.

(e) Contractor's Certificate as to Hiring Provisions

The Contractor shall upon request made by the Engineer at any time in relation to any item of essential hired plant forthwith notify to the Engineer in writing the name and address of the owner and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements of Approval of Materials not Implied. The Contractor shall also upon request as aforesaid give a like notification (but without certificate) in regard to any hire purchase plant.

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(f) Hire Purchase Payment by the Procuring Agency

The Procuring Agency shall in order to avoid seizure by the owner of any hire purchase plant be entitled to pay to such owner the amount of any overdue installment or other sum payable optionally or otherwise under any Agreement of hire purchase and in the event of his doing so any amount so paid by him shall be debt due from the Contractor to the Procuring Agency and may be deducted by the Procuring Agency from any moneys due or that may become due to the Contractor under the Contract or may be recovered by the Procuring Agency from the Contractor at law.

(g) Irrevocability of Certain Plant etc.

No Constructional Plant, Equipment Temporary Works or materials or any part thereof shall be removed from the site without the written consent of the Engineer which consent shall not be unreasonably withheld where the same is no longer immediately required for the purposes of completion of the Works but the Procuring Agency will permit the Contractor the exclusive use of all such Constructional Plant, Equipment, Temporary Works and materials in and for the completion of the Works until the occurrence of any event which gives the Procuring Agency the right to expel the Contractor from the site and proceed with the completion of the Works.

(h) Re-vesting and Removal of Plant

Upon the removal with the consent of the Engineer of any such Constructional Plant Equipment, Temporary Works or materials as have been deemed to have become the property of the Procuring Agency, the property therein shall be deemed to re-vest in the Contractor and, upon completion of the Works the property in the remainder of such Constructional Plant, Equipment, Temporary Works and materials as aforesaid shall subject to the provisions of Sub-Clause 15.2 be deemed to re-vest in the Contractor who shall remove the same together with any essential hired plant or hire purchase plant. If the Contractor shall fail to remove any Constructional Plant, Equipment, Temporary Works or materials as aforesaid or any essential hire plant or hire purchase plant within such reasonable time after completion of the Works as may be allowed by the Engineer then the Procuring Agency may:

i) sell any such Constructional Plant, Equipment, Temporary Works and materials as aforesaid, and

ii) return at the Contractor's expenses to the person firm or company from whom any Essential Hired Plant or any Hire Purchase Plant was held by the Contractor such essential hired plant or hire purchase plant, and after deducting from any proceeds of sale, the costs, charges and expenses of and in connection with such sale and return as aforesaid shall pay the balance (if any) to the Contractor but to the extent that the proceeds of any sale are insufficient to meet all such cost, charges and expenses the excess shall be a debt due from the Contractor to the Procuring Agency and shall be deductible or recoverable by the Procuring Agency accordingly as aforesaid.

(j) Liability for loss or injury to plant

The Procuring Agency shall not at any time be liable for the loss of or injury to any of the Constructional plant, Temporary Works or materials which have been deemed to become the property of the Procuring Agency, hereof save as
mentioned in Sub-Clause 20 hereof.

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(k) Incorporation of Sub-Clause in Sub-Contracts

The Contractor shall when entering into any sub-contract for the execution of any part of the Works incorporate in such sub-contract (by reference or otherwise) the provisions of this Sub-Clause in relation to Constructional Plant, Temporary Works and materials. Essential Hired Plant and Hire Purchase Plant to be brought on the Site by the sub-contractor.

(l) Approval of Materials etc., not implied

The contractor's operation shall not be deemed to imply any approval by the Engineer of the materials or other matters referred to therein nor shall it prevent the rejection of any materials at any time by the Engineer.

6.9 Engineer at Liberty to Object

The following is added at the end of sub clause in General Conditions of Contract:

If the Procuring Agency asks the Engineer to direct Contractor to remove a person who is a member of his staff or workforce stating the reasons the Contractor shall ensure that the person leaves the site immediately and has no further connection with the work in the Contract.

6.10 Records of Contractor's Personnel and Equipment

The following paragraph is added:

The Contractor shall, upon request by the Engineer at any time in relation to any item of hired Contractor's Equipment, forthwith notify the Engineer in writing the name and address of the Owner of the equipment and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements set forth above.

Add the following sub-clause at the end of 6.22 in (GCC)

6.23 Compliance by Subcontractors

The Contractor shall be responsible for compliance by his Subcontractors of the provisions of this Clause.

The following sub-clause 7.9 is added in (GCC)

7.9 Use of Pakistani Materials and Services

The contractor shall, so far as may be consistent with the contract, make the maximum use of materials, supplies, plant and equipment indigenous to or produced or fabricated in Pakistan and services, available in Pakistan provided such materials, supplies, plant, equipment and services shall be of required standard.

8.1 Commencement of Works

The last Para is deleted and substituted with the following:

The contractor shall commence the works on site within the period named in Appendix-A to Bid from the date of receipt by him from the Engineer of a written Notice to Commence. Thereafter, the contractor shall proceed with the works with due expedition and without delay.

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8.3 Program

The following paragraphs are added:

The program/schedule shall be submitted in the form of Critical Path Method (CPM) identifying the critical path/activities, in hard form as well as in soft form in latest version of MS Project or as agreed with the Engineer.

a) The Contractor shall submit to the Engineer detailed programme for the following: (1)

Execution of Works;

(2) Key Deliverables and submittals

(3) Labour Resources;

(4) Local Material Procurement; (5)

Material Imports, if any; and

(6) Other details as required by the Engineer.

b) If Contractor fails to submit updated work schedule within the time instructed by the Engineer/Project Manager, the Engineer/Project Manager may withhold an amount at his discretion from next due amount and continue to withhold this amount until the next payment after the date on which the overdue program has been submitted.

c) During the period of the Contract, the Contractor shall submit to the Engineer no later than the 8th day of the following month, 04 copies each of Monthly Progress Reports covering:

(1) Progress update of the project program/schedule indicating the monthly progress in percentages with actual start and finish dates;

(2) Description of all work carried out since the last report;

(3) Description of the work planned for the next 56 days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;

(4) Monthly summary of daily job record; and

(5) Information about problems and difficulties encountered, if any, and proposals to overcome the same.

d) During the period of the Contract, the Contractor shall keep a daily record of the work progress, which shall be made available to the Engineer as and when requested. The daily record shall include particulars of weather conditions, number of men working, deliveries of materials, quantity, location and assignment of Contractor's equipment.

e) The detailed Cash Flow Estimate shall be submitted within 21 days from the date of receipt of Letter of Acceptance

8.11 Prolonged Suspension

Replace 84 days by 120 days.

13.1 Right to vary

In the last line of last Para, after the word "Variation", the word "in writing" is added.

13.3 Variation procedure

In the 2nd line, after the words "as soon as practicable" following is added: "and within a period not exceeding one-eighth of the completion time"

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13.8 Adjustment for changes in cost

The following provision is added for Bidding Contracts:

The price adjustment shall be paid in accordance with the notification, if any, issued by the Government of Sindh on such material only specified therein.

14.1 The Contract Price

Sub-para (d) & (e) are deleted.

14.2 Advance Payment

This Clause is deleted in its entirety (No Advance or Mobilization Advance payment admissible in the Contract).

14.3 Application for Interim Payment Certificate

The Text is added at the end of sub clause 14.3 as follows:

The Contractor shall submit a certificate signed and stamped by the contractor, certifying that the Contractor has paid all dues of the materials, suppliers, workmen and subcontractors for the works whose payment is claimed in this Application of Interim Payment.

14.5 Plants and Materials intended for Works (Secured Advance)

Add the following paragraph as sub-clause 14.5 (d) for Secured Advance on non – perishable materials and sub-clauses (a), (b) and (c) will be applicable for plants and materials:-

(I) The Contractor shall be entitled to receive from the procuring agency Secured Advance against an INDENTURE BOND in Public Works Account Form No.31 (Fin. R. Form No. 2) acceptable to the procuring agency of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the site but not yet incorporated in the Permanent Works provided that:

(i) The materials are in accordance with the specifications for the permanent works;

(ii) Such materials have been delivered to the site and are properly stored and protected against loss or damage or deterioration to the satisfaction and verification of the Engineer/ Engineer's Representative but at the risk and cost of the Contractor;

(iii) The Contractor's records of the requirements, orders, receipts and use of materials are kept in a form approved by the Engineer, and such records shall be available for inspection by the Engineer;

(iv) The Contractor shall submit with his monthly statement the estimated value of the materials on site together with such documents as may be required by the Engineer for the purpose of valuation of materials and providing evidence of ownership and payment therefore;

(v) Ownership of such materials shall be deemed to vest in the procuring agency and these materials shall not be removed from the site or otherwise disposed of without written permission of the procuring agency;

(vi) The sum payable for such materials on site shall not exceed 75 % of the (i) landed cost of imported materials, or (ii) ex-factory / ex-warehouse price of locally manufactured or produced materials, or (iii) market price of stands other materials;

(vii) Secured Advance shall not be allowed unless and until the previous advance, if any, is fully recovered (per site per respectively for each material);

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(viii) Detailed account of advances must be kept in part II of running account bill or a separate statement; and

(ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 3 months from the date of issue of secured advance and in no case for full quantities of materials for the entire work /contract.

(x) The words "non-perishable materials" occurring in this Clause is limited to the following materials only.

a) Steel reinforcement/Structural Steel
b) Cement
c) Aluminum Works
d) Tiles (Any type)
e) Electrical Wires/Cables (sealed packing only)

(II) Recovery of Secured Advance:

Secured Advance paid on non-perishable materials to the Contractor under the above provisions shall be recovered from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than three months (even if unutilized)

14.7 Payment

For Payment of Interim Payment Certificates, delete and replace 56 days with 42 days, out of which 14 days shall be maximum time for Engineer's review and verification from the date it is submitted in complete with all supporting documents as per agreed format and 28 days' time for the payment to contractor by Procuring agency.

14.8 Delayed Payment

Second Para is replaced with following text:

No Interest shall be paid on delayed payment.

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15.2 Termination by Procuring Agency

The following Para is added at the end of the sub-clause:

Provided further, that in addition to the action taken by the procuring agency against the Contractor under this Clause, the procuring agency may also refer the case of default of the Contractor to Pakistan Engineering Council for punitive action under the Construction and Operation of Engineering Works Bye- Laws 1987, as amended from time to time.

15.6 Corrupt and fraudulent Practices.

The following text is to be added as 3rd paragraph:

Successful Contractor has to provide Integrity Pact (for contracts worth Rs.10.0 million and above).

If the Contractor or any of his Subcontractors, agents or servants is found to have violated or involved in violation of the Integrity Pact signed by the Contractor as Appendix-L to his Bid, then the procuring agency shall be entitled to:

(a) recover from the Contractor an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by the Contractor or any of his Subcontractors, agents or servants;

(b) terminate the Contract; and

(c) recover from the Contractor any loss or damage to the procuring agency as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

The termination under sub-para (b) of this Sub-Clause shall proceed in the manner prescribed under sub-clauses 15.2 & 15.5 and the payment under Sub-Clause 15.4 shall be made after having deducted the amounts due to the procuring agency under Sub-Para (a) and (c) of this Sub- Clause.

16.4 Payment on Termination

Sub-paragraph (c) is deleted.

17.3 Procuring Agency's/ Procuring Agency's Risks

Sub-Clause 17.3 (h) is deleted.

The following text is added in Clause 18.1 (GCC):

18.1 General Requirements for Insurance

The contractor shall be obliged to place all insurances relating to the contract (including, but not limited to, the insurances referred to in Clauses 18.1,18.2,18.3,18.4) with Insurance Company having at least AA rating from PACRA/JCR in favour of the Procuring Agency/Procuring Agency valid for a period 28 days after the Bid Validity date. Costs of such insurances shall be borne by the contractor.

The Contractor shall insure with any one of the insurance companies approved for this purpose by the Procuring Agency. The insurance policies shall be in the joint names of the Procuring Agency, and the Contractor against all losses or damages as stated in the General Conditions of Contract Part I and as stated herein. Notwithstanding the responsibilities of the Contractor for indemnities

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and insurances as described in General Conditions of Contract Part I, the Contractor before commencing work on Site, must discuss fully with the Engineer and the Procuring Agency the insurance coverage provided under any general policies which are to be applied to this Contract to ensure that there are no contingencies left uncovered and to reduce, as far as practicable, duplication of coverage. Should any areas of omission be discovered that are not covered by definition of responsibilities set out in these conditions, the addition or reduction in premiums required to give such insurance coverage will be paid by the Contractor. Such policies shall be obtained by the Contractor with consent of the Engineer/Procuring Agency.

The Contractor shall be responsible for deductibles and losses/damages not covered by insurances other than the excepted risks.

The insurance losses shall not affect the Procuring Agency's or the Contractor's rights and obligations under the Contract.

The Contractor shall be responsible for compliance by his sub-contractors of insurances specified in these Sub-Clauses. Before each sub-contractor starts work, the Contractor shall provide the Procuring Agency proof that the sub-contractor(s) are covered by insurances specified herein for the Contractor.

All policies shall state that:

i) The Procuring Agency shall receive at least 30 days written notice of intended Cancellation or change affecting coverage.

ii) The Contractor is fully protected so as to provide full indemnity to Procuring Agency in respect of liability against losses or damages assumed by the Contractor under the Contract.

iii) The inclusion of more than one insured shall not affect the rights of any other insured.

iv) If a loss occurs the Contractor and the Procuring Agency shall be paid in relation of their share of the loss.

v) The Insurer has no subrogation rights against any person, corporation, or organization including directors, officers, employees, servants' agents thereof which:

- is an insured under the policy or
- is Controlled by, Owned by, or associated with an insured, or
- is a sub-contractor on the works, or has, before or a loss occurs, been released from liability by an insured.

Hold harmless provisions: The Procuring Agency, the Engineer and the Contractor shall be indemnified against all losses.

Procuring Agency use or occupancy: If the Procuring Agency uses or occupies all or part of the works during the life of the insurance policy, the Contractor shall ensure that the policy continues in full force and the Procuring Agency shall pay any resulting extra cost of insurance.

Loss Procedure: If a loss occurs the Contractor shall, on behalf of the Procuring Agency and himself negotiate the value of the loss with the insurer. Unless directed otherwise by the Engineer, when agreement is reached the Contractor shall repair all damages and the Procuring Agency shall pay him in accordance with the Engineer's Certificates for that part of the repairs which is the Procuring Agency's responsibility.

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If directed by the Engineer, instead of carrying out repairs, the Contractor shall pay to the party suffering the loss that part of the agreed value of the loss which is the Contractor's responsibility.

The provisions of this Sub-Clause shall be applicable to other insurance covered by Clauses 18 of General Conditions of Contract Part-I.

Automobile Liability Insurance: The Contractor shall also provide automobile liability insurance of all licensed vehicles owned, hired and operated by the Contractor at the Site and the risk insured shall be bodily injury, death of person and property damage or loss.

There shall be no obligation for the insurances to include loss or damage caused by the risks listed under Procuring Agency's risk.

19.6 Optional Termination, Payment and release by the Procuring Agency

Sub-clauses (c), (d) and (e) are deleted.

20.6 Arbitration

Text is replaced as under;

Any dispute in respect of which:

a. the decision, of the Dispute Board has not become final and binding pursuant to sub-clause 20.2, and

b. amicable settlement has not been reached within the period stated in sub-clause 20.5, shall be finally settled, under the provisions of the Arbitration Act, 1940 as amended or any statutory modification/Rules of Conciliation And Arbitration PEC Islamabad or re-enactment thereof for the time being in force.

The place of arbitration shall be Karachi, in Sindh Province.

Following Sub-Clause 21.1 is added;

21.1 Customs Clearance

Customs clearance shall be Contractor's responsibility.

22.1 Notice to Contractor

The following paragraph is added:

For the purposes of this Sub-Clause, the Contractor shall, immediately after receipt of Letter of Acceptance, intimate in writing to the Procuring Agency and the Engineer by registered post, the address of his principal place of business or any change in such address during the period of the Contract.

2.2 Notice to Procuring Agency and Engineer

For the purposes of this Sub-Clause, the respective addresses are:

a) The Procuring Agency:

Jinnah Sindh Medical University,
Rafiqui, H.J, Iqbal Shaheed Road
Karachi, Pakistan
Telephone No : 021-99205185

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b) The Engineer:

National Engineering Services Pakistan (Pvt.) Limited
4th Floor, NICL Building,
Abbasi Saheed Road,
Karachi

The following Sub-Clauses 23.1 is added:

23.1 Payment of Taxes including GST & SST

The Contractor, Subcontractors and their employees shall be responsible for payment of all their Income Tax, GST, SST and other Taxes on income arising out of the Contract and the rates and prices stated in the Contract shall be deemed to cover all such taxes. As per Government of Pakistan (GoP) regulations, the income tax of the contractor will be deducted at source i.e. Procuring Agency.

The Contractor firm is required to provide details & all relevant documentation/evidence of its registration with relevant registration authorities like FBR &/or Sindh Revenue Board.

Annex PROCEDURAL RULES

Procuring Agency retains SPPRA rules without changes, in case of contracts under Project, Bank and donor's program.

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PART II –SPECIAL/PARTICULAR CONDITIONS OF CONTRACT

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SPECIFICATIONS- SPECIAL
& TECHNICAL PROVISIONS
(Please refer separate Volume II)

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Karachi

TENDER DRAWINGS
(Please refer separate Volume III)

National Engineering Services Pakistan Ltd.
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Karachi

JINNAH SINDH MEDICAL UNIVERSITY

JSMU

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

TENDER DRAWINGS

MARCH, 2026

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED
13th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
PABX:+92-21-99090000 Fax : +92-21-35651994, 99225366
E-mail : karachi@nespak.com.pk, Website: www.nespak.com.pk

ADMIN AND ACADEMIC BUILDING-08		
SR.NO.	DRAWING NOS.	TITLE OF SHEET
01	4596/08/TD/B000	TITLE SHEET
02	4596/08/TD/B000	LIST OF DRAWING
03	4596/08/TD/B000	SURVEY PLAN
04	4596/08/TD/B000	MASTER PLAN
05	4596/08/TD/B000	FINISHES
06	4596/08/TD/B001	BASEMENT - 1
07	4596/08/TD/B002	BASEMENT - 2
08	4596/08/TD/B003	GROUND FLOOR PLAN
09	4596/08/TD/B004	FIRST FLOOR PLAN
10	4596/08/TD/B004-a	MEZZANINE FLOOR PLAN
11	4596/08/TD/B004-b	AUDITORIUM GALLERY
12	4596/08/TD/B005	SECOND FLOOR PLAN
13	4596/08/TD/B006	THIRD FLOOR PLAN
14	4596/08/TD/B007	FOURTH FLOOR PLAN
15	4596/08/TD/B008	FIFTH FLOOR PLAN
16	4596/08/TD/B009	SIXTH FLOOR PLAN
17	4596/08/TD/B010	SEVENTH , EIGHTH & NINTH FLOOR PLAN (TYPICAL
18	4596/08/TD/B011	ROOF PLAN
19	4596/08/TD/B012	ELEVATION - 1
20	4596/08/TD/B013	ELEVATION - 2
21	4596/08/TD/B014	ELEVATION - 3
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23	4596/08/TD/B016	SECTION - AA
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CLIENT

JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.

ARCHITECTURE & PLANNING DIVISION KARACHI.
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
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DRAWN	
SUBMITTED	
RECOMMENDED	
CHD./VER.	
APPROVED	

PROJECT

JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

LIST OF DRAWINGS

DATE: MARCH . 2026

DRAWING No.: 4596/08/TD/B000

SCALE: N.T.S

REV.: 0

CLIENT

JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.

ARCHITECTURE & PLANNING DIVISION KARACHI.
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			
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DRAWN	
SUBMITTED	
RECOMMENDED	
CHD./VER.	
APPROVED	

PROJECT

JSMU

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

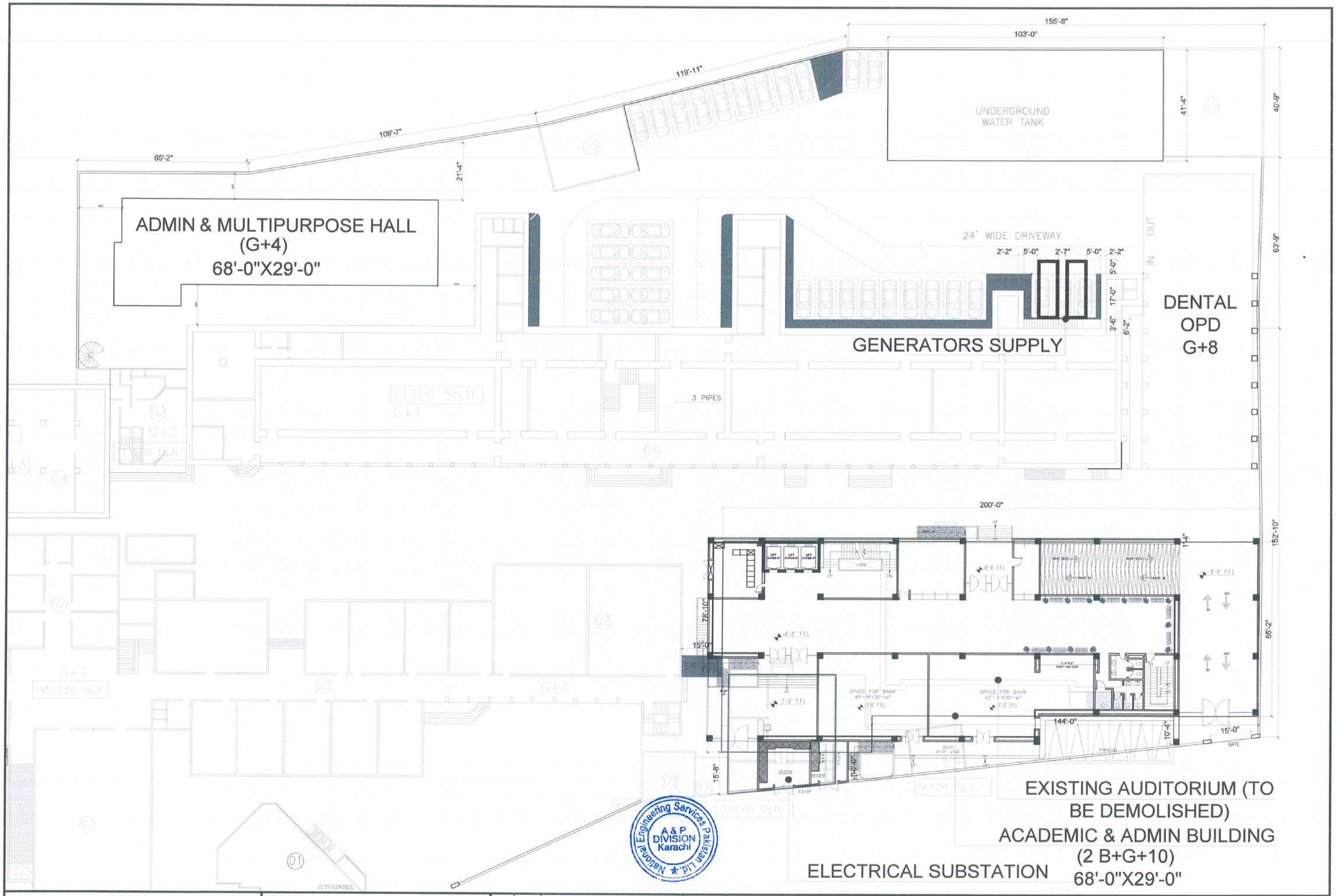
SURVEY PLAN

SCALE: N.T.S

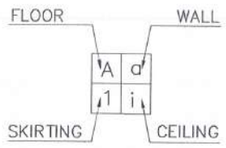
DATE: MARCH 2026

DRAWING No.: 4670/08/TD/ B000

REV.: 0



CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34	04				DRAWN		PROJECT: JSMU	MASTER PLAN	SCALE: N.T.S
		03				SUBMITTED				
		02				RECOMMENDED			DATE: MARCH 2026	DRAWING No.: 4670/08/TD/
		01				CHD./VER.				REV.: 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



SCHEDULE OF FINISHES

FLOOR

A – 24"X24" FULL BODY NON SKID PORCELAIN TILES WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN.
OR
12"X24" FULL BODY NON SKID PORCELAIN TILES WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN.

B – 24"X24"X¾" THICK TORCH FLAME GRANITE TILE FLOORING WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN.

C – ONE PIECE TORCH FLAMED GRANITE ¾" THICK ON STAIR TREADS AND RISERS WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN.

D – ANTISTATIC VINYLE TILE FIXED WITH MATCHING ADDHESIVE ONC. C FLOOR,COMPLETE IN ALL RESPECT.

E – SOLID WOODEN FLOORING FOR STAGE
PROVIDING AND FIXING 6" WIDE X 3/4" THICK MAHAGONY SOLID WOODEN FLOORING FIXED OVER CC STAGE PLATFORM MAKING ALL GOOD PROPER RIGID CARPENTARY JOINT INCLUDING FRENCH POLISHING COMPLETE IN RESPECT.

F – 3" THK. CEMENT SCREED FLOOR IN TROWELLED FINISH WITH SEALER.

G – 3" THK. CEMENTED CONC. WITH HARDNER IN BROOM/TROWELLED FINISH.

H – 40mm THK. GREY/COLORED PRECAST CONC. PAVERS.

I – 80mm THK. GREY/COLORED PRECAST CONC. PAVERS.

J – ONE PIECE POLISHED GRANITE ¾" THICK ON STAIR TREADS AND RISERS WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN.

WALL

a – 3 COATS OF MATT EMULSION OVER 1/2" THICK CS PLASTER.

b – 2 COATS OF WEATHER SHIELD PAINT ON EXTERNAL FACES.

C – COLOR CRETE WITH 12 mm WIDE GROOVES (ALUMINUM – U CHANNEL) ON SPECIFIED EXTERIOR SURFACES.

d – COLLAPSIBLE PARTITION.

SKIRTING/DADO

1 – 24"X4" FULL BODY PORCELAIN TILES GLAZED SKIRTING WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN .
OR
12"X4" FULL BODY PORCELAIN TILES GLAZED WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN .

2 – 24"X24" FULL BODY PORCELAIN TILES GLAZED WITH MATCHING GROUTING AS PER APPROVED COLOR & DESIGN . UPTO 3'/7' HIGH.
OR
12"X24" FULL BODY PORCELAIN TILES GLAZED MATCHING GROUTING AS PER APPROVED COLOR & DESIGN . UPTO 3'/7' HIGH.

3 – 24"X4" POLISHED GRANITE SKIRTING MATCHING WITH FLOOR TILES.
OR
12"X4" POLISHED GRANITE SKIRTING MATCHING WITH FLOOR TILES.

4 – 24"x24" POLISHED GRANITE TILES ON LIFT WALL MATCHING WITH FLOOR TILES UPTO 8' HIGH.

5 – 4" HIGH CEMENTED SKIRTING IN TROWELLED FINISH.

6 – 4" HIGH VINYL SKIRTING WITH APPROVED ADHESIVE.

7 – Providing & Fixing Lasani wooden cladding fabricated with front 18mm High gloss/Tectile lasani wooden sheet (Wilsonart or equivalent) both side machine pressed lamination of approved design & pattern fixed over base of 18mm MDF sheet all fixed over 2" thick anti termite partal wood framing (@2'x4' spacing) entire lasani sheet edges protected with 2mm thick PVC lipping entire wooden work must be treated with antitermite spray complete in all respect.

8 – Providing & Fixing Red Oak 2mm Ply pasted 18mm lasani sheet as per approved design fixed over base of 18mm MDF sheet all fixed over 2" thick anti termite partal wood framing (@2"x4" spacing) entire lasani sheet edges protected with redoak lipping entire wooden work must be treated with antitermite spray including french polishing complete in all respect.

9 – Providing and fixing WPVC panelling ribs wooden design on existing wall/dry partition as per approved design complete in all respect.

CEILING

i – 24"X24"X ½" THICK GYPSUM TILE (MOISTURE RESISTANT) PAINTED WITH GYPSUM BOARDS BULKHEADS, WHERE REQUIRED INCLUDING TWO COATS OF LEAD FREE NON YELLOWING ALKYD ENAMEL FINISHING COATS , SUSPENDED ON G.I FRAMING METAL SYSTEM WITH THE PROVISION OF A.C DUCTING & ELECTRICAL CABLING INCLUDING ACCESS PANEL, TRIMS, EDGE TRIMS, SHADOW TRIMS, EXPANSION JOINTS, COMPLETE IN ALL RESPECT.

ii – 48"X96"X ½" THICK GYPSUM TILE (MOISTURE RESISTANT) PAINTED WITH GYPSUM BOARDS BULKHEADS, WHERE REQUIRED INCLUDING TWO COATS OF LEAD FREE NON YELLOWING ALKYD ENAMEL FINISHING COATS. , SUSPENDED ON G.I FRAMING METAL SYSTEM WITH THE PROVISION OF A.C DUCTING & ELECTRICAL CABLING INCLUDING ACCESS PANEL, TRIMS, EDGE TRIMS, SHADOW TRIMS, EXPANSION JOINTS, COMPLETE IN ALL RESPECT.

iii – 12mm THK. MOISTURE RESISTANT GYPSUM BOARD & BULK HEADS (DFB MANUFACTURER) PAINTED ONTO METAL FRAMED SYSTEM; WITH THE PROVISION OF A.C DUCTING & ELECTRICAL CABLING INCLUDING ACCESS PANEL, TRIMS, EDGE TRIMS, SHADOW TRIMS, EXPANSION JOINTS, COMPLETE IN ALL RESPECT.

iv – 600 X 600 X 0.7 mm THK. NON-PERFORATED METAL CLIP-IN TILES IN COMBINATION OF PERFORATED TILES (DAMPA) WITH BEVELED EDGE IN APPROVED COLOR , LAID IN RECTANGULAR PATTERN CONCEALED ceiling wire hanger METAL SUSPENSION SYSTEM INCLUDING ALL ACCESSORIES INCLUDING BULK HEAD, ACCESS PANEL, TRIMS, EDGE TRIMS, SHADOW TRIMS AT WALL INTERFACE , COMPLETE IN ALL RESPECT – 1 HRFR.

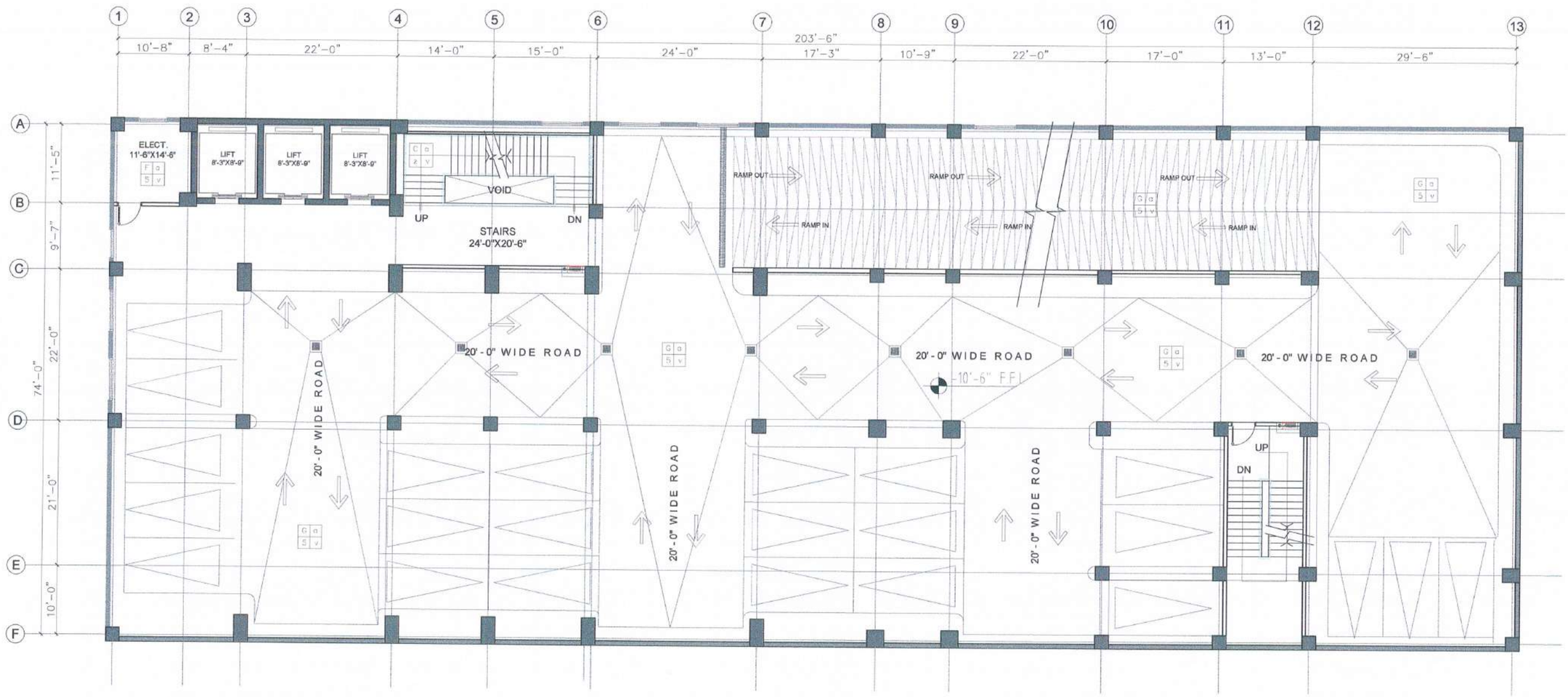
v – 3 COATS OF DISTEMPER PAINT OVER ½" THK. C.C PLASTER

vi – WOODEN TRIMS .

vii – Providing and fixing WPVC panelling ribs wooden design on existing wall/dry partition as per approved design complete in all respect.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.				
	ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99228430-34				
04				DRAWN	
03				SUBMITTED	
02				RECOMMENDED	
01				CHD./VER.	
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING				
SCHEDULE OF FINISHES					
DATE	FEBRUARY, 2026				
DRAWING No.	4596/08/TD/B000				
SCALE	N.T.S				
REV.	0				



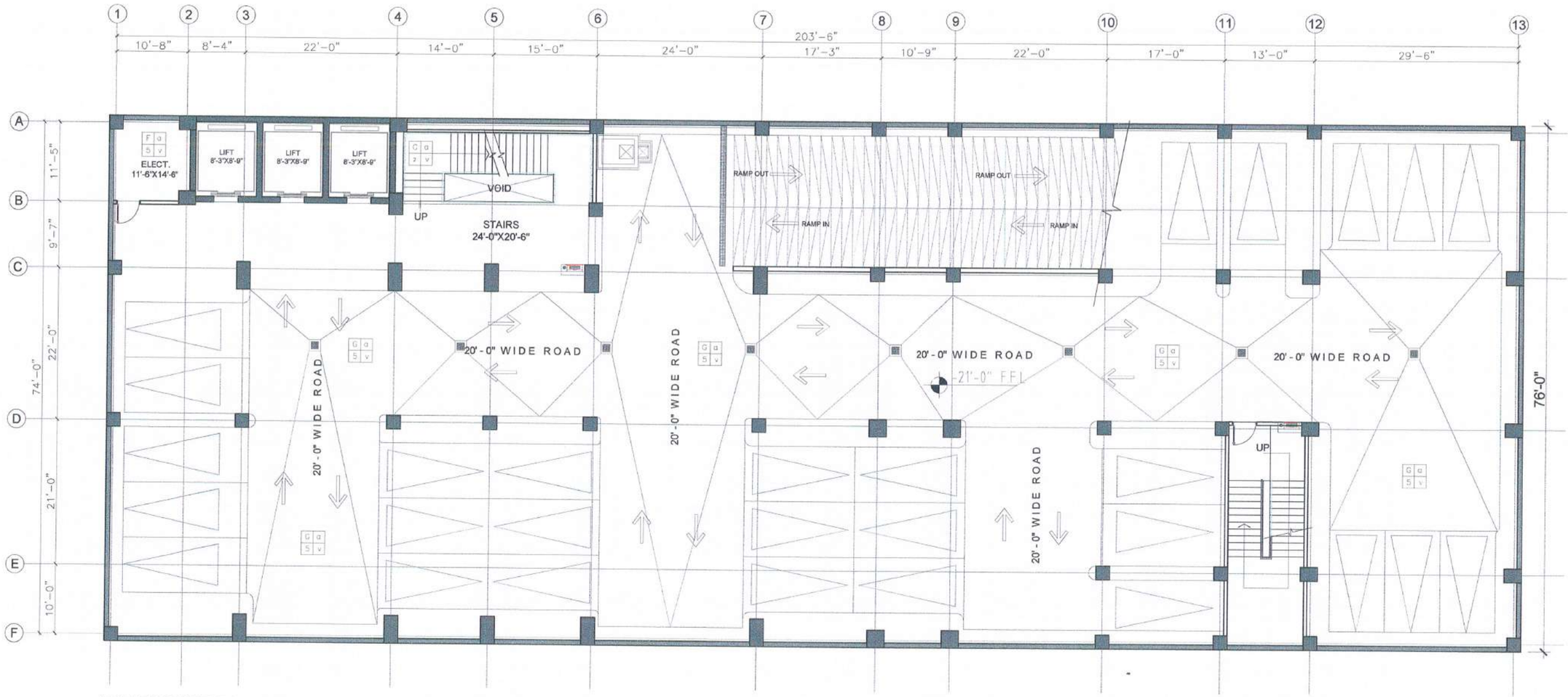
BASEMENT PLAN-1

CARS PARKING 26

TOTAL CARS PARKING B1 +B2 = 52

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99226430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV.	DATE / DESCRIPTION / APPROVED	APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	BASEMENT PLAN -1		
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B001		
SCALE	N.T.S		
REV.	0		



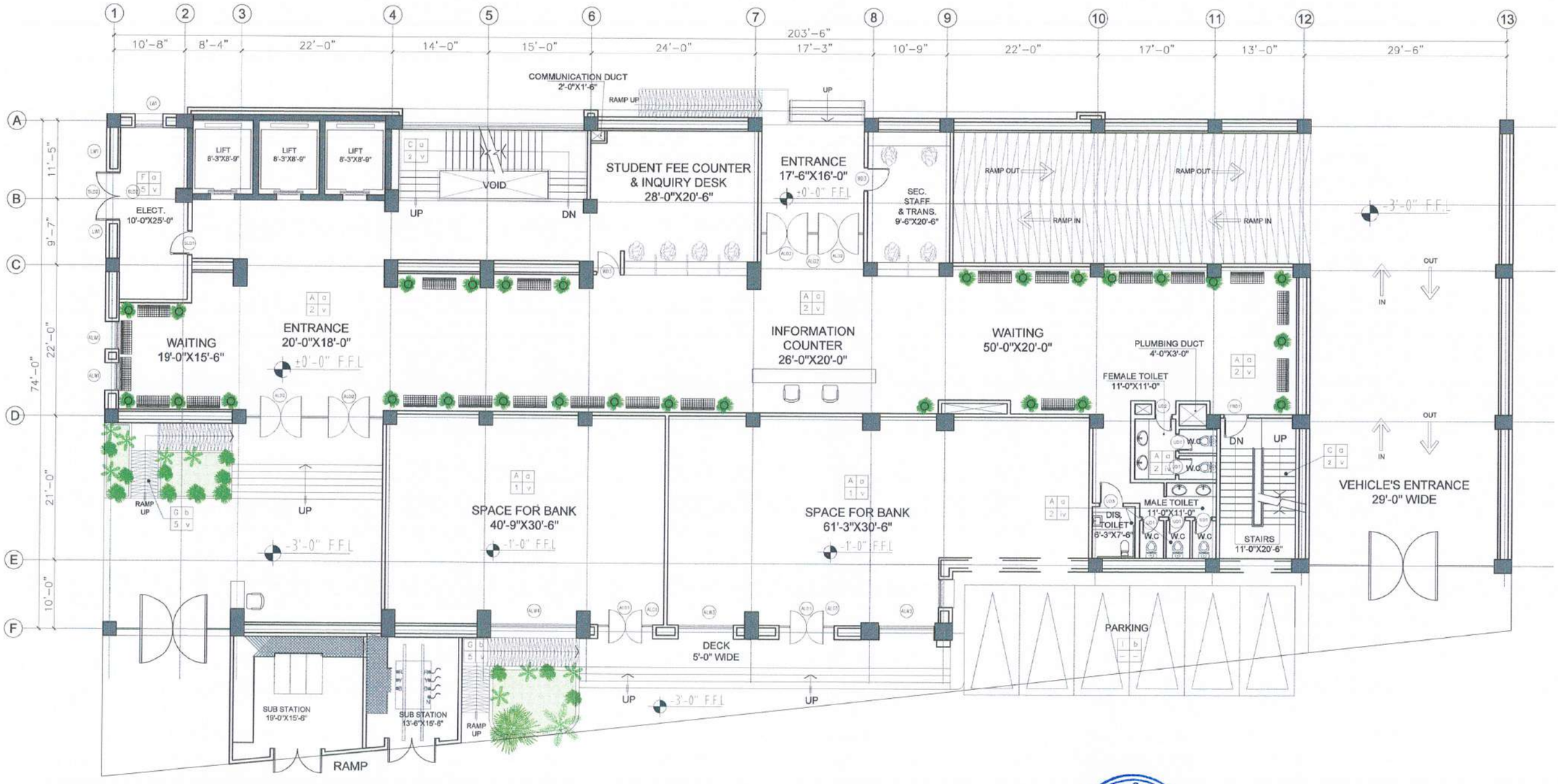
BASEMENT PLAN-2

CARS PARKING 26

TOTAL CARS PARKING B1 +B2 = 52

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	BASEMENT PLAN -2		
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B002		
SCALE	N.T.S		
REV.	0		



GROUND FLOOR PLAN
MAIN ENTRANCE

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	GROUND FLOOR PLAN		
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B003		
SCALE	N.T.S		
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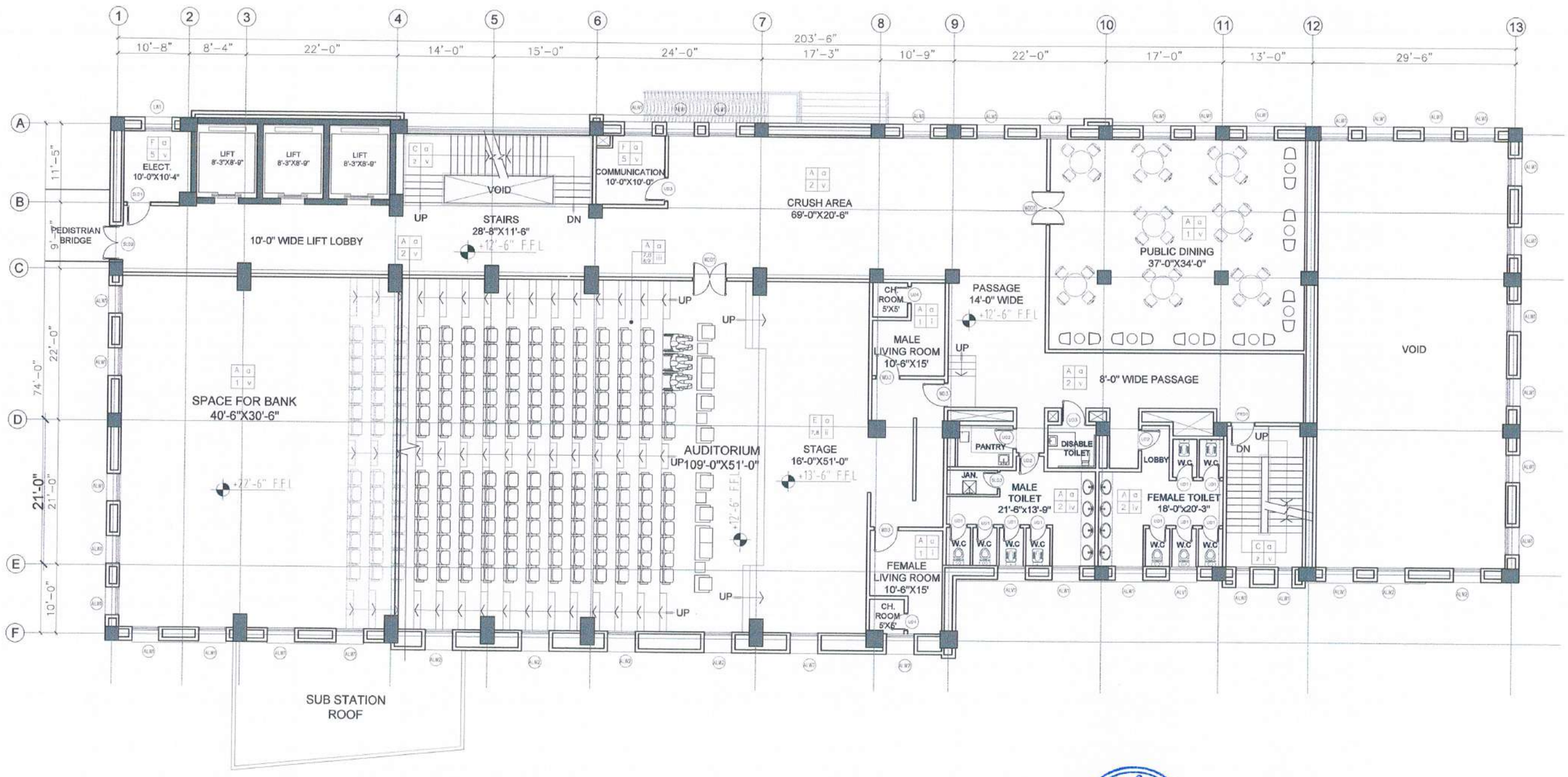
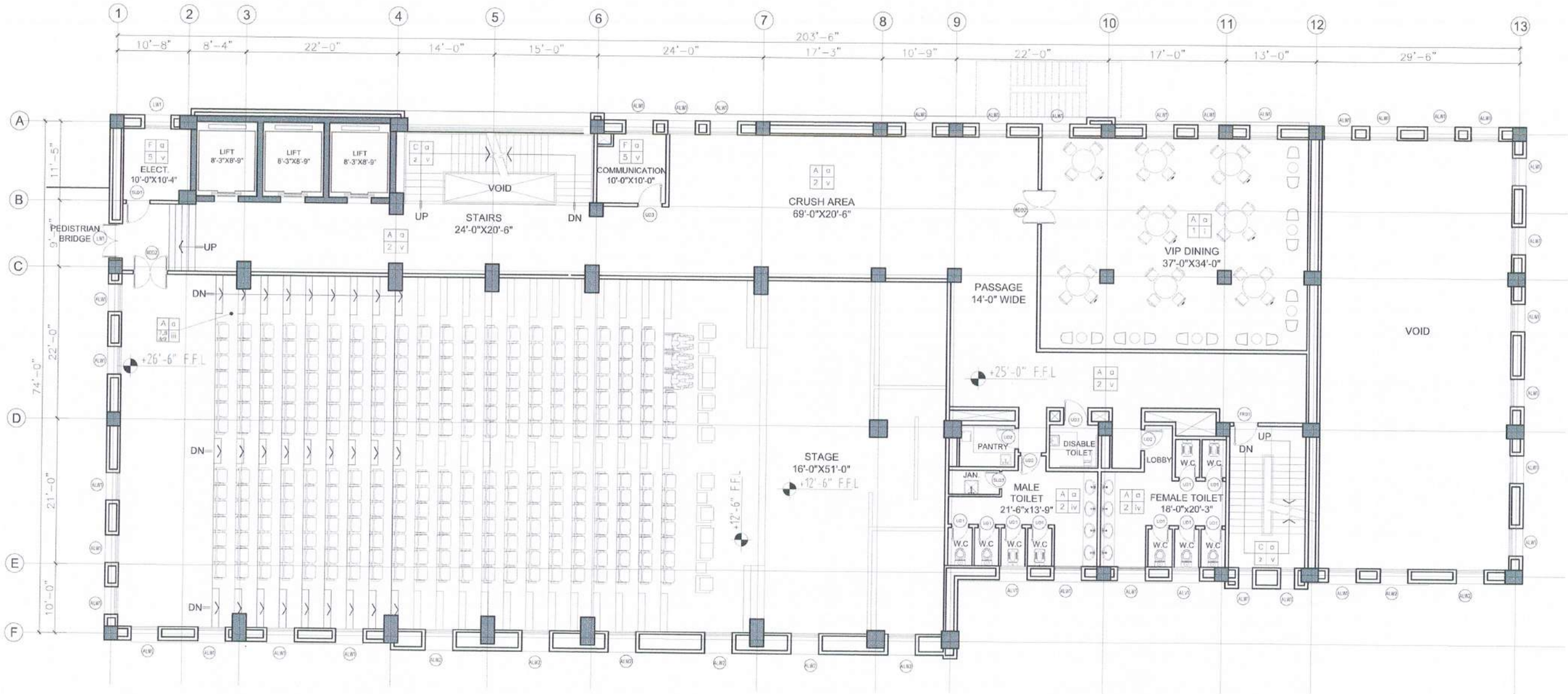


1ST FLOOR PLAN

VIP DINE AND AUDITORIUM

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
1ST FLOOR PLAN			
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B004		
SCALE	N.T.S		
REV.	0		



MEZZANINE FLOOR PLAN
ADMIN AND ACADEMIC

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04 03 02 01 REV. DATE DESCRIPTION APPROVED	DRAWN SUBMITTED RECOMMENDED CHD./VER. APPROVED
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING	MEZZANINE	SCALE: N.T.S
		DATE: MARCH , 2026	DRAWING No.: 4596/08/TD/B004-a
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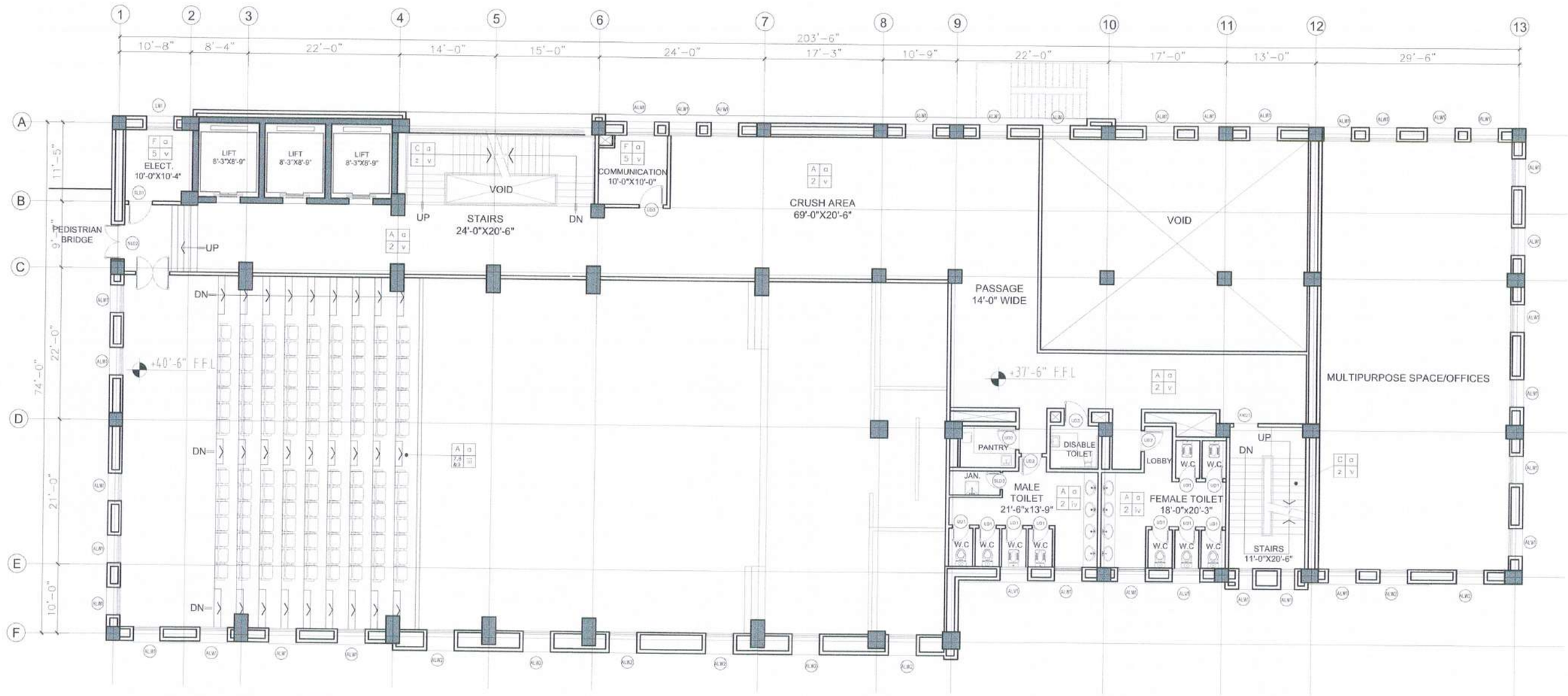

AUDITORIUM GALLERY
ADMIN AND ACADEMIC

National Engineering Services Pakistan Ltd.
A & P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV.	DATE / DESCRIPTION	APPROVED	APPROVED
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	AUDITORIUM GALLERY		
DATE	MARCH , 2026	DRAWING No.	4596/08/TD/B004-b
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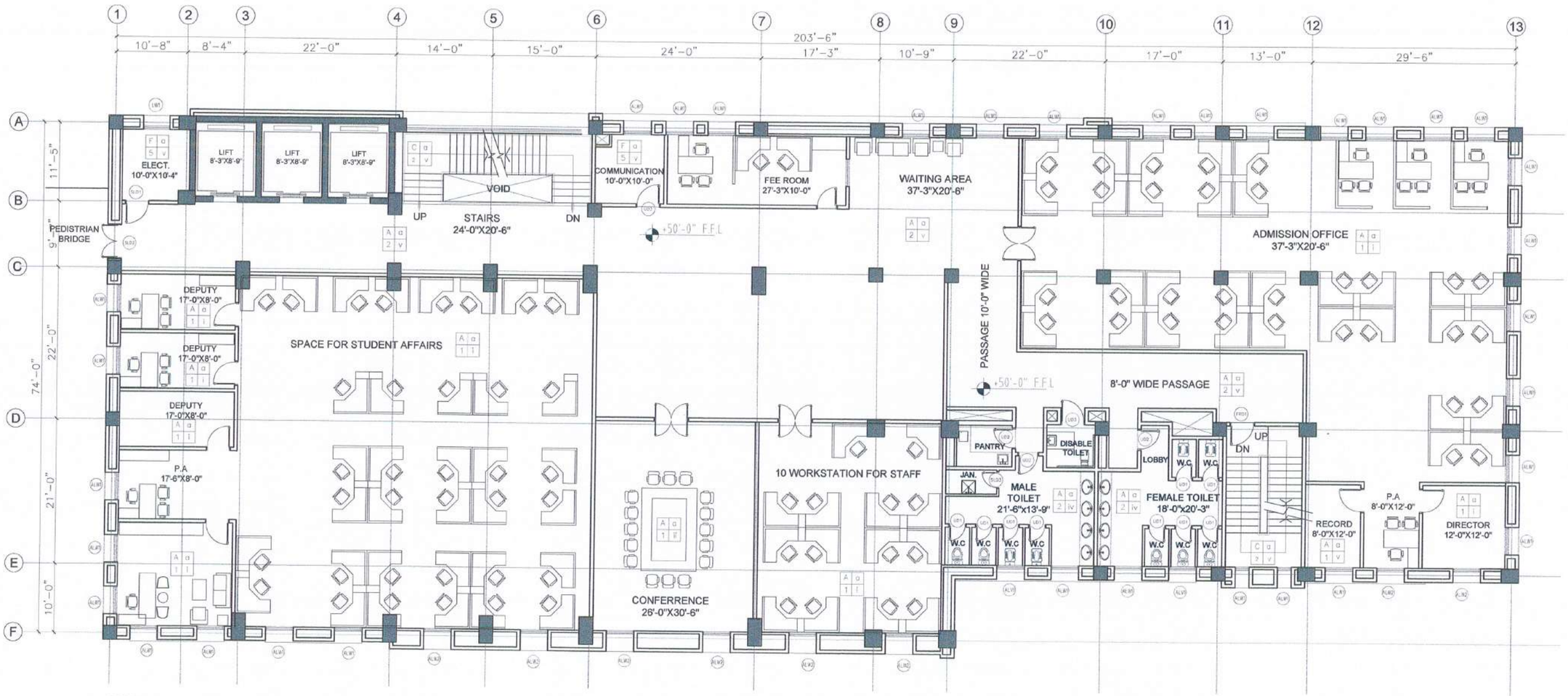

2ND FLOOR PLAN
ADMIN AND ACADEMIC

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV.	DATE / DESCRIPTION	APPROVED	APPROVED
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
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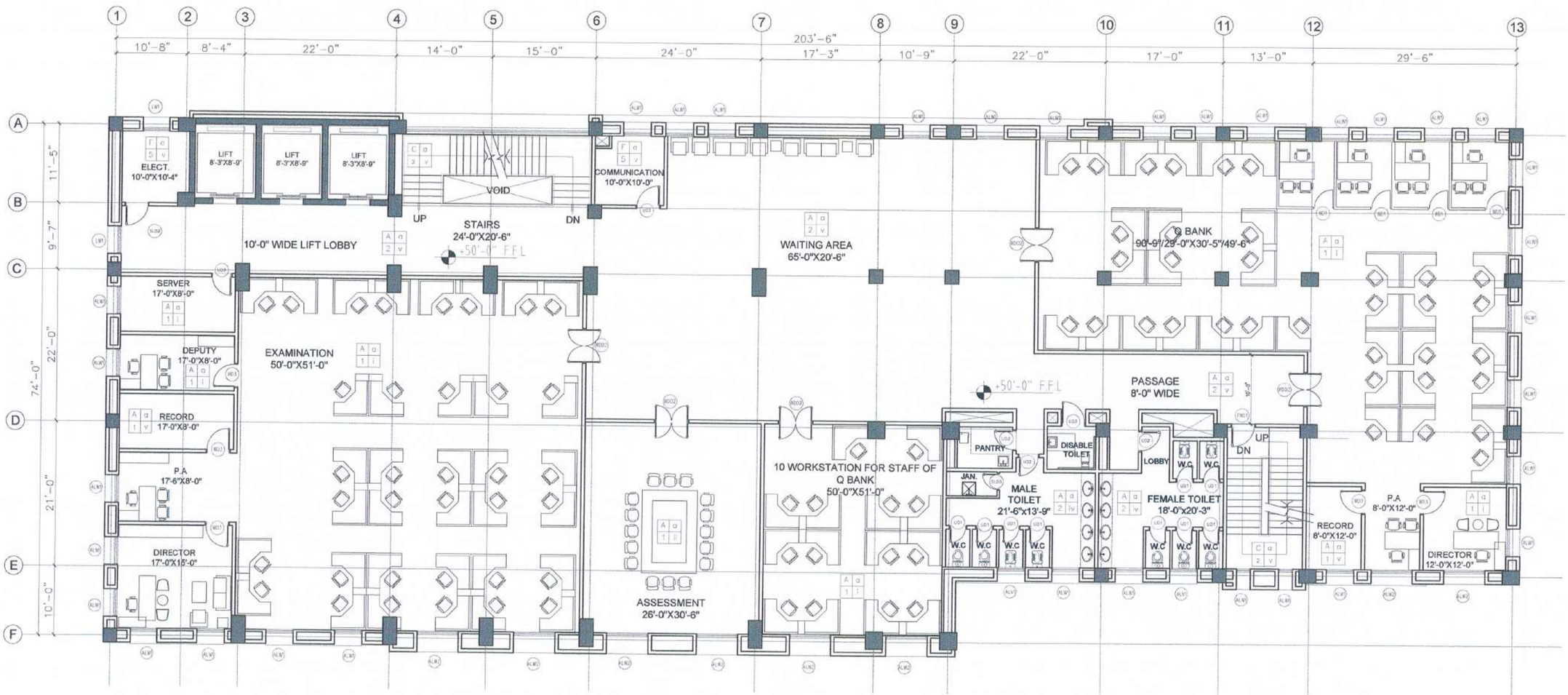
DATE	FEBRUARY, 2026	DRAWING No.	4596/08/TD/B005
SCALE	N.T.S	REV.	0



3RD FLOOR PLAN
Q. BANK/EXAMINATION

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV.	DATE / DESCRIPTION	APPROVED	APPROVED
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	3RD FLOOR PLAN		
DATE	FEBRUARY, 2026	DRAWING No.	4596/08/TD/B006
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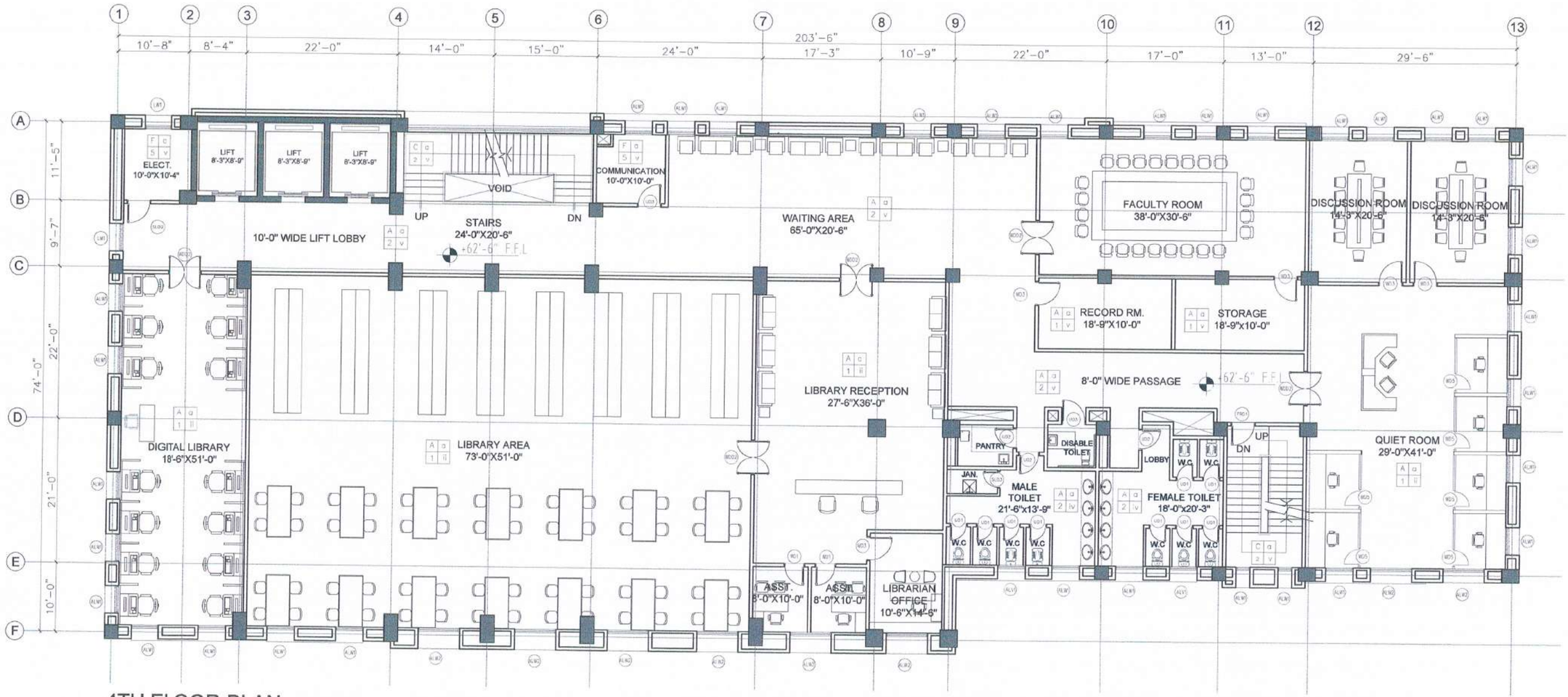

4TH FLOOR PLAN
LIBRARY

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34	PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING
		04	DRAWN		4TH FLOOR PLAN
		03	SUBMITTED	DATE: FEBRUARY, 2026	DRAWING No.: 4596/08/TD/B007
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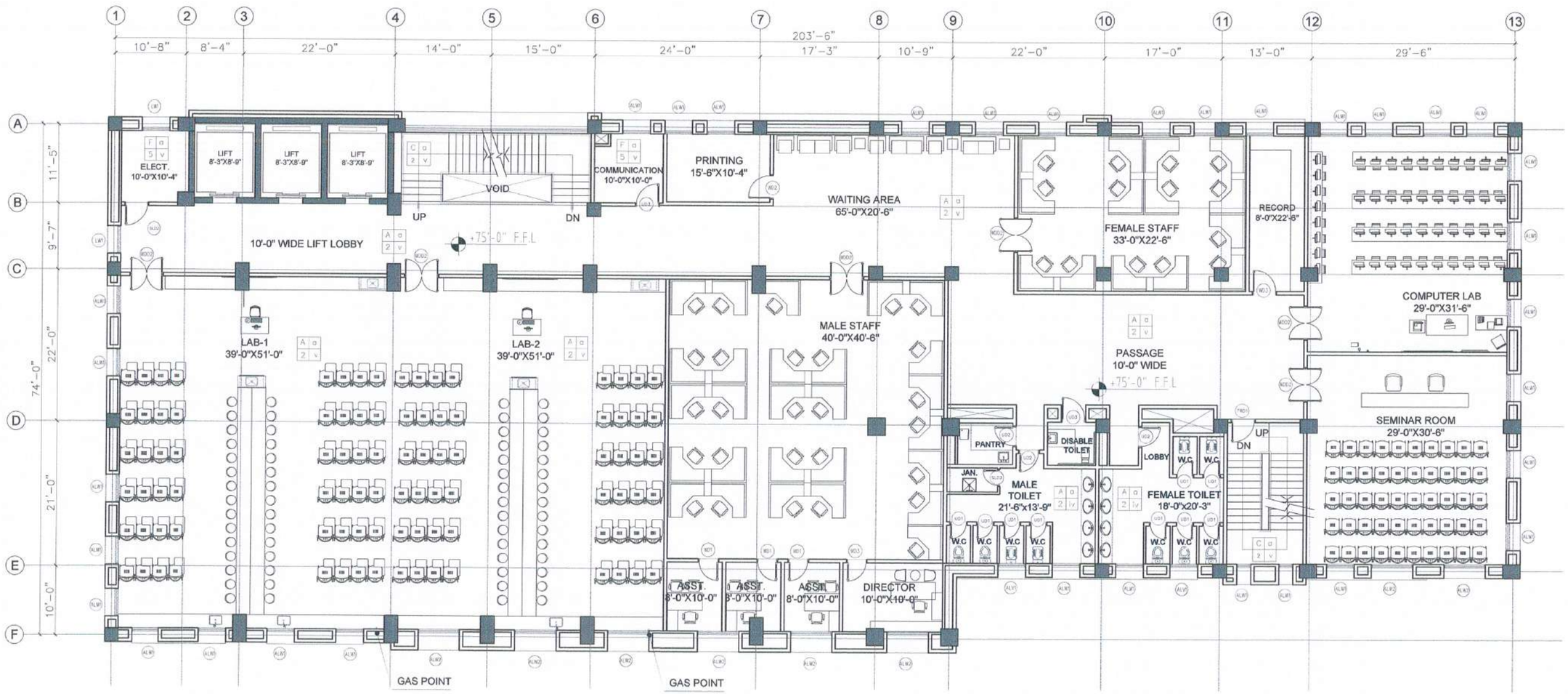
		01	CHD./VER.		
		REV. / DATE / DESCRIPTION / APPROVED	APPROVED		



5TH FLOOR PLAN
DPT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
5TH FLOOR PLAN			
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B008		
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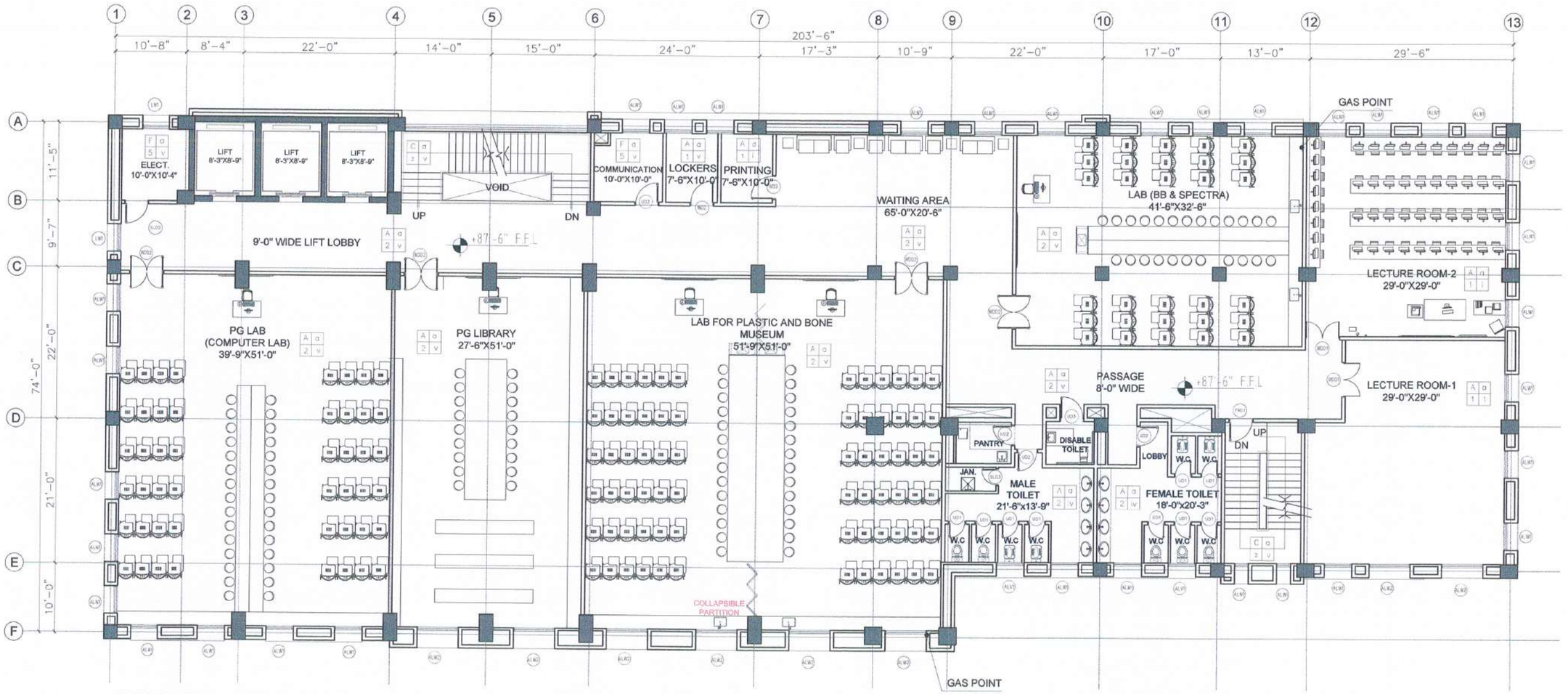

6TH FLOOR PLAN
LABS AND TUTORIAL ROOMS

National Engineering Services Pakistan (Pvt.) Ltd.
A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
6TH FLOOR PLAN			
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B009		
SCALE	N.T.S		
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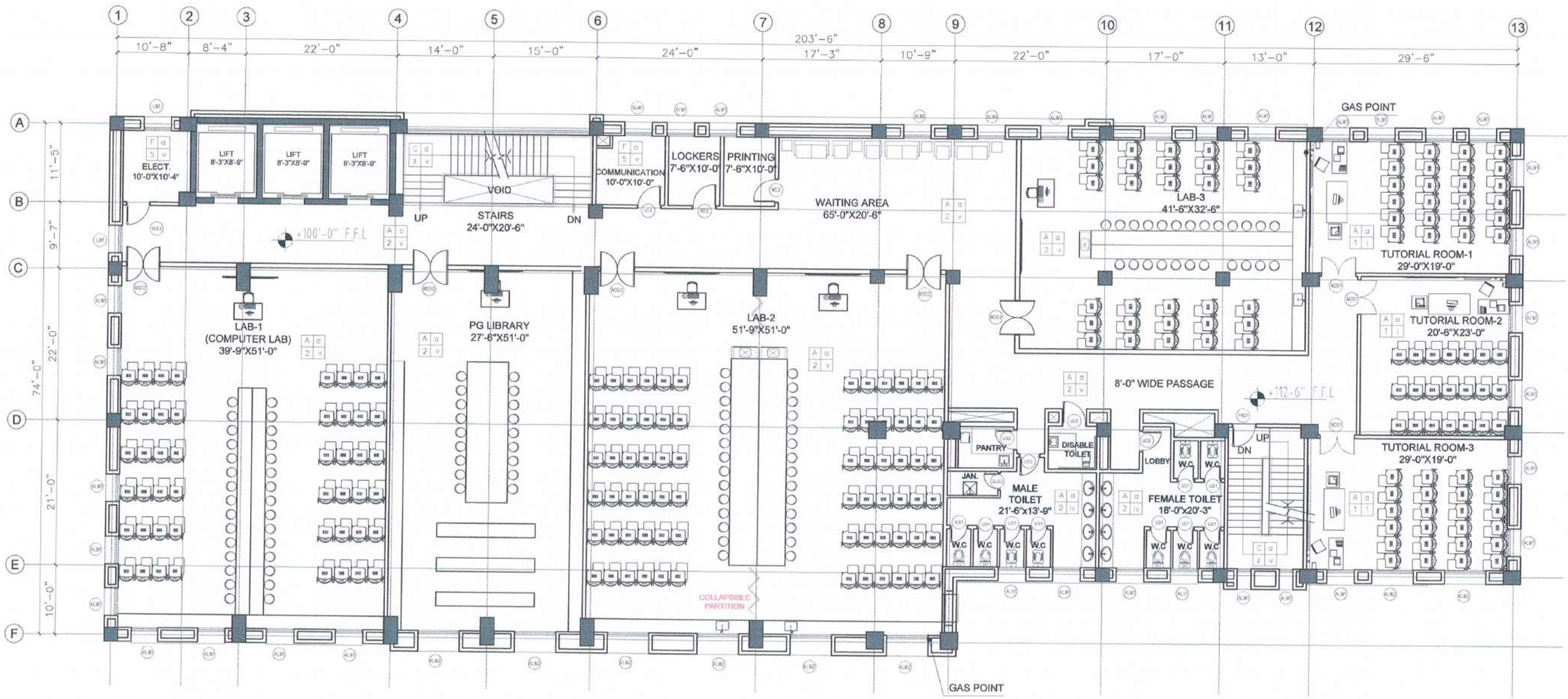

7TH,8TH AND 9TH FLOOR PLANS ARE TYPICAL
LABS AND LECTURE ROOMS

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV.	DATE / DESCRIPTION / APPROVED	APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	7TH FLOOR PLAN		
DATE	FEBRUARY, 2026		
DRAWING No.	4596/08/TD/B010		
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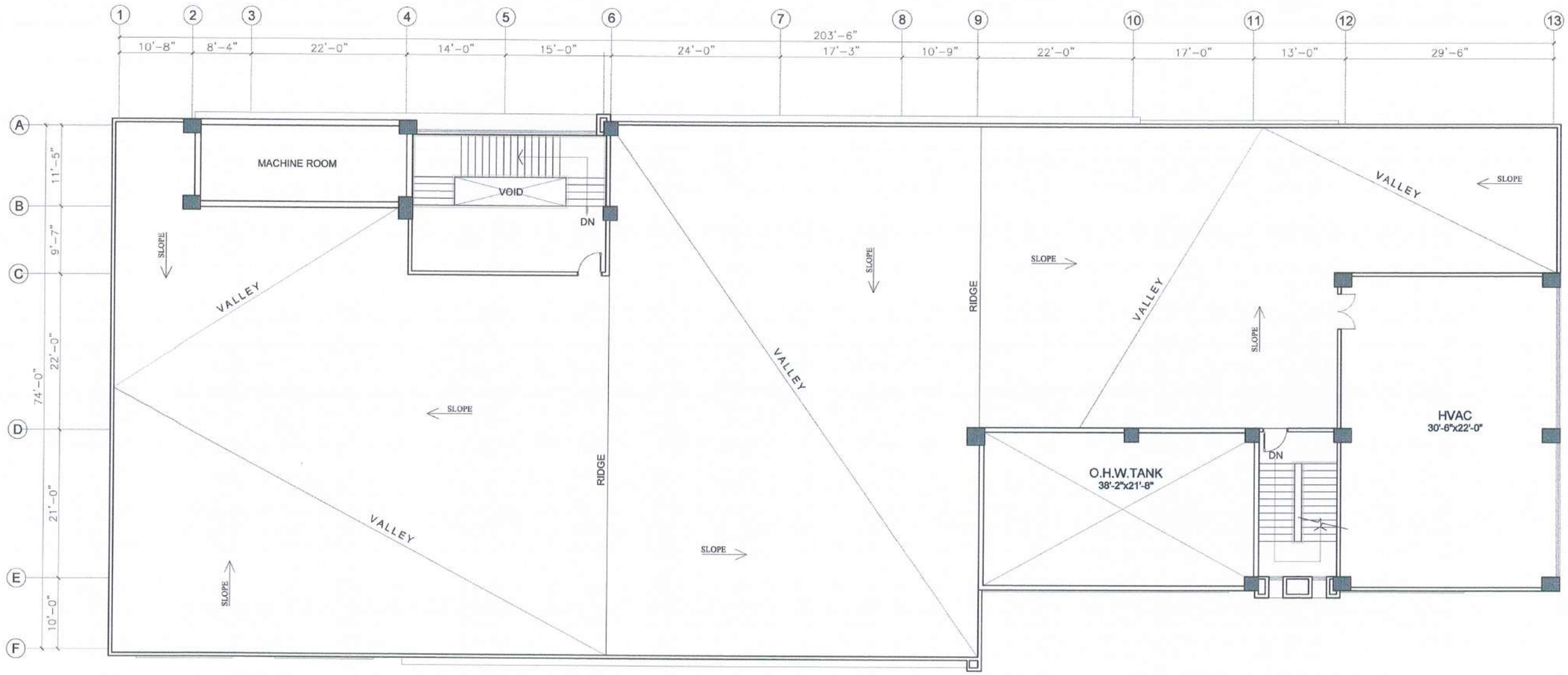

SERVICES MUMMTY

Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34	04 / 03 / 02 / 01	DRAWN / SUBMITTED / RECOMMENDED / CHD./VER. / APPROVED	PROJECT: JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING	ROOF PLAN
		REV. / DATE / DESCRIPTION / APPROVED		DATE: FEBRUARY, 2026	DRAWING No.: 4596/08/TD/B011
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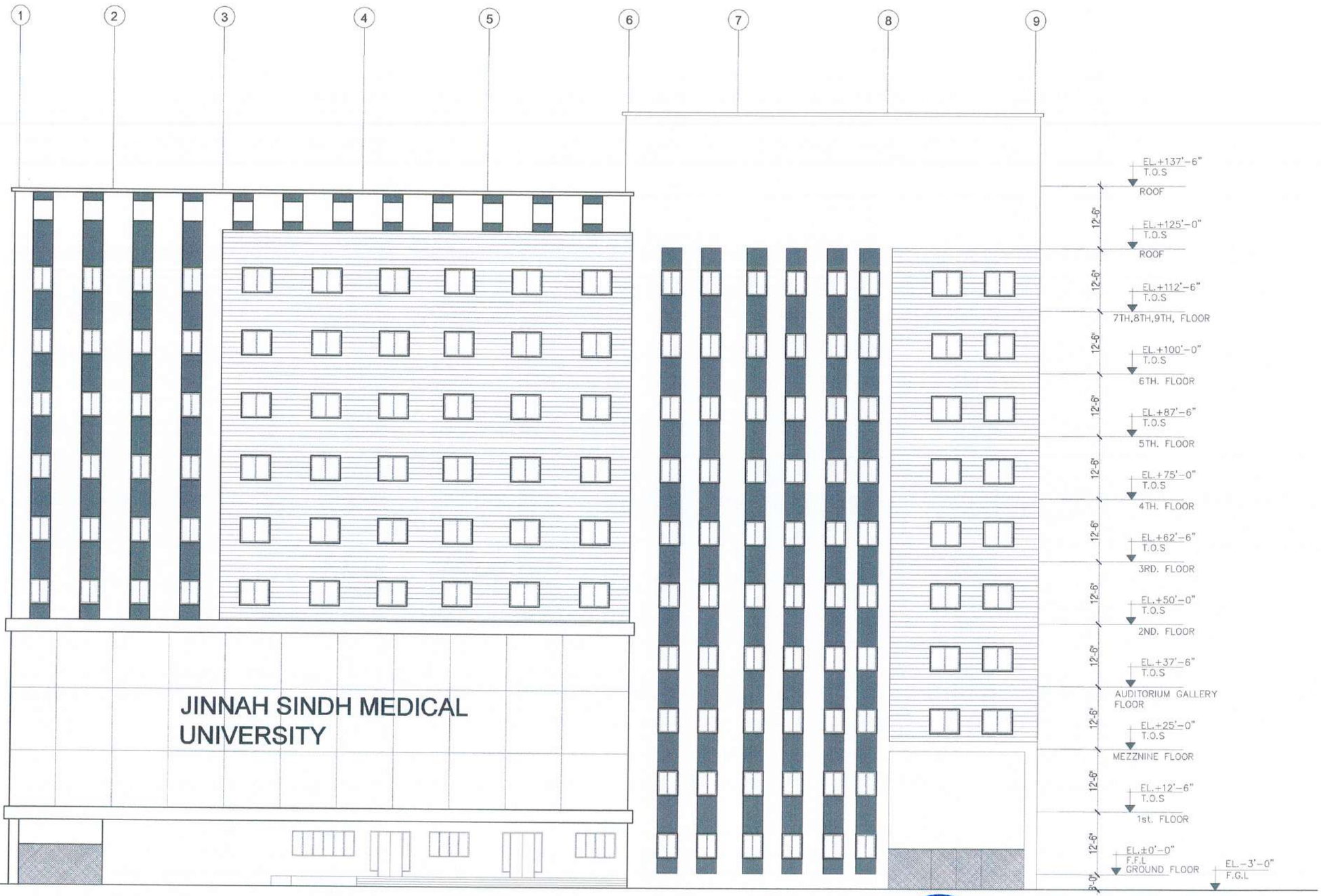
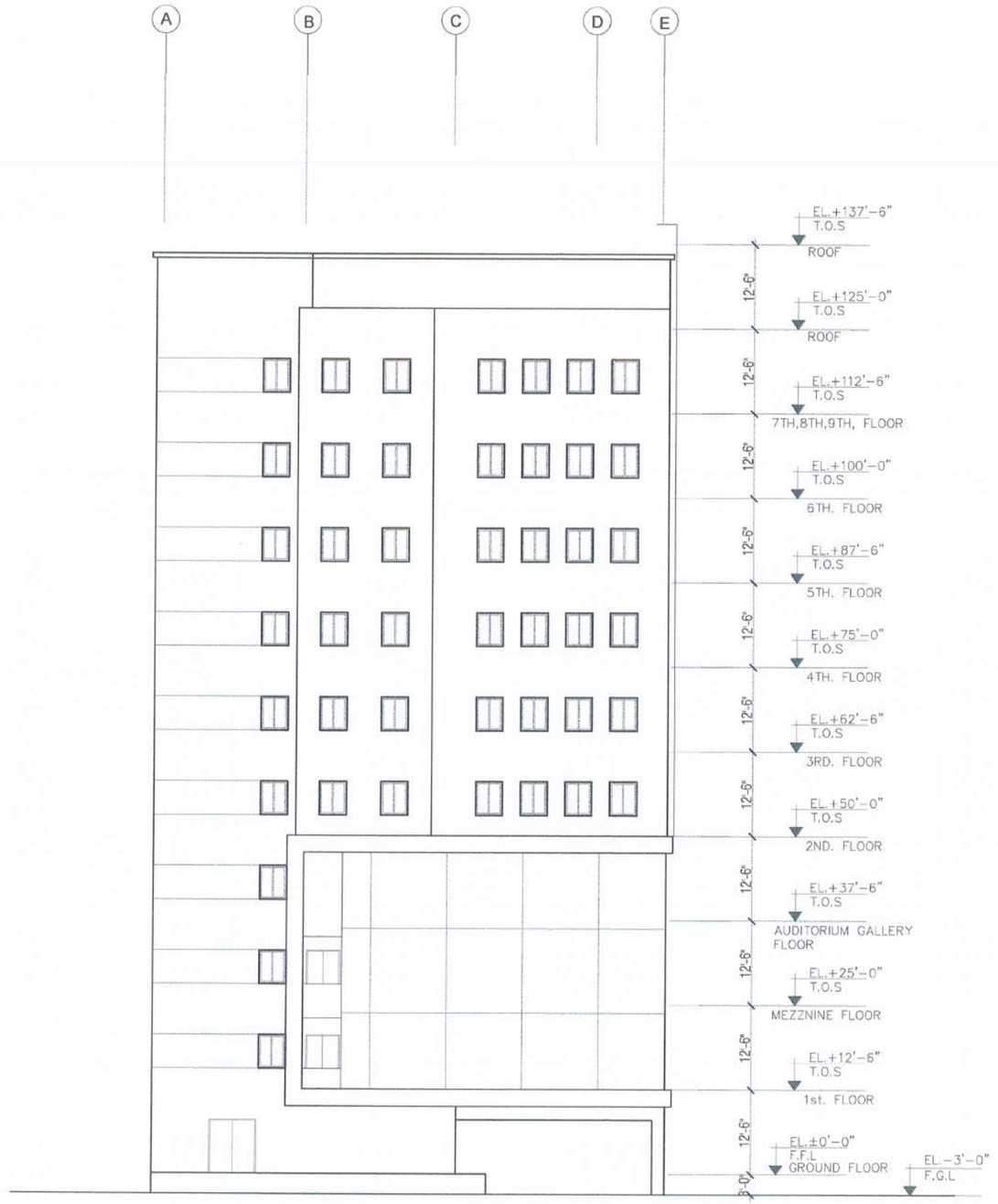


ELEVAITON - 1

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	ELEVATION - 1	SCALE	N.T.S
DATE	FEBRUARY, 2026	DRAWING No.	4596/08/TD/B014
		REV.	0



ELEVAITON - 2

Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VERI.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	ELEVATION - 2	SCALE	N.T.S
DATE	FEBRUARY, 2026	DRAWING No.	4596/08/TD/B015
REV.	0		

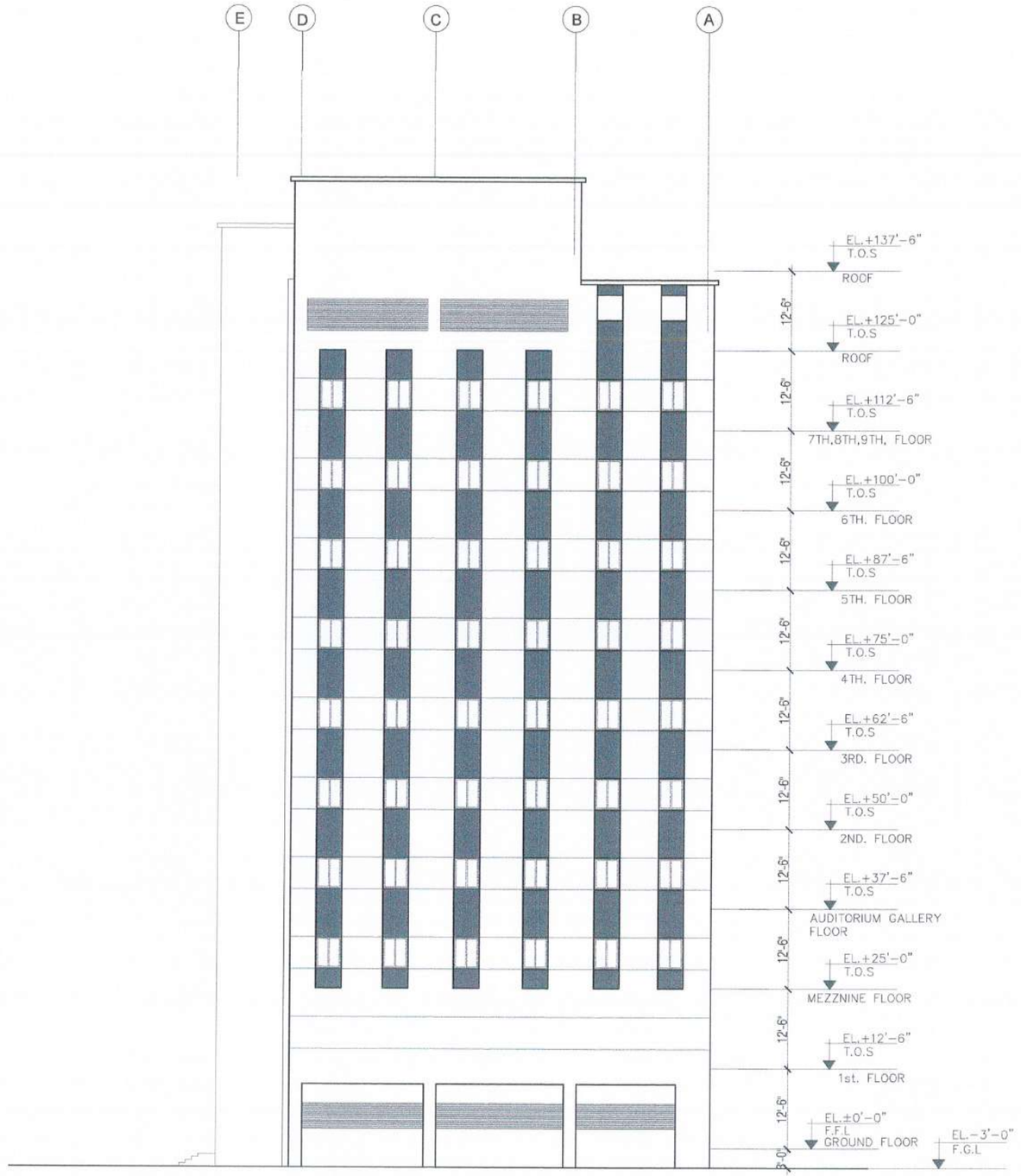
ELEVAITON - 3

Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING	
	ELEVATION - 3	
DATE	FEBRUARY, 2026	
DRAWING No.	4596/08/TD/B016	
SCALE	N.T.S	
REV.	0	

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

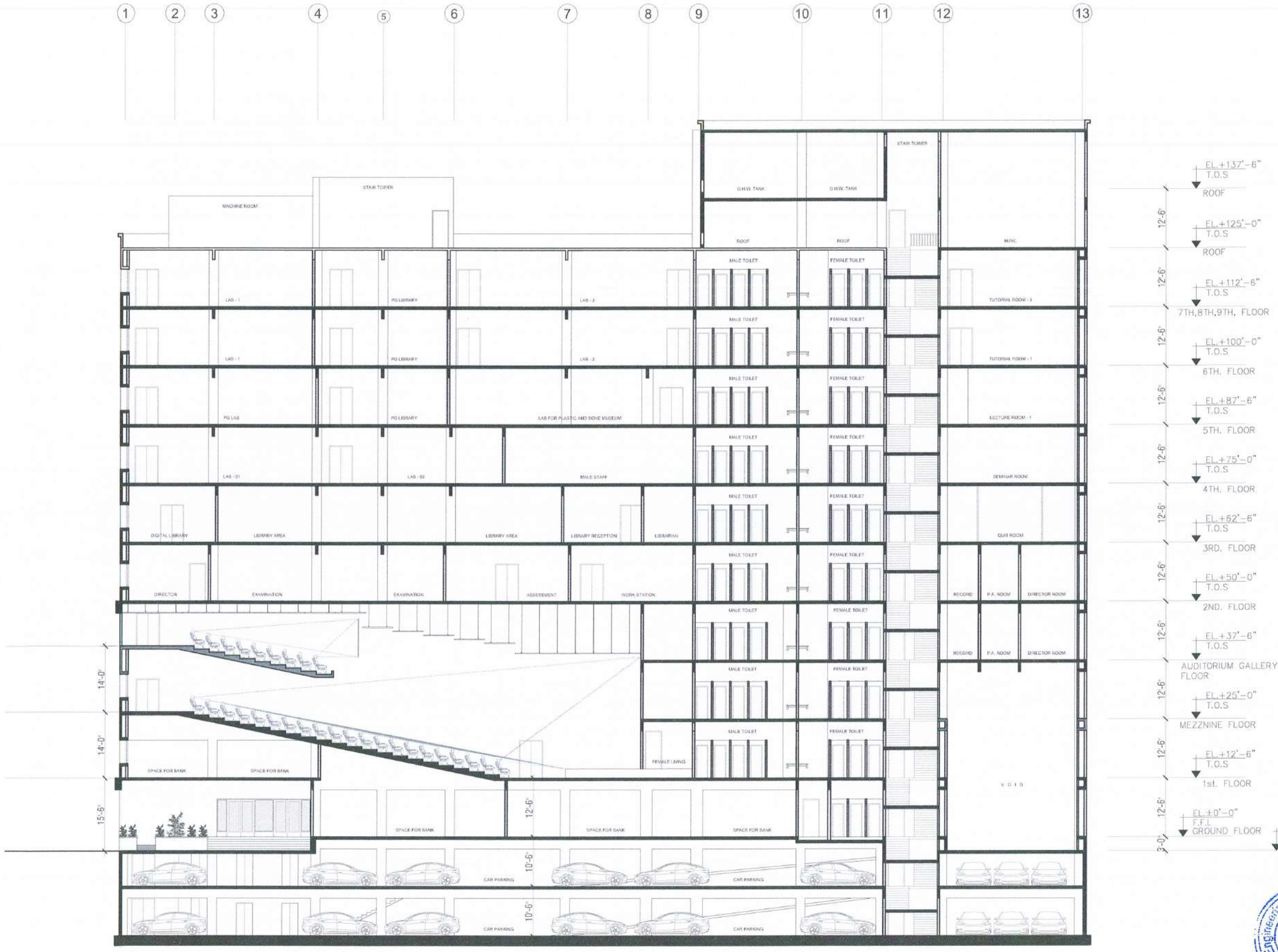
DRAWN
SUBMITTED
RECOMMENDED
CHD./VER.
APPROVED



ELEVAITON - 4

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

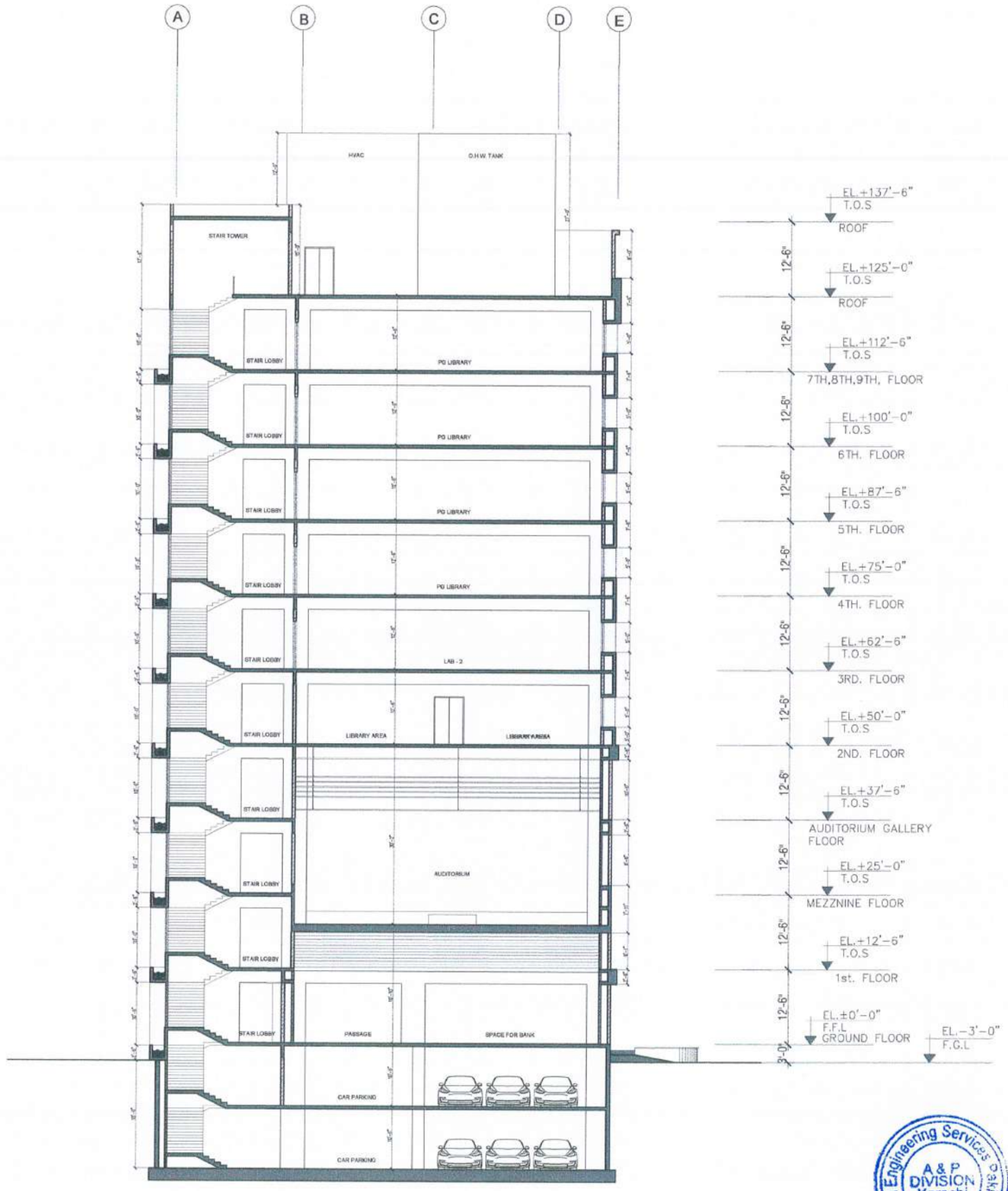
CLIENT	JINNAH SINDH MEDICAL UNIVERSITY		
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34		
04		DRAWN	
03		SUBMITTED	
02		RECOMMENDED	
01		CHD./VER.	
REV. / DATE / DESCRIPTION / APPROVED		APPROVED	
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING		
	ELEVATION - 4		
DATE	FEBRUARY, 2026	DRAWING No.	4596/08/TD/B017
SCALE	N.T.S	REV.	0



SECTION - AA

National Engineering Services Pakistan Ltd. A&P Division Karachi

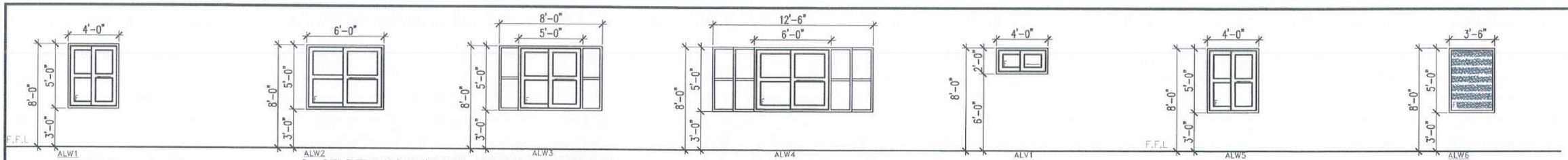
CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34		SECTION - AA
04	DRAWN	DATE	MARCH , 2026
03	SUBMITTED	DRAWING No.	4596/08/TD/B018
02	RECOMMENDED	SCALE	N.T.S
01	CHD./VER.	REV.	0
REV. DATE DESCRIPTION APPROVED	APPROVED		



SECTION - BB

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34	04		DRAWN	
		03		SUBMITTED	
		02		RECOMMENDED	
		01		CHD./VER.	
		REV. / DATE / DESCRIPTION	APPROVED	APPROVED	
PROJECT: JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING	SECTION - BB			SCALE: N.T.S	
	DATE: FEBRUARY, 2026	DRAWING No.: 4596/08/TD/B019		REV.: 0	



ALW1

5mm THICK TINTED GLASS (BELGIUM) GLAZED, SLIDING WINDOW WITH FLY NET PANEL ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALW2

5mm THICK TINTED GLASS (BELGIUM) GLAZED, SLIDING WINDOW WITH FLY NET PANEL ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALW3

5mm THICK TINTED GLASS (BELGIUM) GLAZED, SLIDING WINDOW WITH FLY NET PANEL ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALW4

5mm THICK TINTED GLASS (BELGIUM) GLAZED, SLIDING WINDOW WITH FLY NET PANEL ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALV1

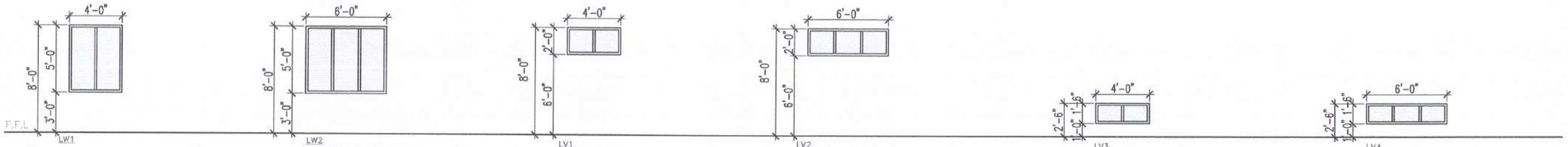
5mm THICK TINTED GLASS (BELGIUM) GLAZED, SLIDING VENTILATOR WITH FLY NET PANEL ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALW5

5mm THICK CLEAR GLASS (BELGIUM) GLAZED, SLIDING WINDOW ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALW6

5mm THICK CLEAR GLASS (BELGIUM) GLAZED, SLIDING WINDOW ON ANODIZED ALUM. (BRONZE) FRAME WITH FROSTED GLASS FILM INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.



LW1

$\frac{3}{4}$"X$\frac{3}{4}$"X$\frac{1}{16}$" THICK 16 SWG STEEL LOUVER WINDOW ON 2" THK. HOLLOW METAL FRAME FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

LW2

$\frac{3}{4}$"X$\frac{3}{4}$"X$\frac{1}{16}$" THICK 16 SWG STEEL LOUVER WINDOW ON 2" THK. HOLLOW METAL FRAME FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

LV1

$\frac{3}{4}$"X$\frac{3}{4}$"X$\frac{1}{16}$" THICK 16 SWG STEEL LOUVER VENTILATOR ON 2" THK. HOLLOW METAL FRAME FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

LV2

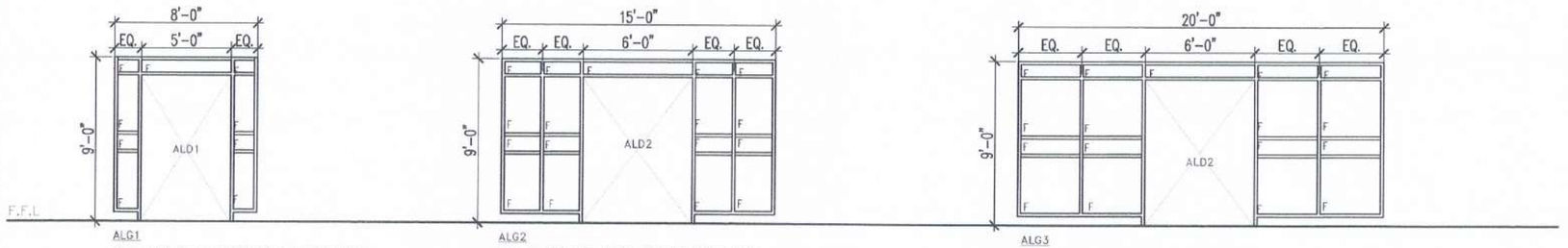
$\frac{3}{4}$"X$\frac{3}{4}$"X$\frac{1}{16}$" THICK 16 SWG STEEL LOUVER VENTILATOR ON 2" THK. HOLLOW METAL FRAME FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

LV3

$\frac{3}{4}$"X$\frac{3}{4}$"X$\frac{1}{16}$" THICK 16 SWG STEEL LOUVER VENTILATOR ON 2" THK. HOLLOW METAL FRAME FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

LV4

$\frac{3}{4}$"X$\frac{3}{4}$"X$\frac{1}{16}$" THICK 16 SWG STEEL LOUVER VENTILATOR ON 2" THK. HOLLOW METAL FRAME FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.



ALG1

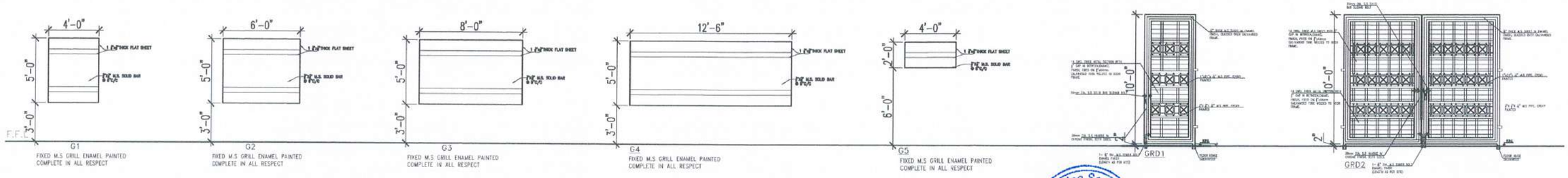
12mm THICK SINGLE GLAZED CLEAR TEMPERED GLASS (BELGIUM) SCREEN ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALG2

12mm THICK SINGLE GLAZED CLEAR TEMPERED GLASS (BELGIUM) SCREEN ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.

ALG3

12mm THICK SINGLE GLAZED CLEAR TEMPERED GLASS (BELGIUM) SCREEN ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING ,COMPATIBLE HARDWARE SET COMPLETE.



G1

FIXED M.S GRILL ENAMEL PAINTED COMPLETE IN ALL RESPECT

G2

FIXED M.S GRILL ENAMEL PAINTED COMPLETE IN ALL RESPECT

G3

FIXED M.S GRILL ENAMEL PAINTED COMPLETE IN ALL RESPECT

G4

FIXED M.S GRILL ENAMEL PAINTED COMPLETE IN ALL RESPECT

G5

FIXED M.S GRILL ENAMEL PAINTED COMPLETE IN ALL RESPECT

GRD1

M.S GRILL DOOR SINGLE LEAF SINGLE SWING WITH RUST PROOFING AND ENAMEL PAINT INCLUDING GRILLS COMPLETE IN ALL RESPECT

GRD2

M.S GRILL DOOR DOUBLE LEAF SINGLE SWING WITH RUST PROOFING AND ENAMEL PAINT INCLUDING GRILLS COMPLETE IN ALL RESPECT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT

JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.

ARCHITECTURE & PLANNING DIVISION KARACHI.
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	
SUBMITTED	
RECOMMENDED	
CHD./VER.	
APPROVED	

PROJECT

JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

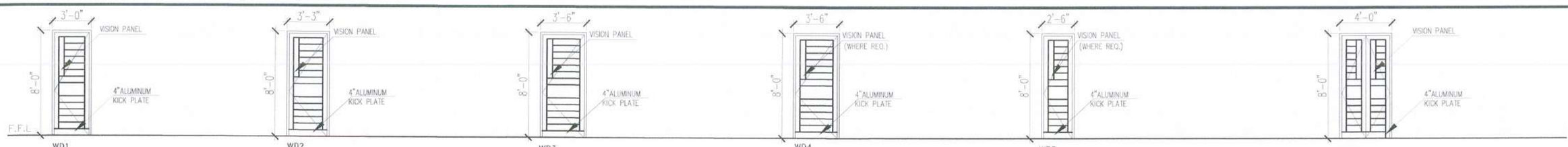
SCHEDULE OF DOORS & WINDOWS-1

SCALE: N.T.S

DATE: FEBRUARY, 2026

DRAWING No.: 4596/08/TD/ B018

REV.: 0



WD1

WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

NOTE:ALL 16 SWG METAL RUST PROOF FRAMES ARE IN M.S ENAMEL PAINT IN MATCHED COLOR ALL HARDWARE IN STAINLESS STEEL.

WD2

WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

WD3

WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

WD4

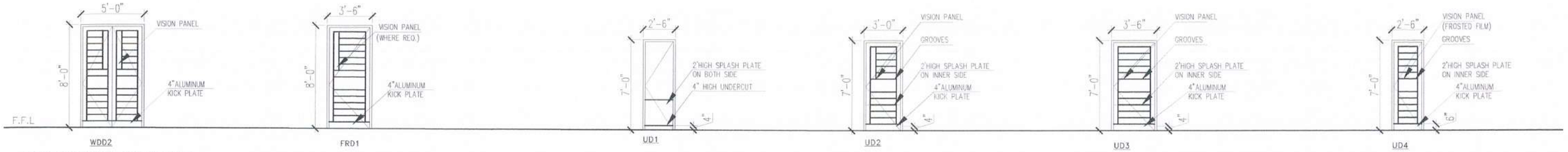
WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

WD5

WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

WDD1

WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).



WDD2

WOODEN ENGINEERED DOORS CONSISTING OF SOLID CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE SHUTTERS CONSISTING OF 2" THICK 4" WIDE FRAME OF RED MERANTI WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH WITH WIRED GLASS VIEW PANEL, ETC. COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

FRD1

FIRE RATED DOOR (2HRS) AS PER NFPA STANDARD INCLUDING ALL OTHER ACCESSORIES, HARDWARE'S & PAINTING AS PER MANUFACTURE RECOMMENDATION, COMPLETE IN ALL RESPECTS AND/OR AS DIRECTED BY THE ENGINEER.

UD1

SINGLE SWING.SINGLE LEAF UPVC DOOR ON UPVC FRAME. COMPLETE IN ALL RESPECT. AS PER APPROVED MANUFACTURER SPECIFICATIONS (SAMPLE APPROVED PRIOR TO THE EXECUTION OF WORKS).

UD2

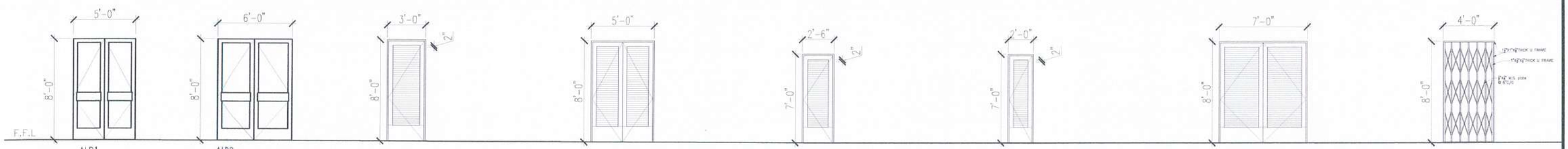
SINGLE SWING.SINGLE LEAF UPVC DOOR ON UPVC FRAME. COMPLETE IN ALL RESPECT. AS PER APPROVED MANUFACTURER SPECIFICATIONS (SAMPLE APPROVED PRIOR TO THE EXECUTION OF WORKS).

UD3

SINGLE SWING.SINGLE LEAF UPVC DOOR ON UPVC FRAME. COMPLETE IN ALL RESPECT. AS PER APPROVED MANUFACTURER SPECIFICATIONS (SAMPLE APPROVED PRIOR TO THE EXECUTION OF WORKS).

UD4

SINGLE SWING.SINGLE LEAF UPVC DOOR ON UPVC FRAME. COMPLETE IN ALL RESPECT. AS PER APPROVED MANUFACTURER SPECIFICATIONS (SAMPLE APPROVED PRIOR TO THE EXECUTION OF WORKS).



ALD1

12mm THICK CLEAR TEMPERED GLASS (BELGIUM) DOUBLE LEAF,DOUBLE SWING GLAZED PIVOT DOOR WITH MACHINE ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING,COMPATIBLE HARDWARE SET COMPLETE.

ALD2

12mm THICK CLEAR TEMPERED GLASS (BELGIUM) DOUBLE LEAF,DOUBLE SWING GLAZED PIVOT DOOR WITH MACHINE ON ANODIZED ALUM. (BRONZE) FRAME INCLUDING,COMPATIBLE HARDWARE SET COMPLETE.

SLD1

1-1/4"X1-1/4"X1/8" THICK 16 SWG STEEL LOUVERE SINGLE LEAF,SINGLE SWING DOOR ON 2" THK. HOLLOW METAL FRAME, FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

SLD2

1-1/4"X1-1/4"X1/8" THICK 16 SWG STEEL LOUVERE SINGLE LEAF,SINGLE SWING DOOR ON 2" THK. HOLLOW METAL FRAME, FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

SLD3

1-1/4"X1-1/4"X1/8" THICK 16 SWG STEEL LOUVERE SINGLE LEAF,SINGLE SWING DOOR ON 2" THK. HOLLOW METAL FRAME, FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

SLD4

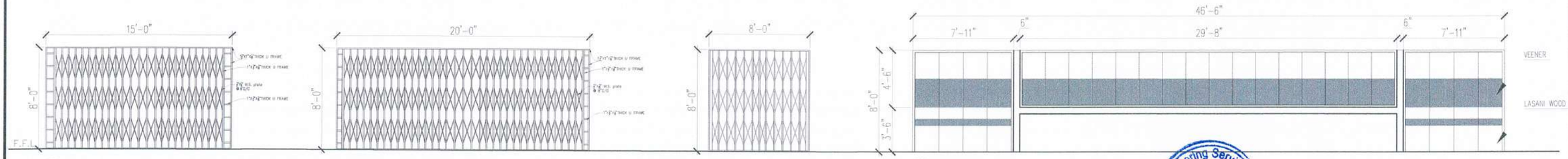
1-1/4"X1-1/4"X1/8" THICK 16 SWG STEEL LOUVERE SINGLE LEAF,SINGLE SWING DOOR ON 2" THK. HOLLOW METAL FRAME, FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

SLD5

1-1/4"X1-1/4"X1/8" THICK 16 SWG STEEL LOUVERE DOUBLE LEAF,SINGLE SWING DOOR ON 2" THK. HOLLOW METAL FRAME, FINISHED IN RUST PROOF PRIMER AND ENAMEL PAINT COMPLETE IN ALL RESPECT.

CD1

M.S RUST PROOF ENAMEL PAINTED COLLAPSIBLE GRILL DOOR WITH WHEEL CHANNEL AND FRAME COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).



CD2

M.S RUST PROOF ENAMEL PAINTED COLLAPSIBLE GRILL DOOR WITH WHEEL CHANNEL AND FRAME COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

CD3

M.S RUST PROOF ENAMEL PAINTED COLLAPSIBLE GRILL DOOR WITH WHEEL CHANNEL AND FRAME COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

CD4

M.S RUST PROOF ENAMEL PAINTED COLLAPSIBLE GRILL DOOR WITH WHEEL CHANNEL AND FRAME COMPLETE IN ALL RESPECTS AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

FD1

2" THICK WOODEN FOLDABLE PARTITION MADE OF CORE COMMERCIAL PLYWOOD WITH 3MM THICK APPROVED VENEER ON BOTH SIDES WITH GROOVE AND LASANI WOOD WOOD FILLING WITH MDF APPROVED QUALITY 10 MM LIPPING IN LACQUERED FINISH 2" THICK AND 4" WIDE METAL FRAME ETC. COMPLETE IN ALL RESPECTS. (U CHANNEL AND HINGES ETC) AS SHOWN ON DRAWINGS / SPECIFICATIONS AND / OR AS DIRECTED BY THE ARCHITECT / ENGINEER (SAMPLE APPROVED BY THE ARCHITECT / ENGINEER).

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT

JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.

ARCHITECTURE & PLANNING DIVISION KARACHI.
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			DRAWN
03			SUBMITTED
02			RECOMMENDED
01			CHD./VER.
			APPROVED

PROJECT

JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

SCHEDULE OF DOORS & WINDOWS-2

DATE: MARCH , 2026

DRAWING No.: 4596/08/TD/ B019

SCALE: N.T.S

REV.: 0

1. GENERAL

1. READ ALL DRAWINGS IN CONJUNCTION WITH ARCHITECTURAL, GEOTECHNICAL, PLUMBING, MECHANICAL, ELECTRICAL & ANY OTHER RELEVANT DRAWINGS.
2. NOTES GIVEN IN THIS DRAWING ARE APPLICABLE TO ALL DRAWINGS UNLESS MENTIONED OTHERWISE. NOTES WRITTEN ON A DRAWING, SHALL BE APPLICABLE TO THAT PARTICULAR DRAWING ONLY UNLESS OTHERWISE CROSS-REFERRED.
3. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE SPECIFICATIONS OF THE CONTRACT DOCUMENTS. IN ABSENCE OF ANY SPECIFICATIONS , ALL MATERIALS & WORKMANSHIP SHALL CONFORM TO RELEVANT ACI/BRITISH CODES AND SHALL BE SUBJECTED TO APPROVAL OF THE ENGINEER.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY OF THE STRUCTURES DURING CONSTRUCTION. HE SHALL ALSO VERIFY ALL DIMENSIONS AND LEVELS BEFORE EXECUTION OF WORK. ANY DISCREPANCY, ERROR OR OMISSION, IF FOUND, SHALL BE BROUGHT TO THE NOTICE OF THE ENGINEER FOR CORRECTION AND APPROVAL.
5. THE CONTRACTOR SHALL CO-ORDINATE WITH VARIOUS SERVICES DRAWINGS FOR SIZES & LOCATION OF ALL STRUCTURAL MEMBERS, FLOORS,WALLS,OPENINGS, FLOOR FINISHES, PIPES ETC.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE EXECUTION OF DEWATERING SYSTEM WHERE SO REQUIRED DURING CONSTRUCTION.
7. ALL DIMENSIONS AND LEVELS ARE IN FEET & INCHES.
8. DO NOT SCALE THE DRAWINGS. DIMENSIONS, GIVEN ON THE DRAWING, SHALL GOVERN.
9. ALL FABRICATION, PAINTING, ERECTION AND QUALITY CONTROL IS TO BE DONE IN ACCORDANCE WITH THE LATEST APPLICABLE ACI/BRITISH SPECIFICATIONS.
10. BACKFILLING AROUND FOUNDATIONS AND WALLS SHALL BE WELL COMPACTED LAYERS NOT EXCEEDING 6 INCHES IN THICKNESS.
11. IT IS STRONGLY RECOMMENDED TO RECONFIRM THE SITE PLAN BEFORE START OF EXECUTION AT SITE.THE SITE SHOULD BE EXAMINED FOR CLEARANCE WITH RESPECT TO LOCAL/SEISMIC HAZARDS.
12. THE CONTRACTOR SHALL INFORM THE ENGINEER ABOUT ANTICIPATED CONSTRUCTION LOADS IN THE STRUCTURE AND OBTAIN ENGINEER'S APPROVAL THEREOF BEFORE COMMENCING THE WORK.
13. THE CONTRACTOR SHALL VERIFY LAYOUT, CONFIGURATION, ALL DIMENSIONS AND LEVELS PERTAINING TO EXISTING WORKS BEFORE PROCEEDING WITH THE WORK. THE CONTRACTOR SHALL ADOPT ADEQUATE AND APPROPRIATE MEASURES SO AS NOT TO DAMAGE THE EXISTING WORKS.
14. THE CONTRACTOR SHALL EXERCISE UTMOST CARE AND PRECAUTION DURING THE WORKS, AGAINST ANY MISHAPS OR ACCIDENTS, FOR WHICH THE CONTRACTOR SHALL BE WHOLLY AND SOLELY RESPONSIBLE. THE CONTRACTOR SHALL INDEMNIFY THE OWNER AGAINST ANY ACCIDENTS AND ANY LOSSES THEREFROM AND SHALL REPAIR AND RECTIFY THEM AT HIS OWN COST AND TIME.
15. ANY DEPARTURES/DEVIATIONS DESIRED FROM THE DESIGN OR SPECIFICATIONS, OR SOLUTIONS TO ANY PROBLEMS ENCOUNTERED, SHALL BE GOT APPROVED FROM THE ENGINEER PRIOR TO IMPLEMENTATION. UNAPPROVED DEPARTURES/DEVIATIONS MAY LEAD TO REJECTION/REPLACEMENT OF THE ENTIRE WORK AT THE CONTRACTOR'S COST.
16. THE CONTRACTOR SHALL PREPARE AND SUBMIT SHOP DRAWINGS AND BAR BENDING SCHEDULES FOR ENGINEER'S APPROVAL AND OBTAIN HIS APPROVAL BEFORE PROCEEDING WITH THE WORK. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE ACCURACY OF SHOP DRAWINGS AND BAR BENDING SCHEDULES. THE ENGINEER'S APPROVAL SHALL NOT RELIEVE THE CONTRACTOR FROM HIS RESPONSIBILITY.

2. FOUNDATIONS

1. FOUNDATION IS DESIGNED FOR MINIMUM GROSS ALLOWABLE BEARING CAPACITY OF 220 kPa AND IS APPLICABLE FOR (B.C) OF 220 kPa AT 10 METERS DEPTH FROM EXISTING NATURAL GROUND LEVEL. THIS VALUE SHOULD BE VERIFIED BY CONTRACTOR BEFORE PLACEMENT OF FOUNDATION. IF THE ACTUAL BEARING CAPACITY IS FOUND DIFFERENT, FOUNDATION DESIGN SHOULD BE REVIEWED BY THE ENGINEER.
2. TOTAL TOLERABLE SETTLEMENT FOR THE FOUNDATIONS WILL BE 2 INCHES.
3. AFTER EXCAVATION TO F.B.L. ALL FOUNDATIONS SHOULD BE PHYSICALLY EXAMINED BY ENGINEERING GEOLOGIST/GEOTECHNICAL ENGINEER FOR THE CONFIRMATION OF ORIGINAL SOIL/ROCK CONDITIONS.
4. UNDER ANY CIRCUMSTANCES, FOUNDATIONS SHOULD NOT BE LAID UPON ANY TYPES/FORMS OF NATURAL FILL OR SLOPE WASH DEPOSITS.
5. IF THE ORIGINAL SOIL COMPRISES COHESIVE(CLAY-RICH) NON-GRAVELLY AND/OR SLIGHT TO MODERATELY GRAVELLY SOIL(GRAVEL<35%) WITH ABUNDANCE OF FINER(COHESIVE) MATRIX AT F.B.L., SUCH SOILS SHOULD BE REPLACED BY 3FT THICK CUSHION OF E.G.F. OF GRADATION APPROVED BY THE ENGINEER. E.G.F. SHOULD BE PLACED IN THREE EQUAL LAYERS OF 1FT COMPACTED THICKNESS. COMPACTION SHOULD BE CONFIRMED BY IN-SITU F.D.T. PRIOR TO PLACEMENT OF THE NEXT LAYER AND SHOULD NOT BE LESS THAN 95% OF MODIFIED AASHTO DENSITY. RECOMMENDED Q(NET ALLOWABLE) FOR THE DESIGN OF FOUNDATIONS ON SUCH E.G.F. SHOULD BE 0.75 T/SFT.
6. HOWEVER, IF SOUND BEDROCK CONDITIONS (WITH THE EXCEPTION OF SHALE & CLAYSTONE) ENCOUNTERED AT F.B.L., THE FOOTINGS SHOULD BE EXTENDED TO ENSURE 1.5FT EMBEDMENT DEPTH IN SOUND BEDROCK CONSIDERING Q(ALLOWABLE) 3.0QT/SFT.
7. DETAILED GEOTECHNICAL INVESTIGATIONS SHOULD BE CARRIED OUT IF BUILDING IS CLOSE TO A SLOPE, SLOPE STABILITY STUDIES TO BE CARRIED OUT AND APPROPRIATE MEASURES TO BE ADOPTED EVALUATION TO BE MADE AS TO PRESENCE OF FILLS,LIQUIFIABLE SOILS ETC.
8. ALL FOUNDATIONS SHALL BE PLACED ON FIRM BEARING STRATA.IF ACCEPTABLE BEARING STRATA IS NOT FOUND AT INDICATED DEPTHS OF FOUNDATION, THE ENGINEER SHALL NOTIFY IN WRITING FOR HIS INSTRUCTIONS.
9. THE BED OF FOUNDATION SHOULD BE THOROUGHLY COMPACTED PRIOR TO LAYING FOUNDATION. ANY LOOSE,WET,SOFT OR OVER-MOIST SOIL, ORGANIC SOILS, PEAT/FAT CLAY SHOULD BE REMOVED AND REPLACED WITH WELL-COMPACTED ENGINEERED GRANULAR FILL OF GRADATION APPROVED BY THE ENGINEER AND COMPACTED TO 95% MODIFIED AASHTO DENSITY.
10. THE FOUNDATION BED SOIL SHOULD BE PROTECTED FROM INGRESS OF MOISTURE FROM ANY SOURCE BY PROVIDING ADEQUATE SURFACE DRAINAGE SYSTEM AND ENSURING LEAK PROOF JOINTING OF SEWERAGE AND WATER SUPPLY LINES. EXCESSIVE AND UNCONTROLLED WATERING FOR CURING AND COMPACTION OF BACKFILL MATERIAL SHOULD BE AVOIDED.
11. ANY SPRINGS/SEEPS ENCOUNTERED NEAR OR AT THE FOUNDATION LEVEL WITHIN THE BUILDING FOOT PRINTS SHOULD BE ADDRESSED PROPERLY BY ADOPTING SUITABLE DE-WATERING MEASURES.
12. THE EXCAVATION LINES AND SLOPES ARE NOT SHOWN ON THE DRAWINGS. IT IS CONTRACTOR'S RESPONSIBILITY TO MAKE THE EXCAVATION ON STABLE SLOPE AND MAINTAIN THE STABILITY OF THE CUT SLOPES.
13. AS AND WHEN REQUIRED APPROPRIATE SLOPE PROTECTION SHOULD BE PROVIDED AROUND THE PROPOSED BUILDING.
14. IF NEAR SLOPE,THE STRUCTURE SHOULD BE SET BACK BY A MINIMUM DISTANCE EQUAL TO 3 TIMES OF THE FOUNDATION WIDTH.
15. TO ENSURE UNIFORM ENGINEERING BEHAVIOR OF SUB-GRADE, LITHOLOGIC HOMOGENEITY OF SUCH SOILS SHOULD BE CAREFULLY EXAMINED. ANY LARGE SIZE ROCK FRAGMENTS SUCH AS ERRATICS, BOULDERS, LARGE COBBLES AND ANY OTHER ROCK FRAGMENTS HAVING DIMENSIONS EXCEEDING 6 IN. SHOULD BE REMOVED UNDERNEATH THE FOUNDATIONS AND ITS CLOSE (<1.5 FT) VICINITY.
16. TERMITE CONTROL TREATMENT SHALL BE CARRIED OUT AS PER SPECIFICATIONS.
17. NO FOOTING SHALL BE PLACED ON FILL. HOWEVER, AREAS WHERE FILLING BELOW THE FOOTINGS BECOMES INEVITABLE OR, OVER-EXCAVATION, IF ANY, SHALL BE FILLED WITH ENGINEERED GRANULAR FILL AS PER GEOTECHNICAL RECOMMENDATIONS OR CONCRETE CLASS 'E'. ALL THIS TO BE DONE WITH PRIOR APPROVAL OF THE ENGINEER.
18. EXISTING UNDERGROUND SERVICES, REQUIRED TO BE LEFT IN POSITION, SHALL BE CAREFULLY PROTECTED DURING EXCAVATION AND BACKFILLING OPERATIONS.
19. EXCAVATIONS ADJACENT TO EXISTING STRUCTURES AND/OR UNDERGROUND SERVICES SHALL BE MADE BY HAND.

3. REINFORCED CONCRETE

1. STRUCTURAL DESIGN IS BASED ON THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE OF AMERICAN CONCRETE INSTITUTE (ACI 318-02).
2. ALL STRUCTURAL CONCRETE SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE (ACI) REQUIREMENTS.
3. CONCRETE MIX TO BE DESIGNED ON THE BASIS OF ACI 211 OR EQUIVALENT. TRIAL STRENGTH RESULTS TO BE SUBMITTED BY THE CONTRACTOR FOR REVIEW AND APPROVAL BEFORE CONCRETING.
4. NO CONCRETING SHALL BE CARRIED OUT UNTIL PERMISSION IS GIVEN IN WRITING.
5. ALL CONCRETE SHALL BE TESTED IN ACCORDANCE WITH ASTM STANDARDS C31, C39, C172 & AS WRITTEN IN SPECIFICATIONS AND THE MINIMUM CYLINDER CRUSHING STRENGTH OF CONCRETE AT 28 DAYS SHALL BE AS FOLLOWS. TESTING OF CLASS D & E CONCRETE SHALL BE PERFORMED IF SO DIRECTED BY THE ENGINEER.

CLASS	MIN. CYLINDER CRUSHING STRENGTH AT 28 DAYS (psi)
A	4,000
B	3,000
C	2,400
D	1,200
E	800

6. CLASS OF CONCRETE FOR DIFFERENT COMPONENTS OF THE STRUCTURE SHALL BE AS FOLLOWS UNLESS NOTED OTHER WISE:

COMPONENT	CONCRETE CLASS
FOUNDATION,COLUMNS & WALLS	CLASS 'A'
SLABS & BEAMS	CLASS 'A'
PCC STEPS	CLASS 'D'
LEAN / BLINDING CONCRETE	CLASS 'E'

7. ORDINARY PORTLAND CEMENT OR CEMENT AS PER PETRO-GRAPHIC ANALYSIS RECOMMENDATIONS SHALL BE USED FOR ALL CONCRETE WORKS.
8. AN INTEGRAL WATER PROOFING AGENT SHALL BE USED IN CONCRETE THAT IS CONSTANTLY OR INTERMITTENTLY IN CONTACT WITH WATER AS PER MANUFACTURER'S RECOMMENDATIONS (GENCON GENPRUF RMC OR PENETRON ADMIX OR EQUIVALENT).
9. WATER CEMENT RATIO FOR WATERTIGHT STRUCTURAL CONCRETE SHALL NOT EXCEED 0.45 AND 0.5 FOR ALL OTHER STRUCTURAL CONCRETE.
10. MINIMUM CEMENT CONTENT FOR STRUCTURAL CONCRETE SHALL NOT BE LESS THAN 356 Kg./cum. OF CONCRETE.
11. ALL DETAILING SHALL BE DONE AS PER ACI STANDARDS ACI-315, ACI-318 & ACI-350R.

4. SHORING AND BRACING

1. SHORE & BRACE ALL PARTS OF THE STRUCTURE DURING CONSTRUCTION, TO THE EXTENT NECESSARY TO ENSURE COMPLETE SAFETY, STRENGTH & SERVICEABILITY OF ALL STRUCTURAL ELEMENTS UNDER ALL CONDITIONS OF LOADS WHICH MAY OCCUR DURING CONSTRUCTION. SUCH SHORING & BRACING IS THE CONTRACTOR'S SOLE RESPONSIBILITY AND IS NOT SHOWN ON STRUCTURAL DRAWINGS OR SPECIFIED IN THE PROJECT.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY AND STABILITY OF THE SLOPES AND SHALL PROVIDE SHORING AND BRACING DURING EXCAVATION AND CONSTRUCTION, WHEREVER AND WHENEVER REQUIRED.
3. SEQUENCE OF REMOVAL OF FORMWORK SHALL BE APPROVED BY THE ENGINEER.
4. AT LEAST ONE LOWER FLOOR SHALL REMAIN PROPPED UNTIL THE UPPER FLOOR IS CAST AND CURED.

5. REINFORCING STEEL

1. ALL REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM-A615 GRADE 60 HAVING A MINIMUM YIELD STRENGTH OF 60,000 PSI. FOR STIRRUPS, TIES AND #3 BARS USE ASTM A615, GRADE 40 HAVING MINIMUM YIELD STRENGTH OF 40,000 PSI.
2. THE ACTUAL YIELD STRENGTH BASED ON MILL TESTS DOES NOT EXCEED THE SPECIFIED STRENGTH BY MORE THAN 18,000 PSI (RETESTS SHALL NOT EXCEED THIS VALUE BY MORE THAN AN ADDITIONAL 3000 PSI)
3. THE RATIO OF THE ACTUAL ULTIMATE TENSILE STRENGTH TO THE ACTUAL TENSILE YIELD STRENGTH IS NOT LESS THAN 1.25
4. CLEAR COVER TO REINFORCEMENT SHALL BE: (inches)

STRUCTURAL ELEMENT	COVER (INCHES)
FOOTINGS	2"
BEAMS	1½"
COLUMNS	1½"
SLABS	3/4"
BASEMENT WALLS	2" - EARTHSIDE FACE 3/4" - INNER FACE

5. DEVELOPMENT & SPLICE LENGTHS FOR FOUNDATIONS, BEAMS & SLABS (FOR fy=60 ksi and fc'= 3 ksi)

BAR DIA	#3*	#4	#5	#6	#7	#8
DEVELOPMENT LENGTH ℓ_d (inches) (BOTTOM BARS)	12	23	28	34	48	55
SPLICE LENGTH (Inches) (BOTTOM BARS)	16	30	37	44	63	72
DEVELOPMENT LENGTH ℓ_d (inches) (TOP BARS)	16	28	36	43	63	72
SPLICE LENGTH (Inches) (TOP BARS)	21	37	46	55	82	94

*-fy=40 ksi FOR #3 BAR.

6. DEVELOPMENT & SPLICE LENGTHS FOR COLUMNS (FOR fy=60 ksi and fc'= 3 ksi)

BAR DIA	#3*	#4	#5	#6	#7	#8
DEVELOPMENT LENGTH ℓ_d (Inches)	12	23	28	34	48	55
SPLICE LENGTH (Inches)	16	30	37	44	63	72

*-fy=40 ksi FOR #3 BAR.

- THE LOCATION OF LAPS SHOWN ARE INDICATED IN TYPICAL ELEVATIONS OF BEAMS & COLUMNS, AND MAY BE ELIMINATED.
- LAPS (IF REQUIRED.) SHALL BE PROVIDED AT LOCATION SHOWN ON THE TYPICAL ELEVATIONS USING MAXIMUM AVAILABLE LENGTH.
- SPLICE LENGTH = $1.3x\ell_d$
- WHERE TWO DIFFERENT DIAMETER BARS SPLICING WITH EACH OTHER, SPLICE LENGTH OF LARGER BAR DIAMETER SHALL BE PROVIDED.
- LAP SPLICE ARE NOT TO BE USED:
  - WITHIN JOINTS
  - WITHIN A DISTANCE OF TWICE THE MEMBER DEPTH FROM THE FACE OF THE JOINT.
- CURTAILMENT LENGTH SHOULD BE EXTEND UPTO L/16,12db OR d. (WHICHEVER GREATER) BEYOND L/3, WHERE:
  L=GREATER CLEAR SPAN, db=DIAMETER OF BAR,d=EFFECTIVE DEPTH
- THE FIRST HOOP SHALL BE LOCATED NOT MORE THAN 2" FROM THE FACE OF THE SUPPORTING MEMBER.

5. REINFORCING STEEL (CONTINUED)

1. ALL REINFORCING STEEL SHALL BE ACCURATELY LOCATED IN THE FORMS AND HELD FIRMLY IN PLACE BEFORE & DURING THE PLACEMENT OF CONCRETE, BY MEANS OF WIRE AND SUPPORTS ADEQUATE TO PREVENT DISPLACEMENT DURING THE COURSE OF CONSTRUCTION.
2. LINTELS ARE EXTENDED AT 9 (INCHES) FROM BOTH SIDES OF OPENING.
3. PROVIDE 135° HOOK IN ADJACENT STIRRUPS ON ALTERNATE SIDES.

6. CONCRETE CONSTRUCTION

1. ALL STRUCTURAL SURFACES, AGAINST WHICH EARTH IS TO BE FILLED, SHALL BE COATED WITH TWO COATS OF HOT BITUMEN OF 10/20 GRADE AT THE RATE OF 0.2 lbs/ft /coat.
2. PROVIDE POLYTHENE SHEET OVER TWO COATS OF HOT BITUMEN AT TOP OF PLINTH BEAM/DPC FOR EXTERIOR WALLS.
3. BEFORE CASTING OF ANY STRUCTURAL MEMBER, THE CONTRACTOR SHALL ENSURE THAT ALL EMBEDDED ITEMS FOR ELECTRICAL, MECHANICAL, HVAC, PLUMBING, STRUCTURAL STEEL AND OTHER WORKS ARE PROPERLY LOCATED AND FIRMLY SECURED IN PLACE.
4. DURING CONSTRUCTION, STACKING OF CONSTRUCTION MATERIALS, BLOCKS, etc. SHOULD BE AVOIDED ON SLAB PANELS.
5. UNLESS OTHERWISE NOTED IN PLANS OR SPECIFICATIONS, CAMBER ALL R.C.C. BEAMS AT LEAST ⅜" FOR EVERY 13'-0" OF CLEAR SPAN EXCEPT CANTILEVERS WHICH SHALL BE 2" FOR EVERY 10'-0" OF CLEAR SPAN OR AS APPROVED BY ENGINEER. ALL CAMBERING WORK SHOULD BE DONE WITH PRIOR APPROVAL OF ENGINEER.
6. UNLESS OTHERWISE NOTED IN PLANS OR SPECIFICATIONS, CAMBER ALL R.C.C. SLABS AT LEAST ⅜" PER 10'-0" OF SHORTER SPAN AND ⅜" FOR EVERY 6'-6" OF SLABS CANTILEVER SPAN OR AS APPROVED BY ENGINEER. ALL CAMBERING WORK SHOULD BE DONE WITH PRIOR APPROVAL OF ENGINEER.

7. SOLID BLOCK MASONRY WORK

1. ALL BLOCK WORK SHALL CONFORM TO SPECIFICATIONS GIVEN IN THE CONTRACT DOCUMENT.
2. ALL BLOCK SHALL BE SOUND, HARD, WELL FORMED AND OF UNIFORM SIZE, COLOUR AND TEXTURE. DIMENSIONAL VARIATION IN SIZES SHALL NOT EXCEED 1/8".
3. ALL BLOCK WORK SHALL BE ERECTED PLUMB AND TRUE TO LINE AND LEVEL. THE MAXIMUM VARIATION IN ANY STOREY HEIGHT OR ANY LENGTH OF WALL SHALL BE 1/8" IN 10'-0".
4. MORTAR USED IN MASONRY CONSTRUCTION SHALL HAVE AN CEMENT TO SAND RATIO OF NOT LESS THAN 1:5 AND SHALL CONFORM TO ASTM C270. COMPRESSIVE STRENGTH OF SOLID BLOCK MASONRY AVERAGE OF 5 UNITS AT 28 DAYS SHALL NOT BE LESS THAN AS SPECIFIED IN SPECIFICATIONS AND SHALL CONFORM TO ASTM C129.
5. ALL DESIGN, DETAILING, MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH RELEVANT ACI, ASTM, AND UBC CODES AND STANDARDS.
6. BEARING OF LINTELS SHALL BE 8" MINIMUM AT BOTH ENDS. (IF LINTEL BAND NOT PRESENT).
7. BLOCK SHOULD BE SOAKED WITH WATER PROPERLY BEFORE USE.
8. STAGGER VERTICAL JOINTS.
9. DON'T BUILD HIGHER THAN 4 FEET PER DAY.
10. COVER THE SURFACE OF MASONRY WITH HAISEN CLOTH AND CURE IT WITH WATER AT LEAST FOR ONE WEEK.
11. ALL MASONRY WALLS SHALL BE ANCHORED TO STRUCTURAL FRAME WORK AS INDICATED ON THE DRAWINGS.

8. CONSTRUCTION JOINTS

1. JOINTS, NOT SHOWN ON THE DRAWING, SHALL BE SO MADE AND LOCATED AS TO LEAST IMPAIR THE STRENGTH OF THE STRUCTURE AND SHALL NEED PRIOR APPROVAL OF THE ENGINEER. THEY SHALL BE LOCATED NEAR THE MIDDLE OF THE SPANS OF SLAB & BEAMS. JOINTS IN WALLS & COLUMNS SHALL BE AT THE UNDER-SIDE OF FLOORS, SLABS OR BEAMS AND AT THE TOP OF FOOTINGS OR FLOOR SLABS.
2. JOINTS SHALL BE PERPENDICULAR TO MAIN REINFORCEMENT. ALL REINFORCING STEEL SHALL BE CONTINUED ACROSS THE JOINTS.
3. JOINTS IN BASE SLAB & WALLS AND ROOF SLAB, IN ADDITION TO THOSE SHOWN ON THE DRAWINGS SHALL BE BORNE BY THE CONTRACTOR. BEAMS & BRACKETS SHALL BE PLACED AT THE SAME TIME AS SLABS.

9. ELECTRICAL CONDUITS

1. CONDUITS, FOR ELECTRICAL WORKS, SHALL BE PLACED WITHIN THE REINFORCED CONCRETE. THEY SHALL BE PLACED WITHIN THE MIDDLE THIRD OF THE SECTION IN BEAMS AND WITHIN THE MIDDLE HALF OF THE THICKNESS IN SLABS.SPACING BETWEEN PARALLEL CONDUITS SHALL NOT BE LESS THAN 6 INCHES.

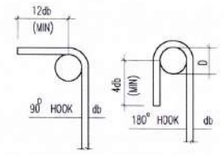
10. SEISMIC & LOADING PARAMETERS

1. THE FOLLOWING ARE SEISMIC PARAMETERS ASSUMED IN THE STRUCTURAL DESIGN (BCP-SP-2007)
   - SEISMIC ZONE FACTOR = ZONE 2B
   - WITH MAXIMUM PGA VALUE = 0.16g to 0.24g
   - SEISMIC ZONE FACTOR = 0.2
   - IMPORTANCE FACTOR (I) = 1.00
   - RW IN BOTH HORIZONTAL DIRECTIONS (RW) = 8.5 (FOR DUAL SYSTEMS)
   - SOIL PROFILE TYPE (STYP) = SC (VERY DENSE SOIL & SOFT ROCK)
   - CT VALUE = 0.020
2. THE FOLLOWING ARE LOADING PARAMETERS ASSUMED IN THE STRUCTURAL DESIGN (BCP-SP-2007)
   - WALL LOAD ON BEAMS (WHERE WALLS PRESENT AS PER ARCHI. = 1000 LBS/FT FOR 9" THICK BRICK MASONRY)
   - FLOOR FINISHES = 30 PSF
   - PARTITION LOADS = 20 PSF

   LIVE LOADS
   - PARKING AREA (CARS) = 50 PSF
   - WAITING AREAS = 80 PSF
   - CORRIDORS,STAIRS & LOBBY = 80 PSF
   - CORRIDORS & STAIRS ABOVE FIRST FLOOR = 80 PSF
   - OFFICES/STORES/EXAM HALL = 50 PSF
   - LABORATORIES/LIBRARY = 150 PSF
   - ROOF LIVE LOAD = 20 PSF
3. NO OTHER LOADS THAN MENTIONED ABOVE INCLUDING ACCIDENTAL HAVE BEEN CONSIDERED IN DESIGN.
4. STRUCTURE HAS BEEN DESIGNED FOR TWO BASEMENTS, GROUND PLUS NINE STORIES AS PER ARCHITECTURAL DESIGN WITH NO PROVISION OF ADDITIONAL STORIES.

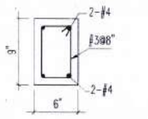
LEGEND

MS	MILD STEEL
PVC	POLYVINYL CHLORIDE
C.G.I	CORRUGATED GALVANIZED IRON
G.I	GALVANIZED IRON
SQ	SQUARE
C.J	CONSTRUCTION JOINT
T&B	TOP AND BOTTOM
EF	EACH FACE
BF	BOTH FACES
ϕ/db/#	DIAMETER OF BAR
@	AT THE RATE OF
B	BOTTOM
C/C	CENTER TO CENTER
B.W	BOTHWAYS
E.L.	STRUCTURAL ELEVATION
EQ.	EQUAL
F.F.L	FINISH FLOOR LEVEL
F.G.L	FINISH GROUND LEVEL
F.B.L.	FOUNDATION BED LEVEL
N.S.L.	EXISTING NATURAL SURFACE LEVEL
N.T.S.	NOT TO SCALE
ST.	STIRRUPS
T	TOP
TYP.	TYPICAL
U.N.O	UNLESS NOTED OTHERWISE
N.T.S.	NOT TO SCALE
	LEVEL ON PLAN
℄	CENTER LINE

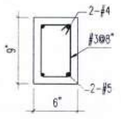


MAIN BARS HOOKS DETAIL

STIRRUPS/TIES HOOKS DETAIL



LINTEL BEAM TYPICAL SECTION (UPTO 6' SPAN)

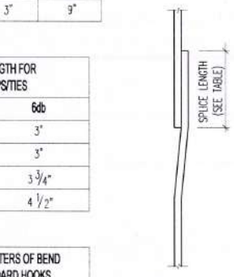


LINTEL BEAM TYPICAL SECTION (FOR SPANS GREATER THAN 6' UP TO 8')

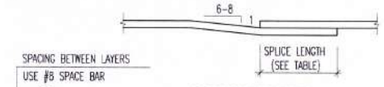
HOOK LENGTH FOR MAIN BARS		
BAR DIA	4db	12db
#3	2 ½"	4 ½"
#4	2 ½"	6"
#5	2 ½"	7 ½"
#6	3"	9"

HOOK LENGTH FOR STIRRUPS/TIES	
BAR DIA	6db
#3	3"
#4	3"
#5	3 ¾"
#6	4 ½"

MINIMUM DIAMETERS OF BEND 'D' FOR STANDARD HOOKS	
BAR DIA.	MIN. DIA.
#3 THR. #8	6db
#9 THR. #11	8db
#14 THR. #18	10db



COLUMN SPLICE (TYP.)

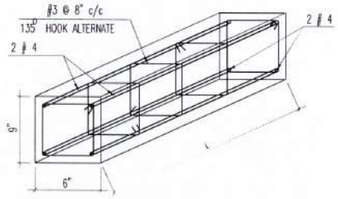


BEAM SPLICE (TYP.)

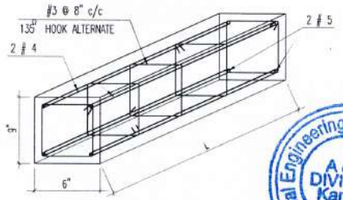
SPACING BETWEEN BARS IN A LAYER SHALL BE LARGER BAR DIAMETER OR 1", WHICHEVER IS GREATER.

BAR SPACING IN BEAM

VERTICAL BAR SPACING IN COLUMN



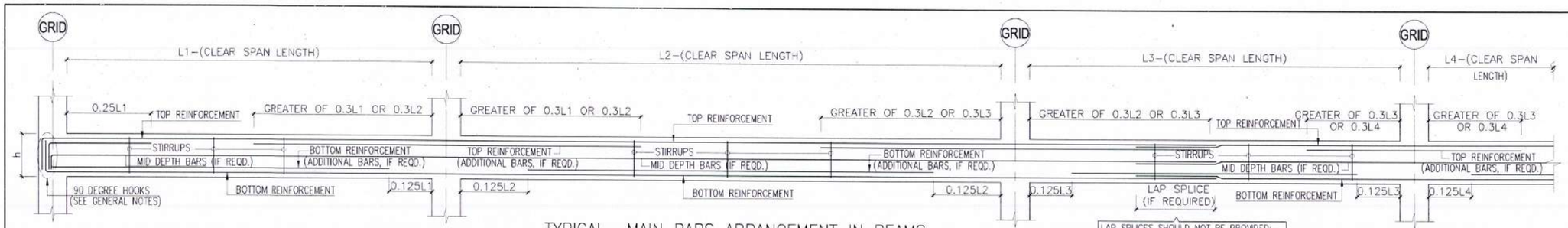
TYPICAL LINTEL BEAM (UPTO 6' SPAN)



TYPICAL LINTEL BEAM (FOR SPANS GREATER THAN 6' UP TO 8')

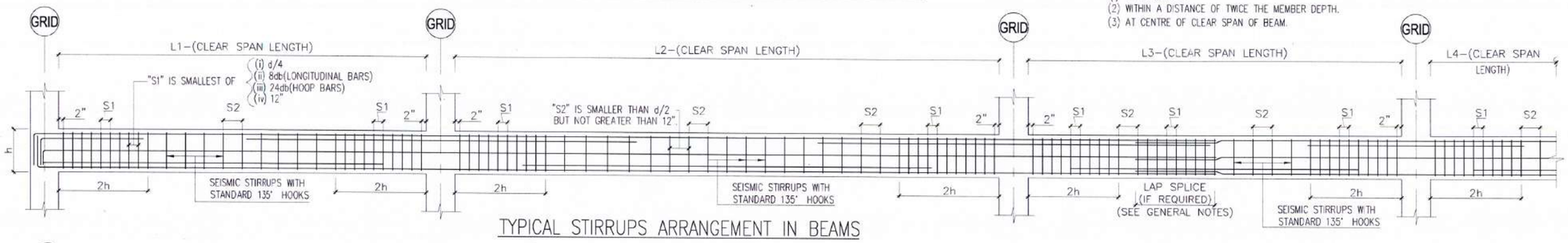
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.				
	ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13				
04				DRAWN	
03				SUBMITTED	
02				RECOMMENDED	
01				CHD./VER.	
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	
PROJECT	JSMU				
	ADMIN & ACADEMIC BUILDING				
	GENERAL NOTES				
DATE	MARCH, 2026				
DRAWING No.	4596/328/TD/G01				
SCALE	N.T.S				
REV.	0				

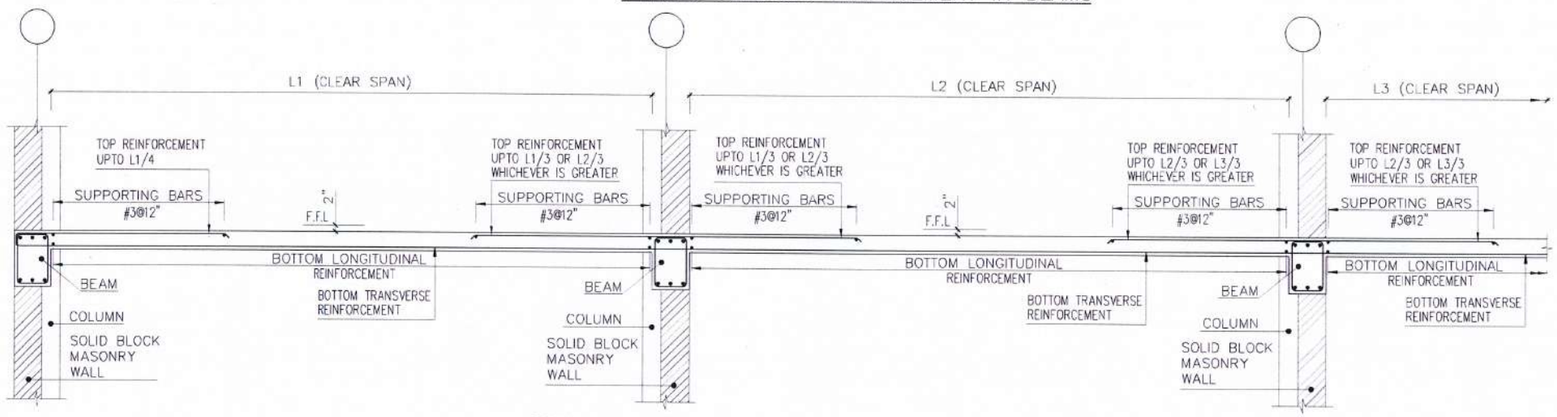


TYPICAL MAIN BARS ARRANGEMENT IN BEAMS

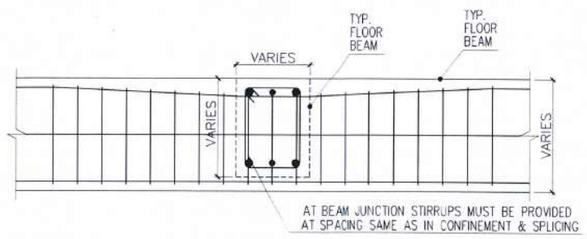
LAP SPLICES SHOULD NOT BE PROVIDED:
(1) WITHIN JOINTS.
(2) WITHIN A DISTANCE OF TWICE THE MEMBER DEPTH.
(3) AT CENTRE OF CLEAR SPAN OF BEAM.



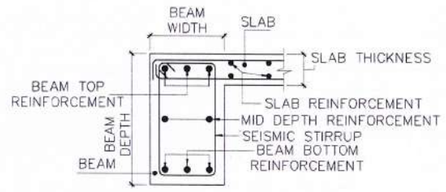
TYPICAL STIRRUPS ARRANGEMENT IN BEAMS



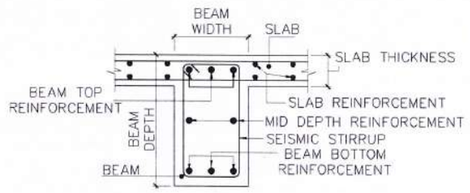
TYPICAL SECTION OF SLAB
REINFORCEMENT CURTAILMENT DETAIL



TYP. BEAM–BEAM JOINT DETAIL



TYP. SECTION OF EXTERNAL BEAM (L–SHAPED)

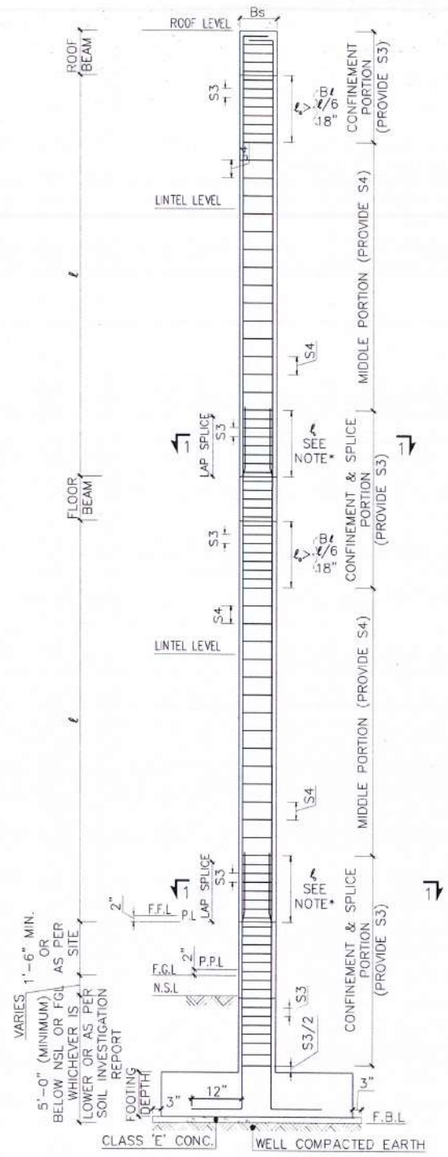


TYP. SECTION OF INTERNAL BEAM (T–SHAPED)

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

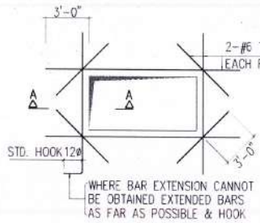
CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING TYPICAL DETAILS (SHEET 1 OF 2)	SCALE: N.T.S
			DATE: MARCH, 2026	DRAWING No.: 4596/328/TD/G02(A)
				REV.: 0

REV.	DATE	DESCRIPTION	APPROVED	
04				DRAWN
03				SUBMITTED
02				RECOMMENDED
01				CHD./VER.
REV.	DATE	DESCRIPTION	APPROVED	APPROVED



TYPICAL COLUMN DETAIL

*AT SPLICE REGION, THE LENGTH OF CONFINING PORTION SHALL BE GREATER ℓ OR SPLICE LENGTH



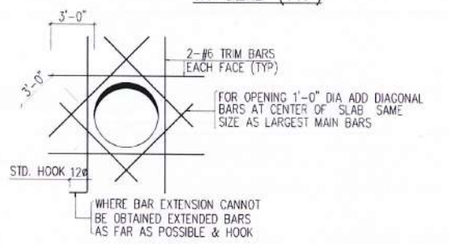
SECTION 1-1

TYP. LAP SPLICE DETAIL

NOTES

- FOR OPENING WITH MAXIMUM DIMENSION OVER 5'-0" REFER TO OTHER DETAILS.
- USE THIS DETAILS IF NOT SHOWN IN DESIGN DRAWINGS.

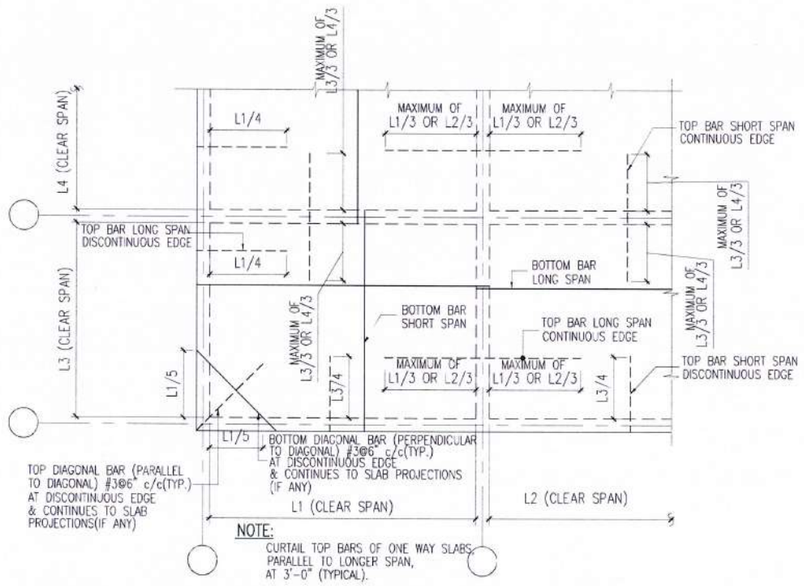
REINFORCEMENT DETAIL AT OPENING IN SLAB (TYP)



NOTES

MAXIMUM DIAMETER OF SLEEVE IS 1'-0" FOR TRIM BARS BARS AROUND LARGE SLEEVE REFER TO OTHER DETAILS

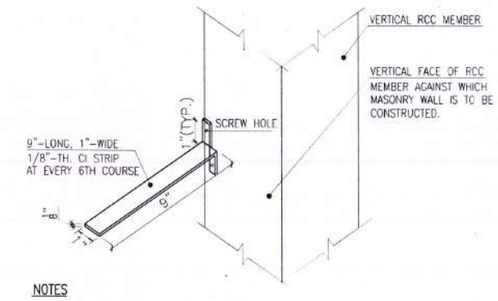
REINFORCEMENT AROUND SLEEVE IN SLAB (TYP)



NOTE:

CURTAIL TOP BARS OF ONE WAY SLABS PARALLEL TO LONGER SPAN, AT 3'-0" (TYPICAL).

TYP. TWO WAY SLAB REINFORCEMENT CURTAILMENT DETAIL



NOTES

- LOCATION OF ANCHORAGE AS PER SITE ENGINEER'S APPROVAL.
- SCREW SHALL BE NO.12ø-2" IN LENGTH (MINIMUM) WITH WASHER OR AS INSTRUCTED BY SITE ENGINEER.

TYPICAL ANCHORAGE DETAIL OF BLOCK MASONRY WITH R.C.C. MEMBERS

LEGENDS

S1	STIRRUPS SPACING IN BEAM NEAR SUPPORTS & LAP SPLICES
S2	STIRRUPS SPACING IN BEAM IN MIDSPAN
S3	CROSSTIE SPACING IN COLUMNS IN CONFINEMENT & LAP SPLICE
S4	CROSSTIE SPACING IN COLUMNS IN MIDDLE PORTION.
h	DEPTH OF BEAM
db	DIAMETER OF BAR
Bs	LEAST LATERAL DIMENSION OF COLUMN
Bℓ	GREATER LATERAL DIMENSION OF COLUMN
ℓ	CLEAR HEIGHT OF COLUMN
ℓo	LENGTH OF CONFINEMENT PORTION
ℓd	DEVELOPMENT LENGTH FOR STEEL BAR
d	EFFECTIVE DEPTH OF BEAM

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

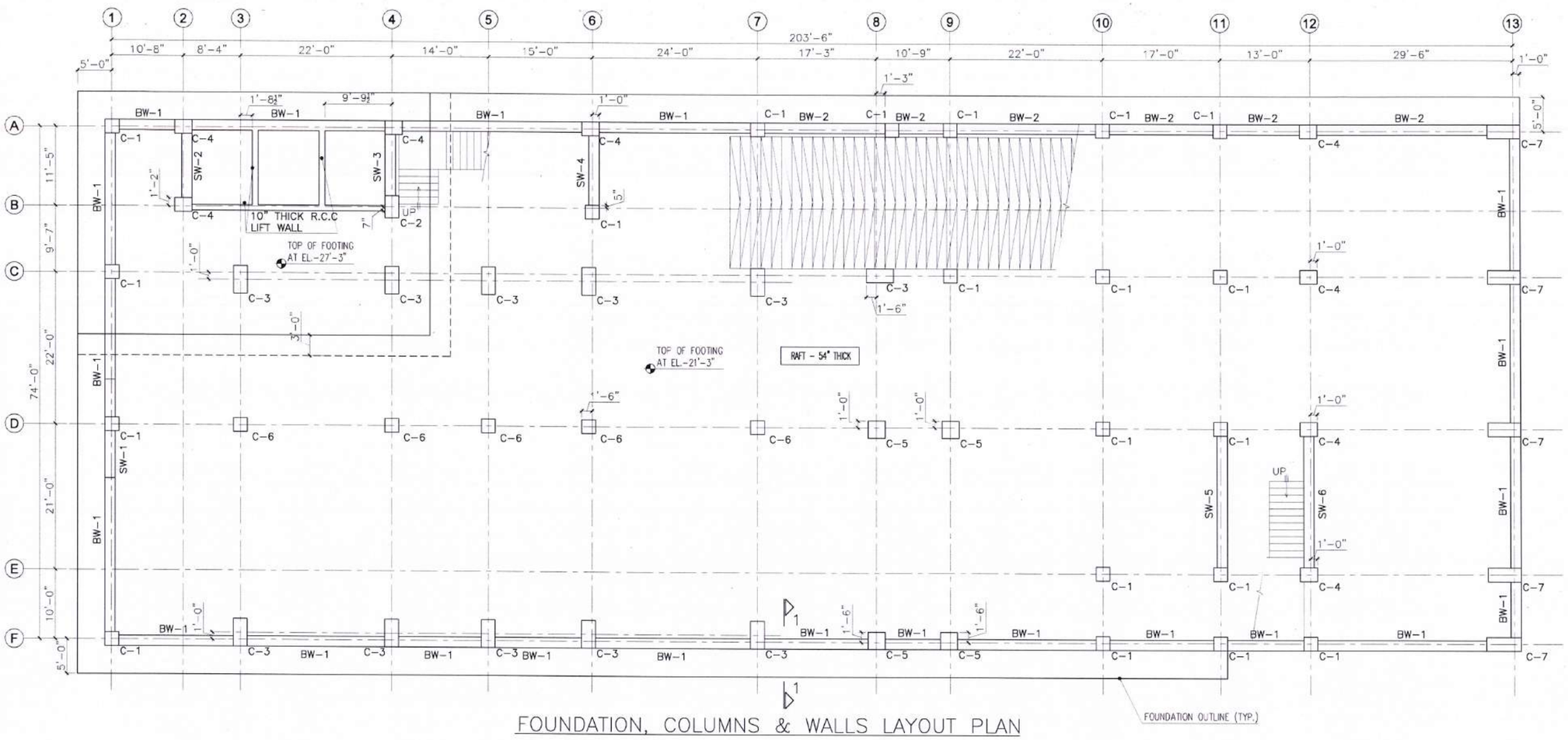
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
TYPICAL DETAILS (SHEET 2 OF 2)

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G02(B)
SCALE: N.T.S
REV.: 0



FOUNDATION, COLUMNS & WALLS LAYOUT PLAN

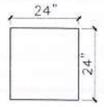
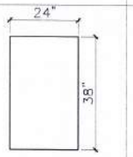
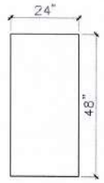
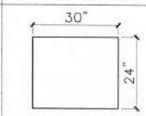
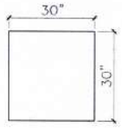
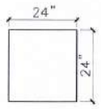
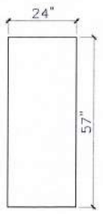
NOTES:

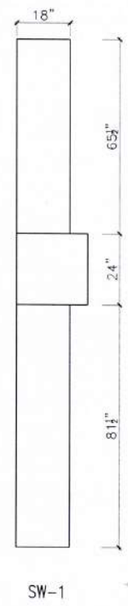
1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG & RECOMMENDATIONS OF GEO-TECHNICAL REPORT.
3. THE FOUNDATION HAS BEEN DESIGNED ON NET ALLOWABLE BEARING CAPACITY OF 220 KPA AT A DEPTH OF 10 METERS (32'-9") BELOW N.S.L.
4. IF COMPETENT BEARING STRATA IS NOT FOUND AT INDICATED DEPTH, THE ENGINEER SHALL BE NOTIFIED FOR HIS PRIOR INSTRUCTIONS.
5. FOR SCHEDULE OF COLUMNS & STRUCTURAL WALLS, REFER DWG. NO. 4596/328/TD/G04.
6. FOR EL. ±0'-0", REFER MASTER PLAN
7. ALL COLUMNS ARE CENTERED WITH GRIDS UNLESS OTHERWISE NOTED.
8. FOR TYPICAL DETAILS OF WATERPROOFING OF FOUNDATIONS & BASEMENT WALLS, REFER DWG. NO. 4596/328/TD/G05.
9. TO ENSURE THE SAFETY OF ADJACENT STRUCTURES AND ROADWAYS, THE CONTRACTOR SHOULD IMPLEMENT A TEMPORARY DEEP EXCAVATION SUPPORT SYSTEM, SUCH AS BRACED TANGENT OR SECANT PILE WALLS WITH A STRUTTING SYSTEM, OR ANOTHER APPROPRIATE BRACING SOLUTION. THIS SUPPORT SYSTEM WILL HELP MINIMIZE LATERAL MOVEMENTS AND GROUND DISPLACEMENT WHILE EFFECTIVELY MANAGING GROUNDWATER SEEPAGE INTO THE CONSTRUCTION SITE. MOREOVER, INSTRUMENTATION SHOULD BE INSTALLED ON-SITE TO MONITOR GROUND MOVEMENT THROUGHOUT THE CONSTRUCTION PROCESS.
10. THE CONTRACTOR SHOULD SUBMIT METHOD STATEMENT AND COMPLETE DESIGN OF TEMPORARY DEEP EXCAVATION SUPPORT SYSTEM, DRAINAGE AND DEWATERING SYSTEMS AND INSTRUMENTATION TO THE ENGINEER FOR THE APPROVAL PRIOR TO START OF EXCAVATION WORKS AT THE SITE.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	PROJECT	JSMU
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13		ADMIN & ACADEMIC BUILDING FOUNDATION, COLUMNS & WALLS LAYOUT PLAN
04 / 03 / 02 / 01 / REV. / DATE / DESCRIPTION / APPROVED	DRAWN / SUBMITTED / RECOMMENDED / CHD./VER. / APPROVED	SCALE	N.T.S
DATE	MARCH, 2026	DRAWING No.	4596/328/TD/G03
REV.	0		

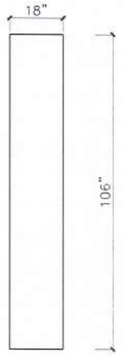
COLUMN SCHEDULE

S.NO.	COL. NO.	SIZE	FROM	TO
1	C-1		TOP OF FOUNDATION	AS PER FRAMING PLAN
2	C-2		TOP OF FOUNDATION	AS PER FRAMING PLAN
3	C-3		TOP OF FOUNDATION	AS PER FRAMING PLAN
4	C-4		TOP OF FOUNDATION	AS PER FRAMING PLAN
5	C-5		TOP OF FOUNDATION	AS PER FRAMING PLAN
6	C-6		TOP OF FOUNDATION	AS PER FRAMING PLAN
7	C-7		TOP OF FOUNDATION	AS PER FRAMING PLAN



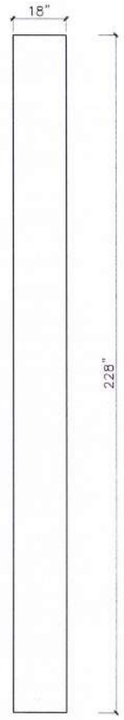
SW-1

SW-2



SW-3

SW-4



SW-5&6

National Engineering Services Pakistan Ltd.
A & P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR FOUNDATION, COLUMN & WALLS LAYOUT PLAN, REFER DWG. NO.4596/328/TD/G03.
4. FOR FINAL ELEVATIONS, REFER RESPECTIVE FRAMING PLANS IN ADDITION TO COLUMN SCHEDULE.
5. FOR TYPICAL ELEVATION OF COLUMN & OTHER TYPICAL DETAILS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
6. AT SPLICE REGION IN COLUMNS, THE LENGTH OF CONFINEMENT PORTION SHALL BE GREATER OF ℓ_o OR SPLICE LENGTH OF MAIN LONGITUDINAL REINFORCEMENT.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

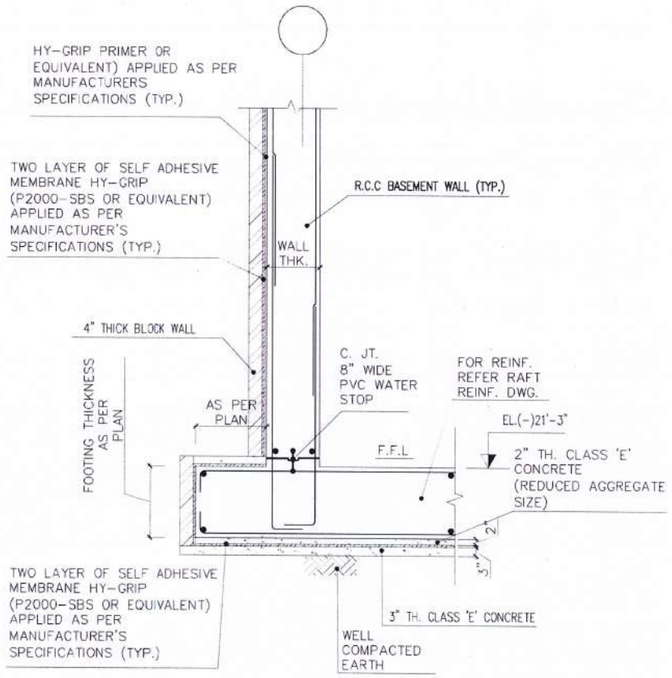
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

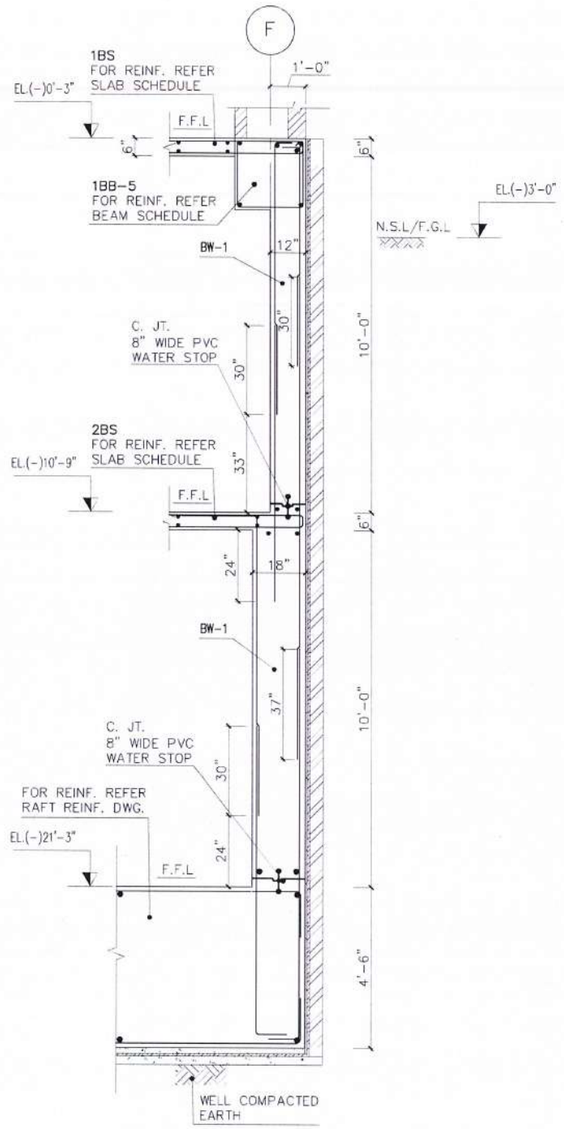
PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF COLUMNS & STRUCTURAL WALLS

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G04
SCALE: N.T.S
REV.: 0



TYP. SECTION OF WATER PROOFING FOR FOUNDATION & BASEMENT RETAINING WALL



TYP. SECTION OF BASEMENT WALL, BW-1
SECTION 1-1

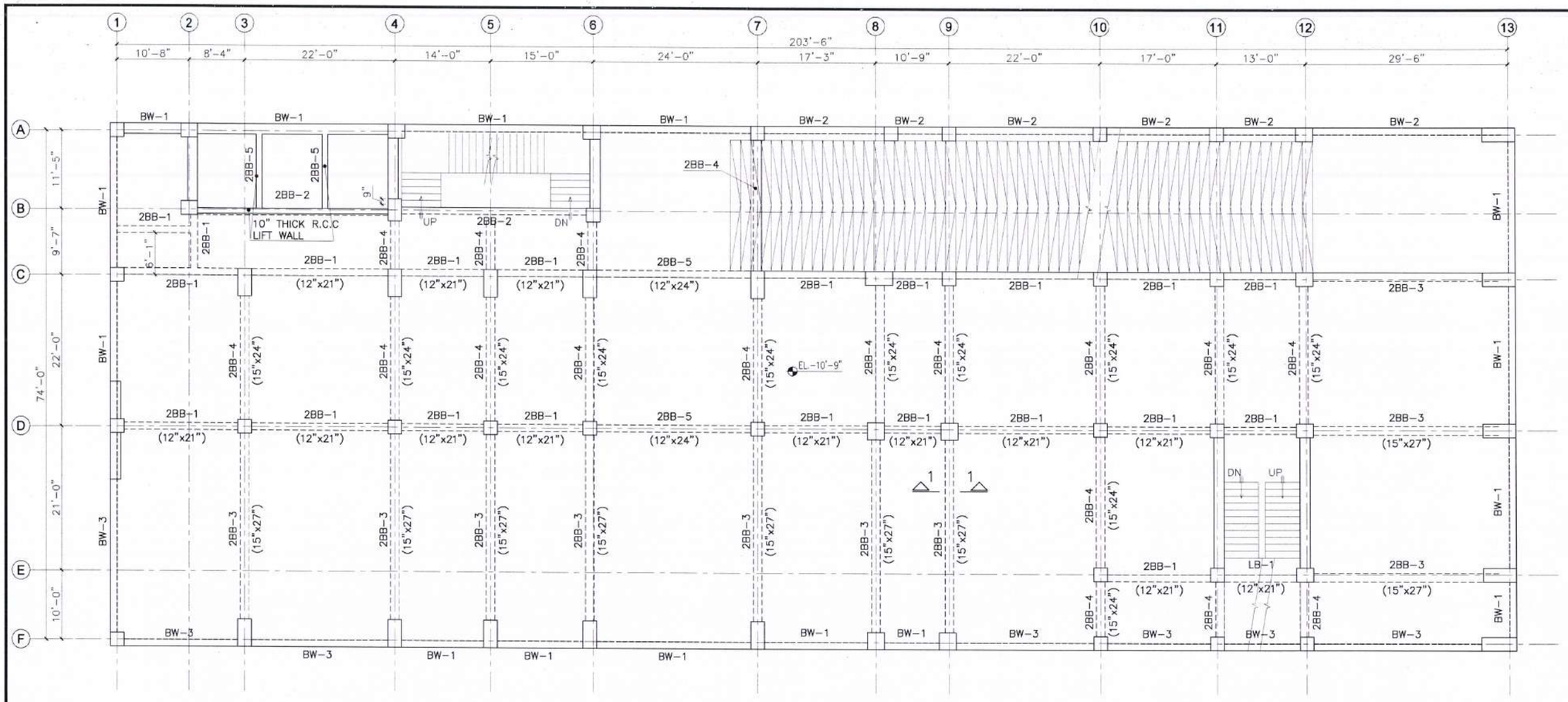
Engineering Services Pakistan (National) Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR FOUNDATION, COLUMN & WALLS LAYOUT PLAN, REFER DWG. NO.4596/328/TD/G03.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING TYPICAL SECTION OF WATERPROOFING OF FOUNDATION & WALLS & SECTION 1-1	SCALE: N.T.S	
			DATE: MARCH, 2026	DRAWING No.: 4596/328/TD/G05	REV.: 0

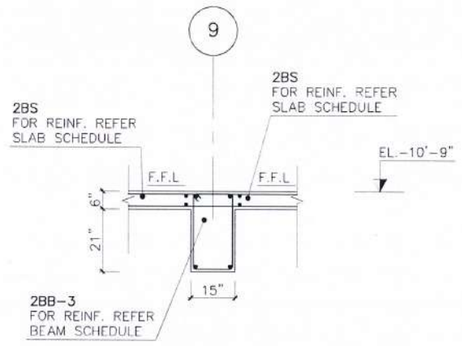
REV.	DATE	DESCRIPTION	APPROVED		
04				DRAWN	
03				SUBMITTED	
02				RECOMMENDED	
01				CHD./VER.	
				APPROVED	



FRAMING PLAN AT EL.-10'-9"

BEAMS SCHEDULE AT EL.-10'-9"

S.NO.	BEAM NO.	SIZE
1	2BB-1	12" x 21"
2	2BB-2	12" x 36"
3	2BB-3	15" x 27"
4	2BB-4	15" x 24"
5	2BB-5	10" x 36"



SECTION 1-1

TYP. SECTION OF INTERNAL FLOOR BEAM

Engineering Services Pakistan A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS INCLUDING RAMP ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel: 051-9221910-13

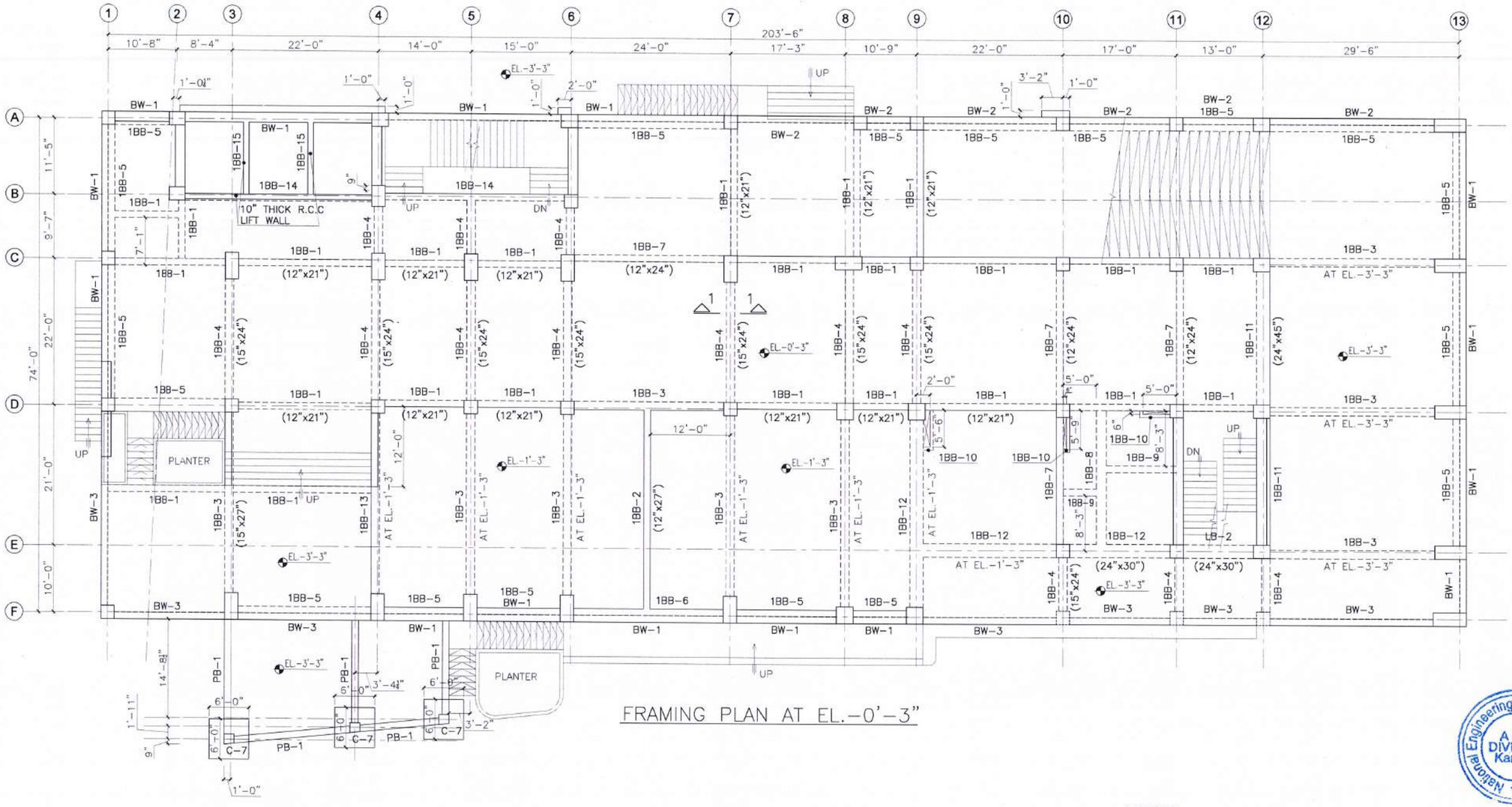
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
FRAMING PLAN AT EL.-10'-9"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G06
REV.: 0



FRAMING PLAN AT EL.-0'-3"

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS INCLUDING RAMP ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.-0'-3", REFER DWG. NO. 4596/328/TD/G08.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel: 051-9221910-13	
PROJECT	JSMU	
	ADMIN & ACADEMIC BUILDING FRAMING PLAN AT EL.-0'-3"	
SCALE	N.T.S	
DATE	MARCH, 2026	
DRAWING No.	4596/328/TD/G07	
REV.	0	

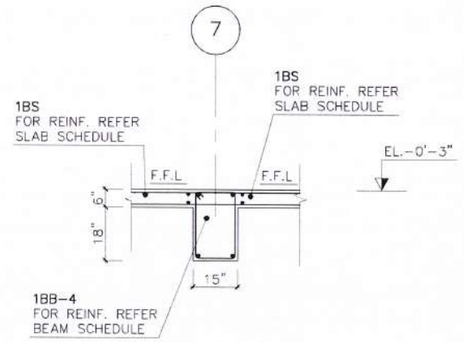
REV.	DATE	DESCRIPTION	APPROVED
04			DRAWN
03			SUBMITTED
02			RECOMMENDED
01			CHD./VER.
			APPROVED

BEAMS SCHEDULE AT EL.-0'-3"

S.NO.	BEAM NO.	SIZE
1	1BB-1	12" × 21"
2	1BB-2	12" × 27"
3	1BB-3	15" × 27"
4	1BB-4	15" × 24"
5	1BB-5	24" × 24"
6	1BB-6	24" × 27"
7	1BB-7	12" × 24"
8	1BB-8	18" × 21"
9	1BB-9	12" × 18"
10	1BB-10	6" × 18"
11	1BB-11	24" × 45"
12	1BB-12	24" × 30"
13	1BB-13	15" × 30"
14	1BB-14	12" × 36"
15	1BB-15	10" × 36"
16	PB-1	12" × 21"

COLUMN SCHEDULE

S.NO.	COLUMN NO.	SIZE
1	C-7	18" × 18", 16" × 18"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.-0'-3", REFER DWG. NO. 4596/328/TD/G07.

National Engineering Services Pakistan LLP. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

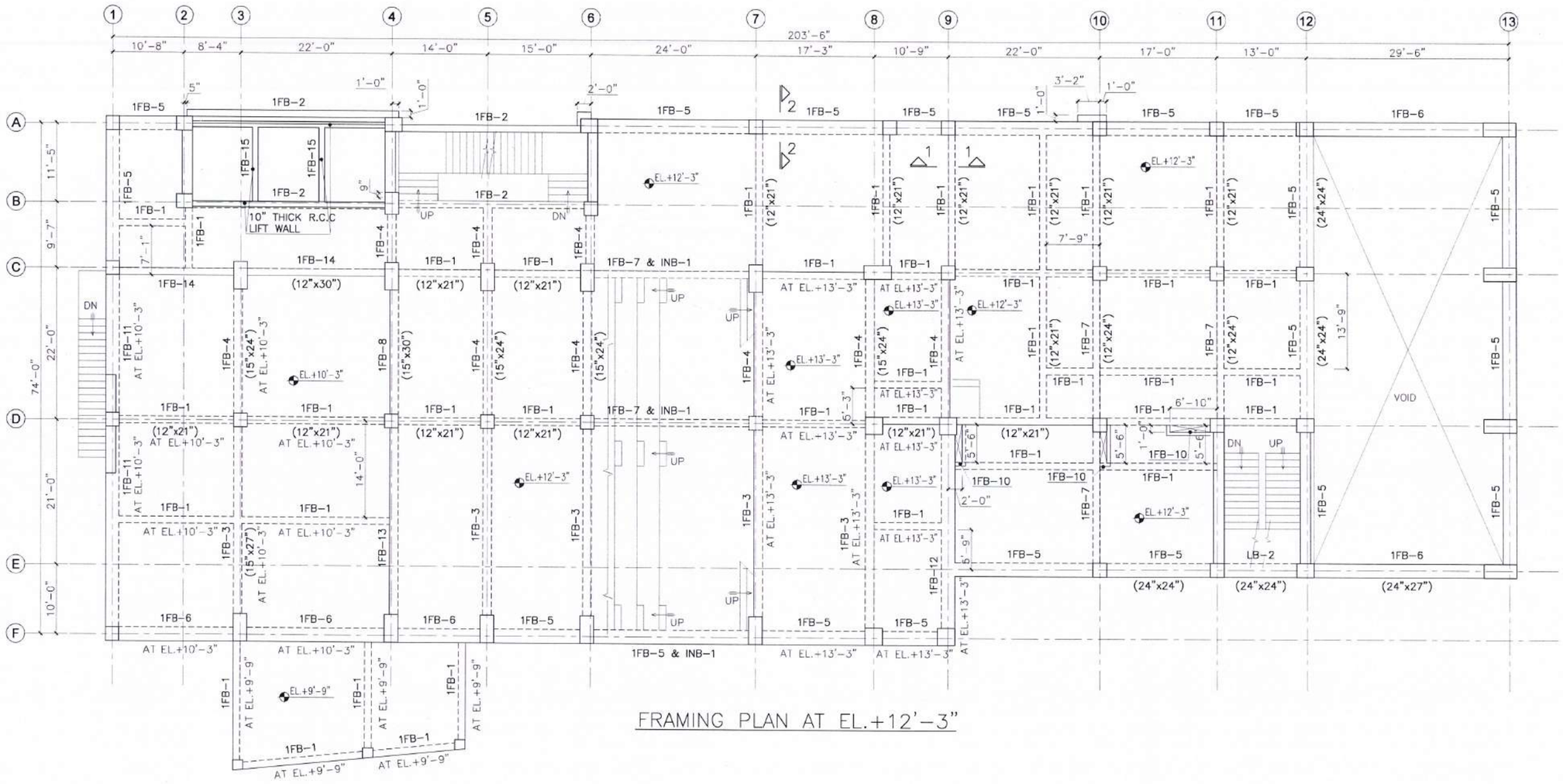
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.-0'-3"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G08
REV.: 0



FRAMING PLAN AT EL.+12'-3"

NOTES:

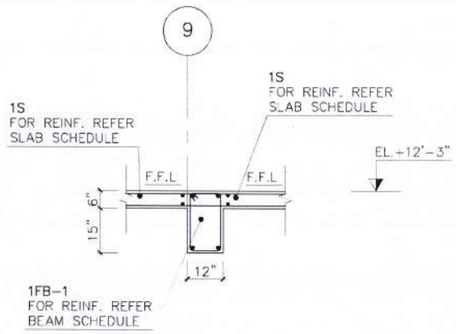
1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL RAMP SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
7. FOR SCHEDULE OF BEAMS AT EL.12'-3", REFER DWG. NO. 4596/328/TD/G10.

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

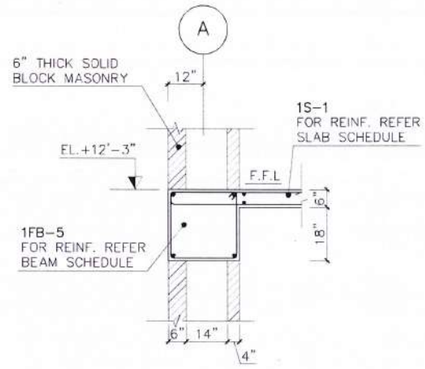
CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING — FRAMING PLAN AT EL.+12'-3"	SCALE: N.T.S	
04 / 03 / 02 / 01 — REV. / DATE / DESCRIPTION / APPROVED	DRAWN / SUBMITTED / RECOMMENDED / CHD./VER. / APPROVED		DATE: MARCH, 2026	DRAWING No.: 4596/328/TD/G09	REV.: 0

BEAMS SCHEDULE AT EL.+12'-3"

S.NO.	BEAM NO.	SIZE
1	1FB-1	12" × 21"
2	1FB-2	12" × 36"
3	1FB-3	15" × 27"
4	1FB-4	15" × 24"
5	1FB-5	24" × 24"
6	1FB-6	24" × 27"
7	1FB-7	12" × 24"
8	1FB-8	15" × 30"
9	1FB-9	12" × 18"
10	1FB-10	6" × 18"
11	1FB-11	24" × 45"
12	1FB-12	24" × 36"
13	1FB-13	15" × 48"
14	1FB-14	12" × 30"
15	1FB-15	10" × 36"
16	1NB-1	12" × 21"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.12'-3", REFER DWG. NO. 4596/328/TD/G09.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

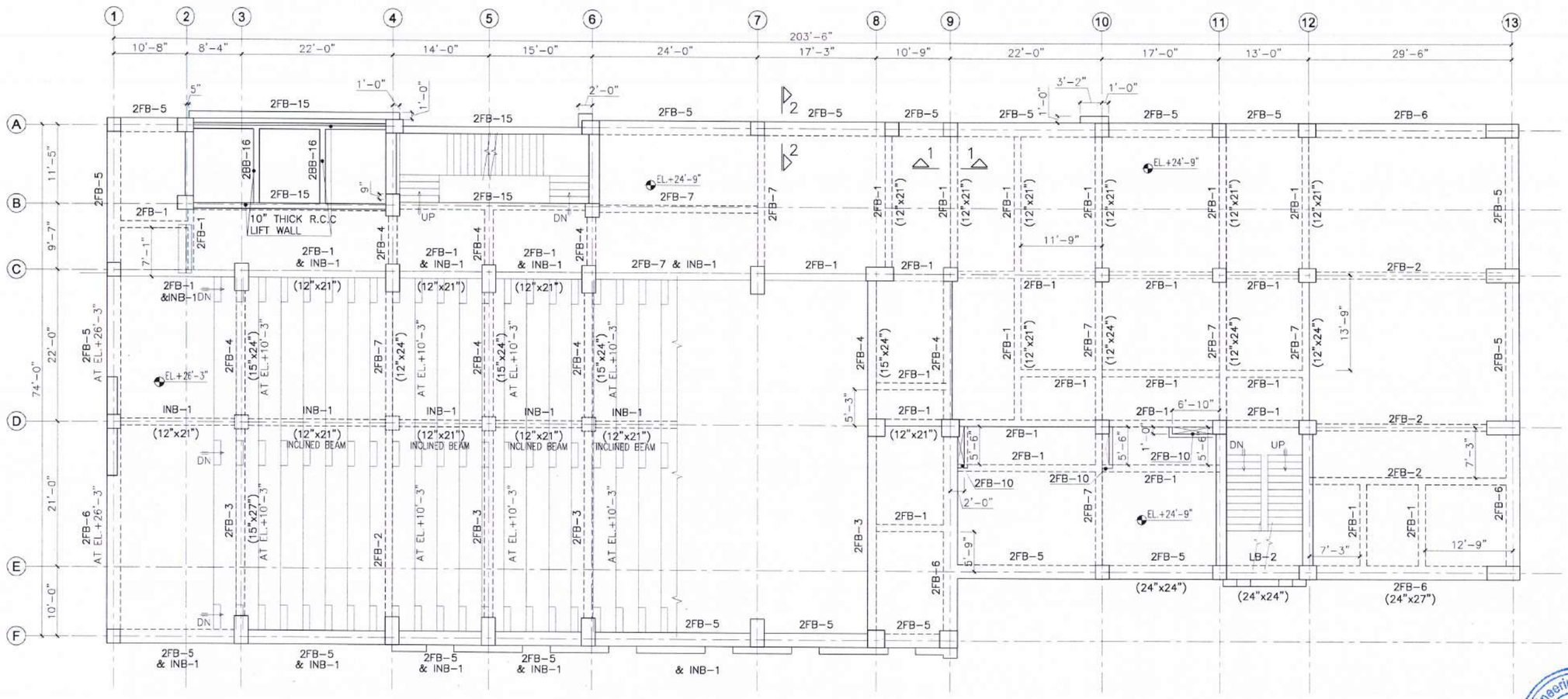
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./YER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+12'-3"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G10
REV.: 0



FRAMING PLAN AT EL.+24'-9"

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

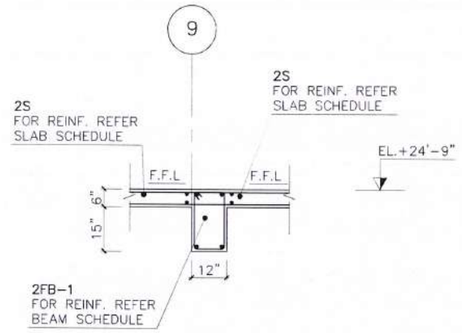
NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL RAMP SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
7. FOR SCHEDULE OF BEAMS AT EL.24'-9", REFER DWG. NO. 4596/328/TD/G12.

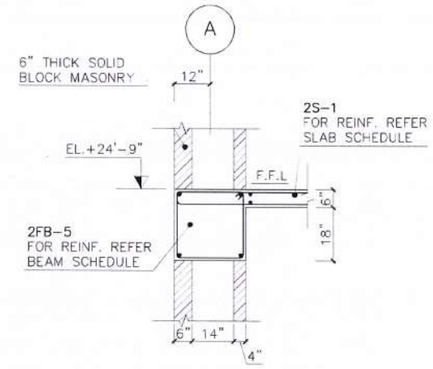
CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	04				DRAWN		PROJECT: JSMU	ADMIN & ACADEMIC BUILDING FRAMING PLAN AT EL.+24'-9"
		03				SUBMITTED			
		02				RECOMMENDED			
		01				CHD./VER.			
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			

SCALE	DATE	DRAWING No.	REV.
N.T.S	MARCH, 2026	4596/328/TD/G11	0

BEAMS SCHEDULE AT EL.+24'-9"		
S.NO.	BEAM NO.	SIZE
1	2FB-1	12" × 21"
2	2FB-2	12" × 27"
3	2FB-3	15" × 27"
4	2FB-4	15" × 24"
5	2FB-5	24" × 24"
6	2FB-6	24" × 27"
7	2FB-7	12" × 24"
8	2FB-8	15" × 30"
9	2FB-9	12" × 18"
10	2FB-10	6" × 18"
11	2FB-11	24" × 45"
12	2FB-12	24" × 36"
13	2FB-13	15" × 48"
14	2FB-14	12" × 30"
15	2FB-15	12" × 36"
16	2FB-16	10" × 36"
17	1NB-1	12" × 21"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.24'-9", REFER DWG. NO. 4596/328/TD/G11.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

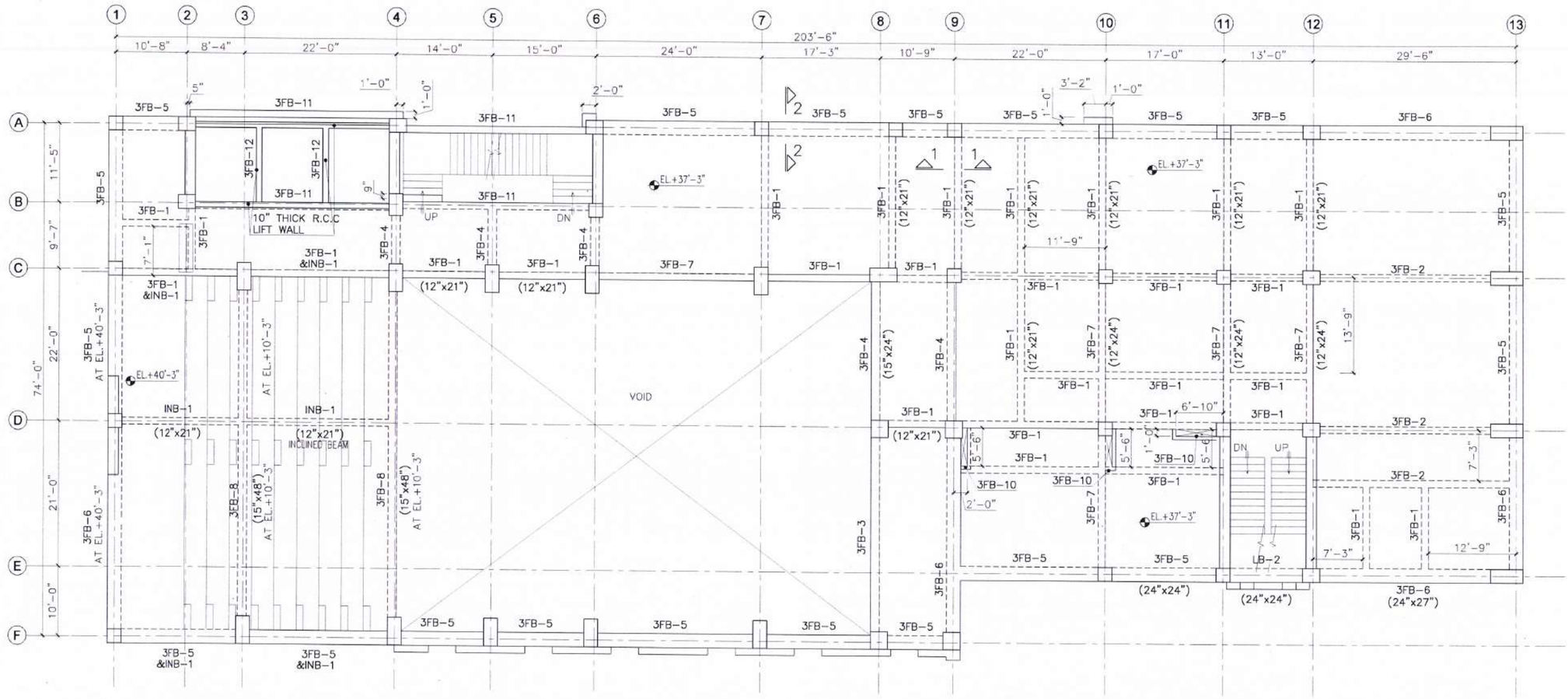
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+24'-9"

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G12
SCALE: N.T.S
REV.: 0



FRAMING PLAN AT EL.+37'-3"

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL RAMP SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
7. FOR SCHEDULE OF BEAMS AT EL.37'-3", REFER DWG. NO. 4596/328/TD/G14.

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

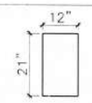
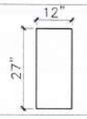
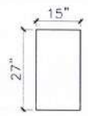
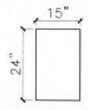
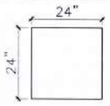
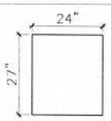
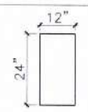
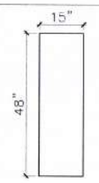
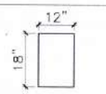
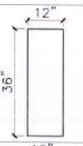
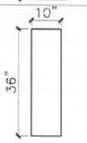
REV	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

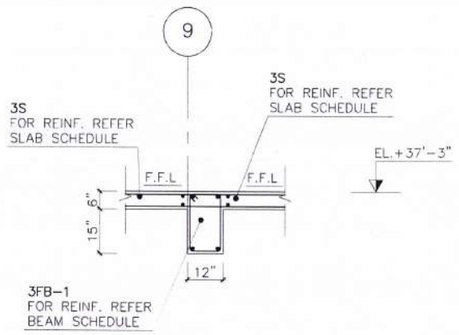
DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

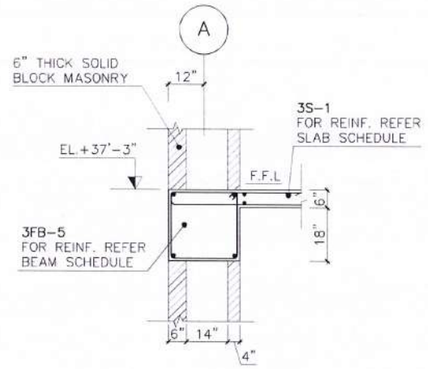
ADMIN & ACADEMIC BUILDING
FRAMING PLAN AT EL.+37'-3"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G13
REV.: 0

BEAMS SCHEDULE AT EL.+37'-3"		
S.NO.	BEAM NO.	SIZE
1	3FB-1	
2	3FB-2	
3	3FB-3	
4	3FB-4	
5	3FB-5	
6	3FB-6	
7	3FB-7	
8	3FB-8	
9	3FB-9	
10	3FB-10	
11	3FB-11	
12	3FB-12	
13	1NB-1	



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.37'-3", REFER DWG. NO. 4596/328/TD/G13.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

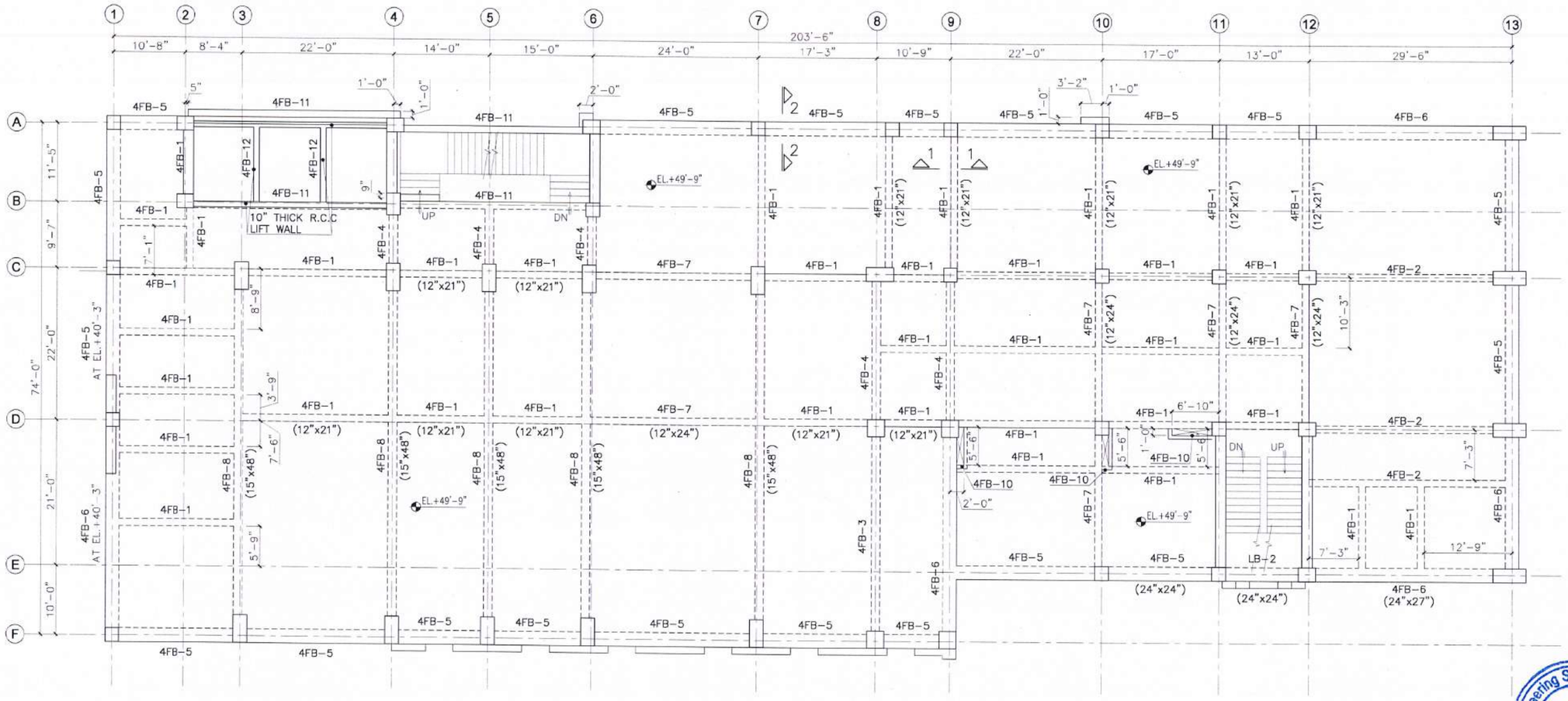
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	
SUBMITTED	
RECOMMENDED	
CHD./VER.	
APPROVED	

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT 37'-3"

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G14
SCALE: N.T.S
REV.: 0



FRAMING PLAN AT EL.+49'-9"

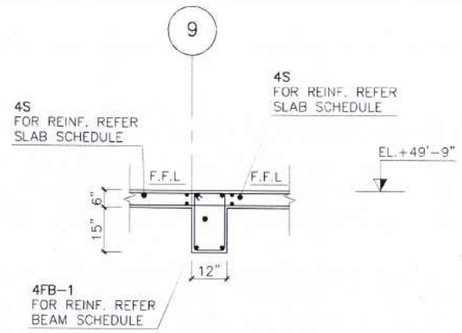
National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

NOTES:

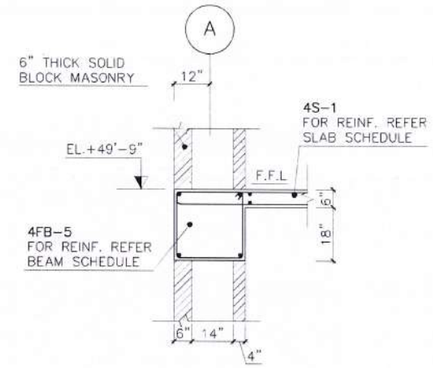
1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.+49'-9", REFER DWG. NO. 4596/328/TD/G16.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	PROJECT	JSMU
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13		ADMIN & ACADEMIC BUILDING FRAMING PLAN AT EL.+49'-9"
04 03 02 01	DRAWN SUBMITTED RECOMMENDED CHD./VER.	SCALE	N.T.S
REV. DATE DESCRIPTION APPROVED	APPROVED	DATE	MARCH, 2026
		DRAWING No.	4596/328/TD/G15
		REV.	0

BEAMS SCHEDULE AT EL.+49'-9"		
S.NO.	BEAM NO.	SIZE
1	4FB-1	12" × 21"
2	4FB-2	12" × 27"
3	4FB-3	15" × 27"
4	4FB-4	15" × 24"
5	4FB-5	24" × 24"
6	4FB-6	24" × 27"
7	4FB-7	12" × 24"
8	4FB-8	15" × 48"
9	4FB-9	12" × 18"
10	4FB-10	6" × 18"
11	4FB-11	12" × 36"
12	4FB-12	10" × 36"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.+49'-9", REFER DWG. NO. 4596/328/TD/G15.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel: 051-9221910-13

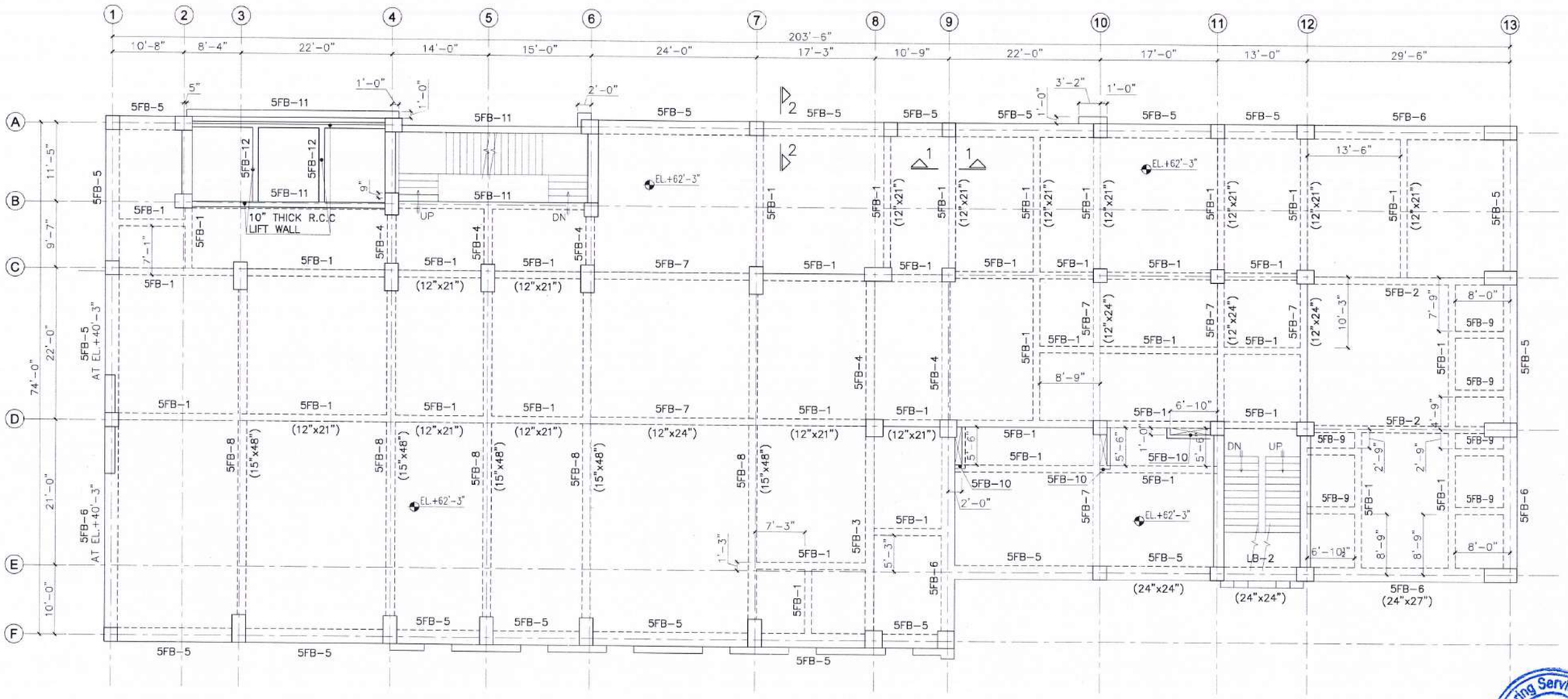
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+49'-9"

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G16
SCALE: N.T.S
REV.: 0



FRAMING PLAN AT EL.+62'-3"

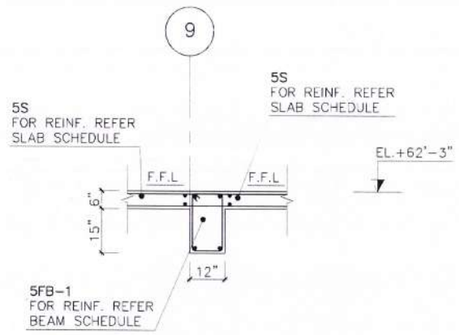
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

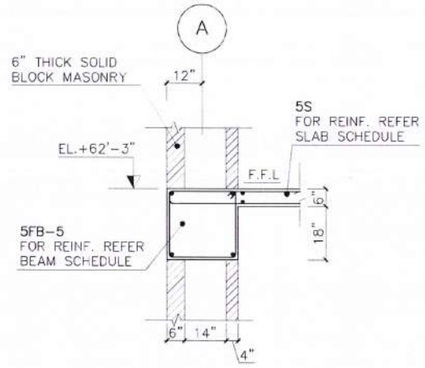
1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.+62'-3", REFER DWG. NO. 4596/328/TD/G18.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	04 / 03 / 02 / 01 — REV. / DATE / DESCRIPTION / APPROVED	DRAWN / SUBMITTED / RECOMMENDED / CHD./VER. / APPROVED	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING — FRAMING PLAN AT EL.+62'-3"
					DATE: MARCH, 2026 — DRAWING No.: 4596/328/TD/G17 — SCALE: N.T.S — REV.: 0

BEAMS SCHEDULE AT EL.+62'-3"		
S.NO.	BEAM NO.	SIZE
1	5FB-1	12" × 21"
2	5FB-2	12" × 27"
3	5FB-3	15" × 27"
4	5FB-4	15" × 24"
5	5FB-5	24" × 24"
6	5FB-6	24" × 27"
7	5FB-7	12" × 24"
8	5FB-8	15" × 48"
9	5FB-9	12" × 18"
10	5FB-10	6" × 18"
11	5FB-11	12" × 36"
12	5FB-12	10" × 36"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

Engineering Services Pakistan (Pvt.) Ltd. * National
A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.62'-3", REFER DWG. NO. 4596/328/TD/G17.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

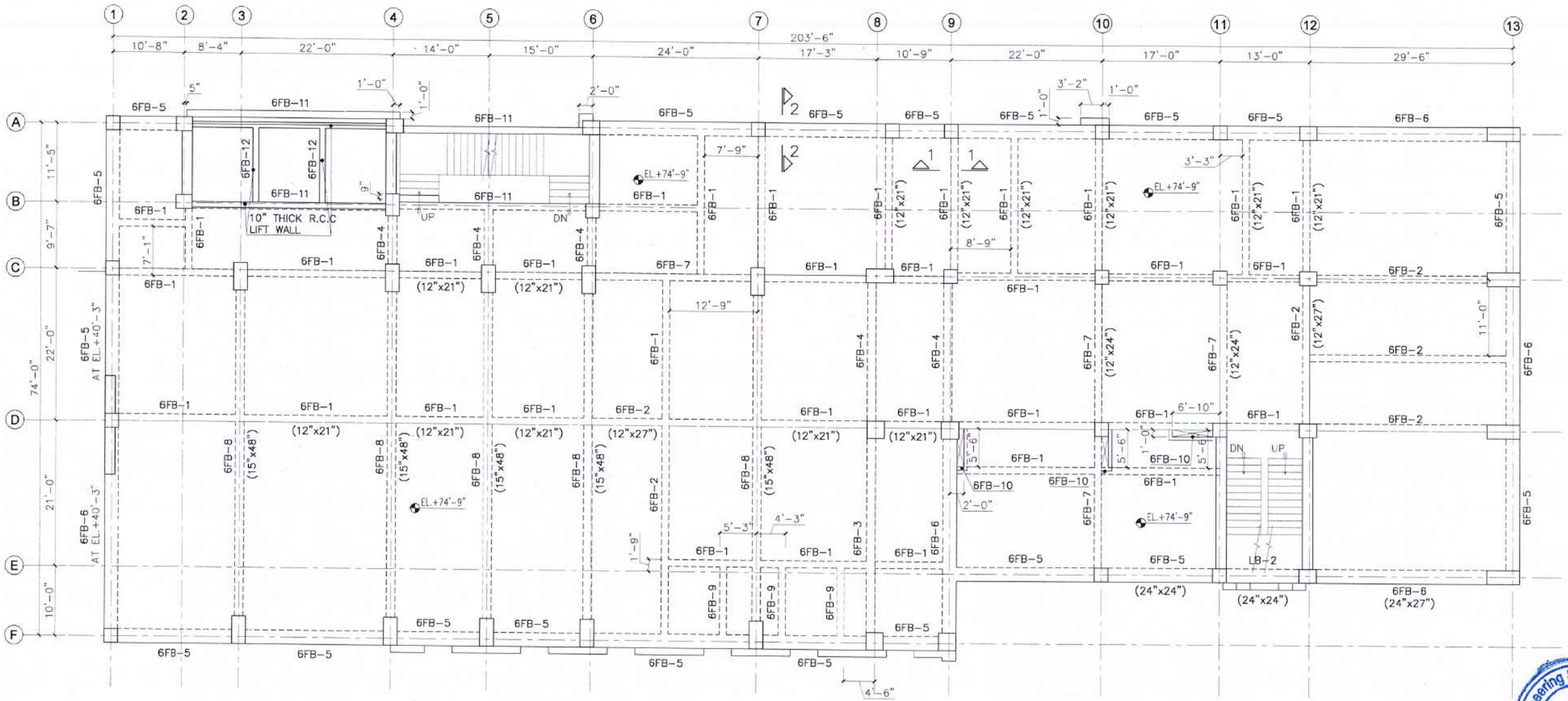
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+62'-3"

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G18
SCALE: N.T.S
REV.: 0



FRAMING PLAN AT EL.+74'-9"

Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.+74'-9", REFER DWG. NO. 4596/328/TD/G20.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

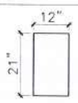
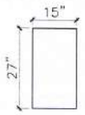
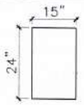
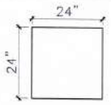
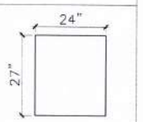
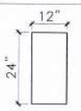
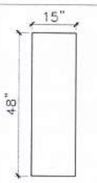
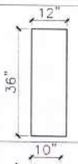
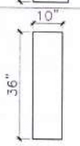
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

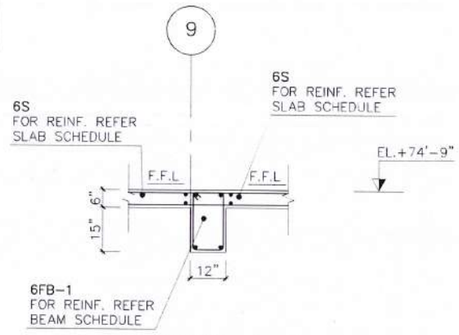
DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

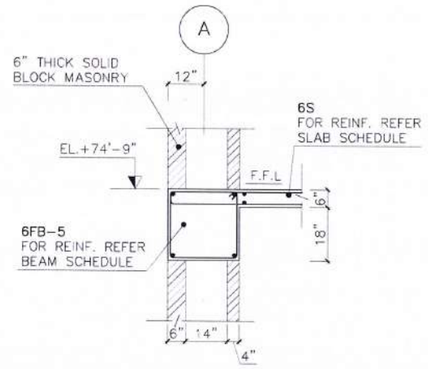
ADMIN & ACADEMIC BUILDING
FRAMING PLAN AT EL.+74'-9"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G19
REV.: 0

BEAMS SCHEDULE AT EL.+74'-9"		
S.NO.	BEAM NO.	SIZE
1	6FB-1	
2	6FB-2	
3	6FB-3	
4	6FB-4	
5	6FB-5	
6	6FB-6	
7	6FB-7	
8	6FB-8	
9	6FB-9	
10	6FB-10	
11	6FB-11	
12	6FB-12	



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

Engineering Services Pakistan Ltd. National
A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.+74'-9", REFER DWG. NO. 4596/328/TD/G19.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel: 051-9221910-13

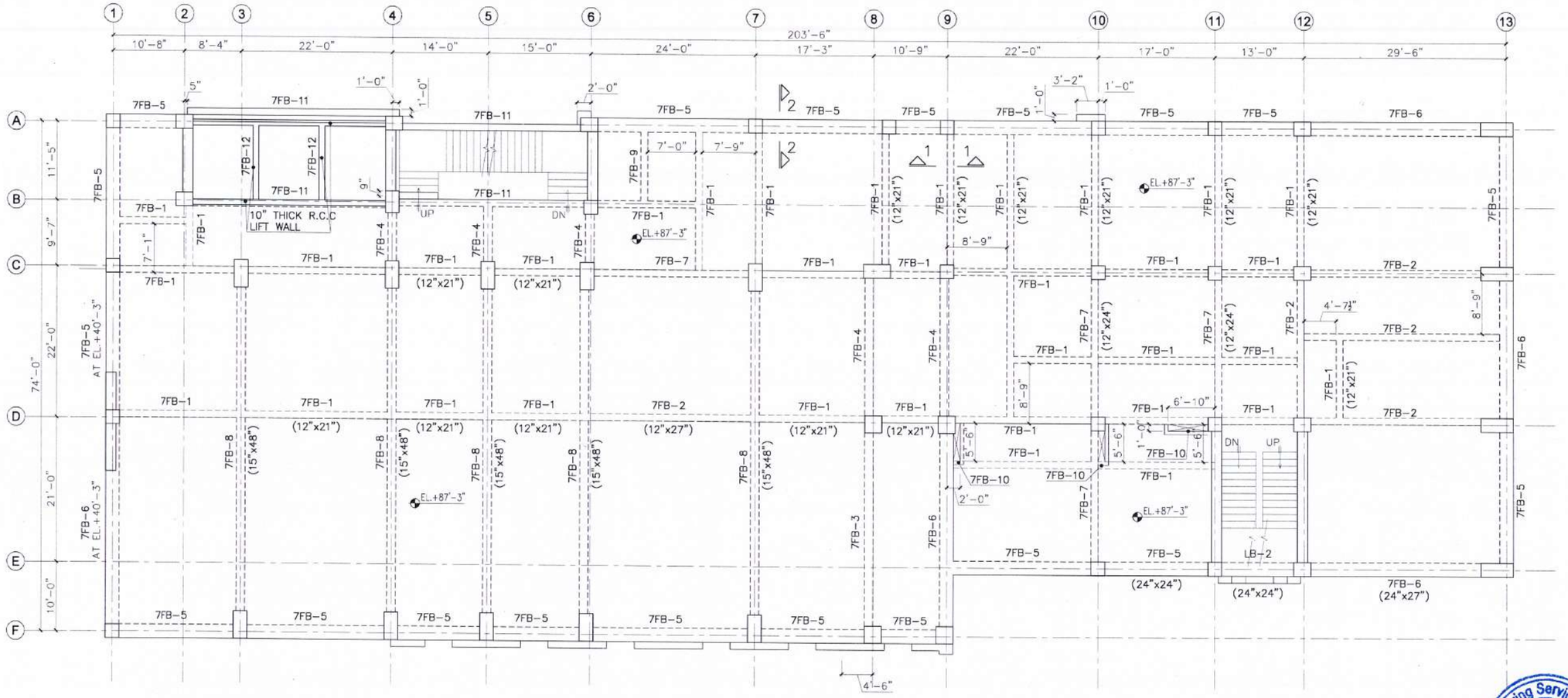
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+74'-9"

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G20
SCALE: N.T.S
REV.: 0



Engineering Services Pakistan Ltd. A&P DIVISION Karachi National

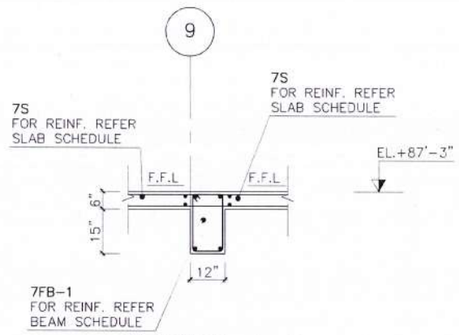
NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.+87'-3", REFER DWG. NO. 4596/328/TD/G22.

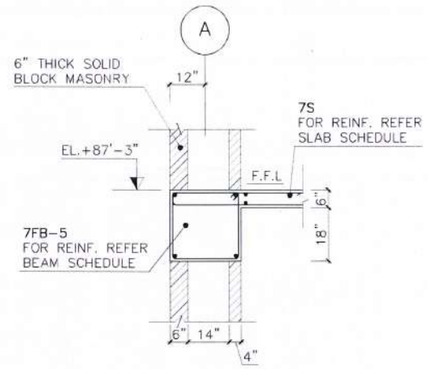
CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13
PROJECT	JSMU	
	ADMIN & ACADEMIC BUILDING	
	FRAMING PLAN AT EL.+87'-3"	
SCALE	N.T.S	
DATE	MARCH, 2026	
DRAWING No.	4596/328/TD/G21	
REV.	0	

REV.	DATE	DESCRIPTION	APPROVED	
04				DRAWN
03				SUBMITTED
02				RECOMMENDED
01				CHD./VER.
				APPROVED

BEAMS SCHEDULE AT EL.+87'-3"		
S.NO.	BEAM NO.	SIZE
1	7FB-1	12" × 21"
2	7FB-2	12" × 27"
3	7FB-3	15" × 27"
4	7FB-4	15" × 24"
5	7FB-5	24" × 24"
6	7FB-6	24" × 27"
7	7FB-7	12" × 24"
8	7FB-8	15" × 48"
9	7FB-9	12" × 18"
10	7FB-10	6" × 18"
11	7FB-11	12" × 36"
12	7FB-12	10" × 36"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.+87'-3", REFER DWG. NO. 4596/328/TD/G21.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

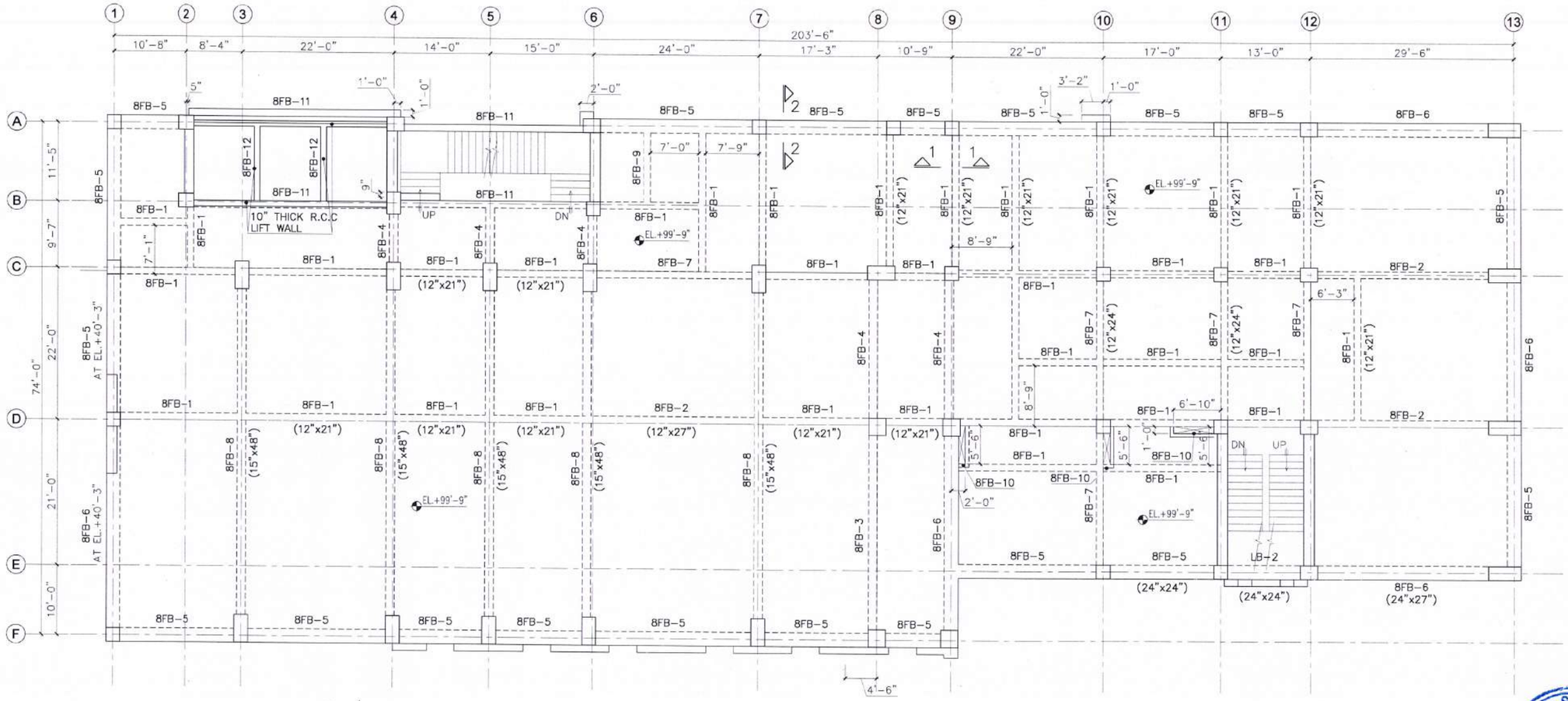
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	
SUBMITTED	
RECOMMENDED	
CHD./VER.	
APPROVED	

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+87'-3"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G22
REV.: 0



FRAMING PLAN AT EL.+99'-9"

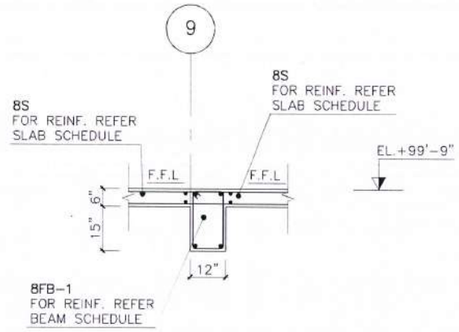
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

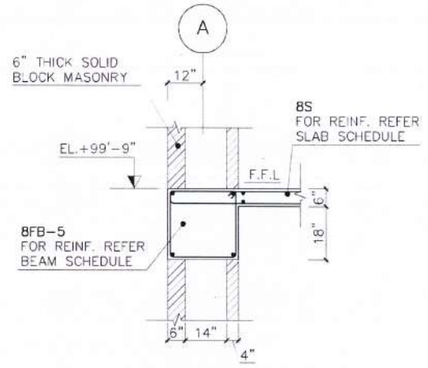
1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.+99'-9", REFER DWG. NO. 4596/328/TD/G24.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	04				DRAWN		PROJECT: JSMU
		03				SUBMITTED		ADMIN & ACADEMIC BUILDING FRAMING PLAN AT EL.+99'-9"
		02				RECOMMENDED		SCALE: N.T.S
		01				CHD./VER.		DATE: MARCH, 2026
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		DRAWING No.: 4596/328/TD/G23
								REV.: 0

BEAMS SCHEDULE AT EL.+99'-9"		
S.NO.	BEAM NO.	SIZE
1	8FB-1	12" × 21"
2	8FB-2	12" × 27"
3	8FB-3	15" × 27"
4	8FB-4	15" × 24"
5	8FB-5	24" × 24"
6	8FB-6	24" × 27"
7	8FB-7	12" × 24"
8	8FB-8	15" × 48"
9	8FB-9	12" × 18"
10	8FB-10	6" × 18"
11	8FB-11	12" × 36"
12	8FB-12	10" × 36"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

Nationwide Engineering Services Pakistan Ltd. A&P Division Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.+99'-9", REFER DWG. NO. 4596/328/TD/G23.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

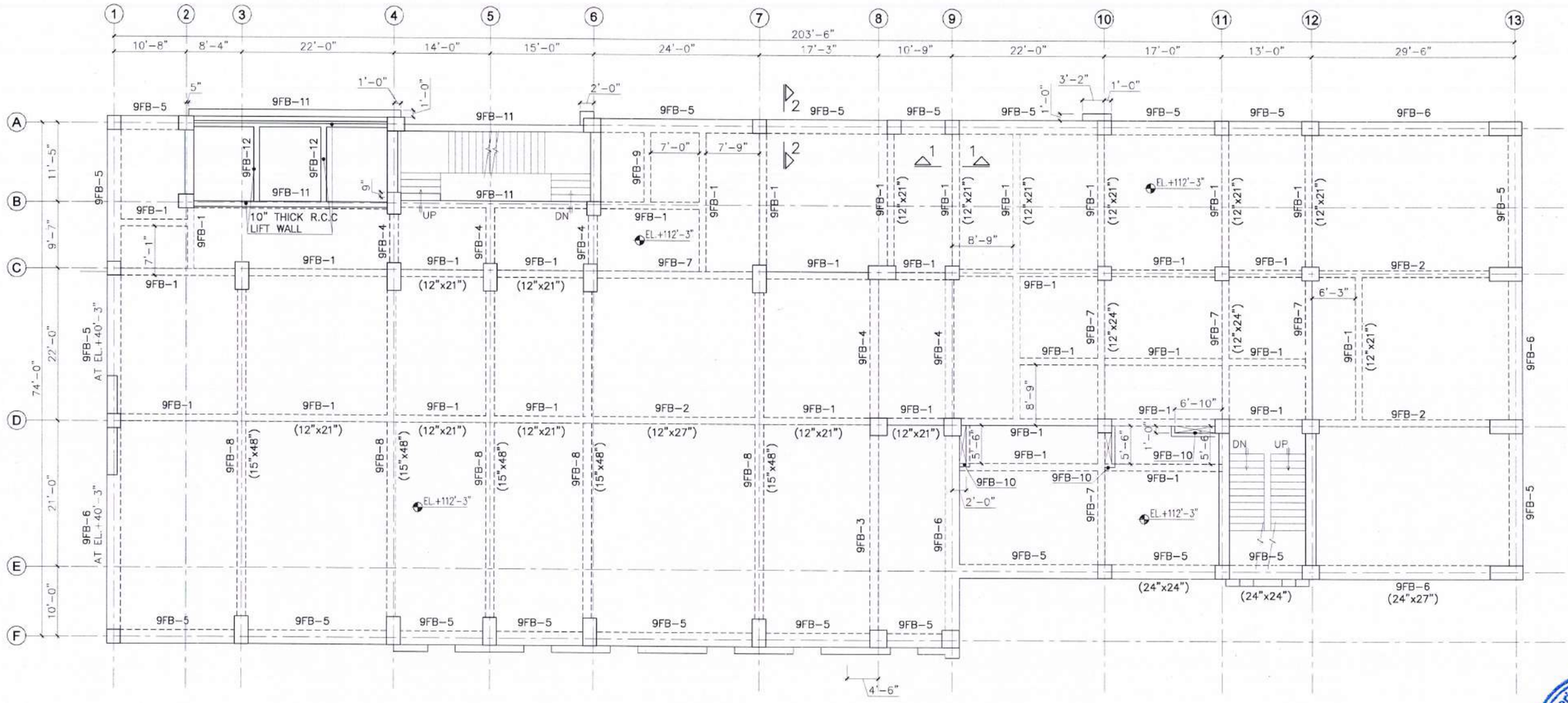
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+99'-9"

DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G24
SCALE: N.T.S
REV.: 0



FRAMING PLAN AT EL.+112'-3"

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

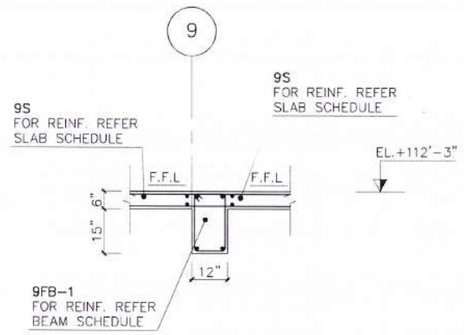
NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.112'-3", REFER DWG. NO. 4596/328/TD/G26.

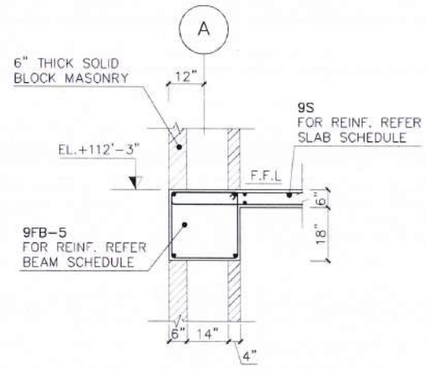
CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING — FRAMING LAYOUT PLAN AT EL.+112'-3"	SCALE: N.T.S	
			DATE: MARCH, 2026	DRAWING No.: 4596/328/TD/G25	REV.: 0

REV.	DATE	DESCRIPTION	APPROVED	
04				DRAWN
03				SUBMITTED
02				RECOMMENDED
01				CHD./VER.
				APPROVED

BEAMS SCHEDULE AT EL.+112'-3"		
S.NO.	BEAM NO.	SIZE
1	9FB-1	12" × 21"
2	9FB-2	12" × 27"
3	9FB-3	15" × 27"
4	9FB-4	15" × 24"
5	9FB-5	24" × 24"
6	9FB-6	24" × 27"
7	9FB-7	12" × 24"
8	9FB-8	15" × 48"
9	9FB-9	12" × 18"
10	9FB-10	6" × 18"
11	9FB-11	12" × 36"
12	9FB-12	10" × 36"



SECTION 1-1
TYP. SECTION OF INTERNAL FLOOR BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL FLOOR BEAMS

Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.+112'-3", REFER DWG. NO. 4596/328/TD/G25.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

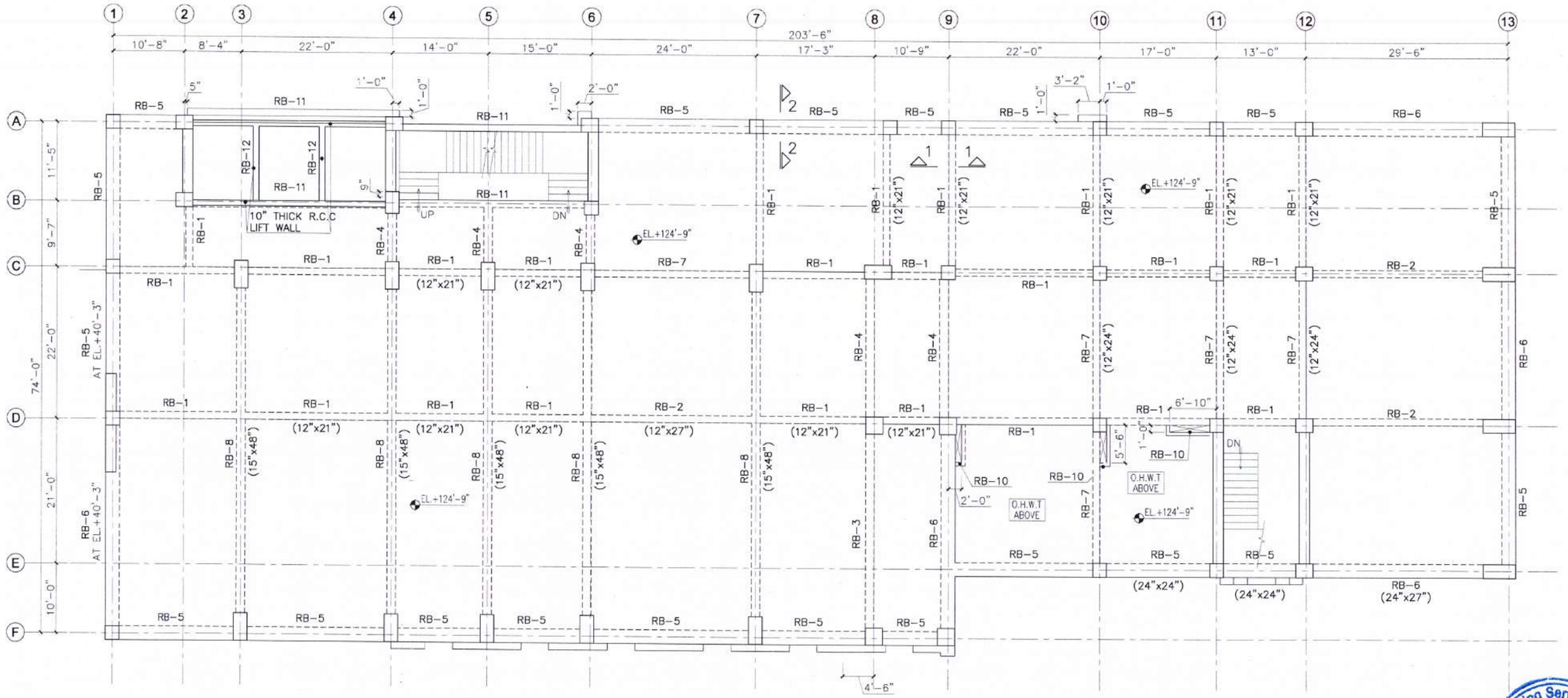
REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+112'-3"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G26
REV.: 0



ROOF FRAMING PLAN AT EL.+124'-9"

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.
5. ALL STAIR WAIST SLABS ARE 7" THICK UNLESS NOTED OTHERWISE.
6. FOR SCHEDULE OF BEAMS AT EL.124'-9", REFER DWG. NO. 4596/328/TD/G28.

Engineering Services PAKISTAN (PVT.) LTD. National A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ISLAMABAD OFFICE, ISLAMABAD. 3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13	PROJECT	JSMU
				ADMIN & ACADEMIC BUILDING	ROOF FRAMING PLAN AT EL.+124'-9"
				DATE	MARCH, 2026
				DRAWING No.	4596/328/TD/G27
				SCALE	N.T.S
				REV.	0

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
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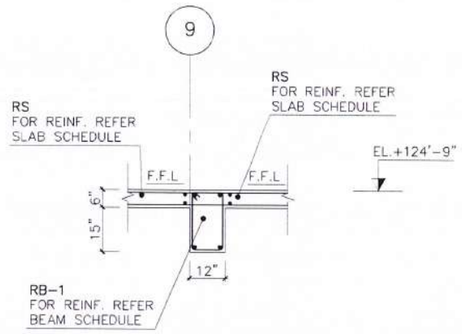
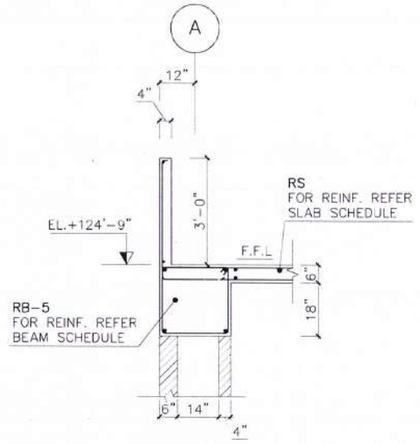
DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

BEAMS SCHEDULE AT EL.+124'-9"		
S.NO.	BEAM NO.	SIZE
1	RB-1	12" × 21"
2	RB-2	12" × 27"
3	RB-3	15" × 27"
4	RB-4	15" × 24"
5	RB-5	24" × 24"
6	RB-6	24" × 27"
7	RB-7	12" × 24"
8	RB-8	15" × 48"
9	RB-9	12" × 18"
10	RB-10	6" × 18"
11	RB-11	12" × 36"
12	RB-12	10" × 36"



SECTION 1-1
TYP. SECTION OF INTERNAL ROOF BEAM



SECTION 2-2
TYPICAL SECTION OF EXTERNAL ROOF BEAMS

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. FOR FRAMING PLAN AT EL.+124'-9", REFER DWG. NO. 4596/328/TD/G27.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN | SUBMITTED | RECOMMENDED | CHQ./VER. | APPROVED

PROJECT: JSMU

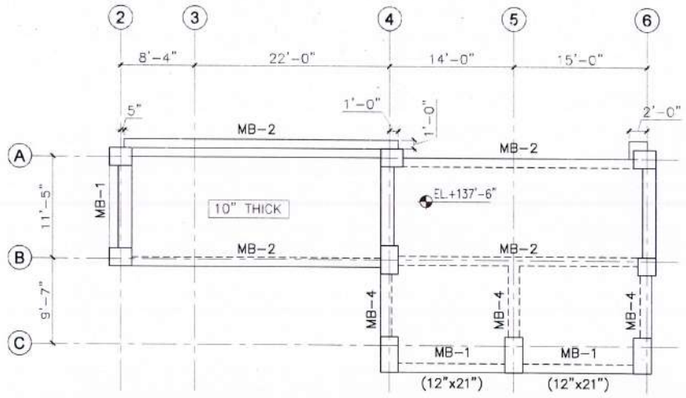
ADMIN & ACADEMIC BUILDING
SCHEDULE OF BEAMS AT EL.+124'-9"

SCALE: N.T.S

DATE: MARCH, 2026

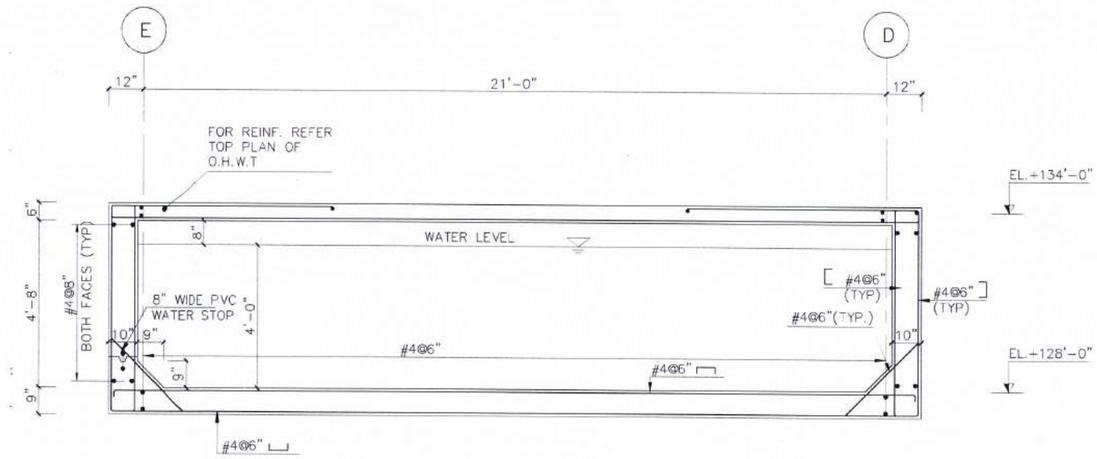
DRAWING No.: 4596/328/TD/G28

REV.: 0



FRAMING PLAN AT EL.+137'-6"

BEAMS SCHEDULE AT EL.+137'-6"		
S.NO.	BEAM NO.	SIZE
1	MB-1	12" × 21"
2	MB-2	12" × 27"
3	MB-3	15" × 27"
4	MB-4	15" × 24"



SECTION OF O.H.W.T.

NOTES:

1. FOR GENERAL NOTES, REFER DRAWING NO. 4596/328/TD/G01.
2. READ THIS DRAWING IN CONJUNCTION WITH ALL THE RELEVANT PROJECT DWG.
3. FOR TYPICAL DETAILS & TYPICAL ELEVATION OF BEAMS, REFER DRAWING NO. 4596/328/TD/G02(A) & (B).
4. ALL SLABS ARE 6½" THICK UNLESS NOTED OTHERWISE.

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ISLAMABAD OFFICE, ISLAMABAD.
3RD FLOOR, NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel. 051-9221910-13

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
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01			

DRAWN | SUBMITTED | RECOMMENDED | CHD./VER. | APPROVED

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
FRAMING PLAN AT EL.+137'-6"

SCALE: N.T.S
DATE: MARCH, 2026
DRAWING No.: 4596/328/TD/G29
REV.: 0

GENERAL NOTES :

1. PLUMBING WORKS SHALL BE COORDINATED WITH OTHER WORKS SUCH AS STRUCTURAL, ELECTRICAL, COMMUNICATION, AND HVAC ETC. TO AVOID CONFLICT OR INTERFERENCE BEFORE EXECUTION.
2. PIPES PASSING THROUGH WALLS, SLABS OR ROOFS SHALL PASS THROUGH SLEEVES AS SPECIFIED.
3. PROVIDE CLEAN OUT PLUG (COP) ON WALLS, VERTICAL STACKS OF WASTE, SOIL AND ROOF DRAINAGE ON EACH FLOOR OR AS SPECIFIED.
4. DRAINAGE STACKS SHALL BE CONNECTED TO UNDERGROUND DRAIN PIPE BY 90° LARGE/LONG RADIUS BEND OR TWO 45° BENDS AS PER SITE CONDITIONS.
5. ALL PIPE SIZES SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
6. SIZE OF FLOOR DRAIN SHALL BE SAME AS THE SIZE OF OUTLET DRAIN PIPE UNLESS OTHERWISE SPECIFIED.
7. WHEREVER FLOOR DRAIN OR TRAP IS SHOWN, SLOPE THE FLOOR TOWARDS THE DRAIN, AFTER COORDINATING WITH THE ENGINEER.
8. VENT PIPE THROUGH ROOF SHALL BE TERMINATED AT LEAST 600mm ABOVE FINISHED ROOF LEVEL AND NOT LESS THAN 300mm FROM VERTICAL SURFACE. EACH VENT TERMINAL SHALL BE MADE WATER TIGHT WITH THE ROOF BY PROPER FLUSHING AND CLAMPING AS PER ARCHITECTURAL DETAILS.
9. WHERE THE CHANGE OF DIRECTION IS 45° OR LESS, IT IS NOT NECESSARY TO PROVIDE A CLEAN OUT, HOWEVER WHEN THE CHANGE IN DIRECTION IS MORE THAN 45°, A CLEAN OUT SHOULD BE PROVIDED.
10. CLEAN OUTS, FLOOR TRAPS, AND FLOOR DRAINS SHALL BE FLUSHED WITH FLOORS.
11. ALL TRAPS AND FLOOR DRAINS SHALL HAVE A WATER SEAL NOT LESS THAN 50mm.
12. PROVIDE PRESSURE RELIEF VALVES OR ENERGY SHUT OFF DEVICES FOR ALL EQUIPMENT USED FOR THE HEATING AND STORAGE OF HOT WATER.
13. ACCESS PANELS / DOORS FOR PIPES AND FOR THE OPERATION OF VALVES SHALL BE PROVIDED IN DUCTS AS PER THE ENGINEER'S INSTRUCTIONS AND REQUIREMENTS OF SITE.
14. PROVIDE GATE VALVES ON EACH ENTRY TO TOILETS AND ON THE LONG RUNS IN TOILETS WHETHER IT IS SHOWN ON DRAWINGS OR NOT AND AFTER OBTAINING THE ENGINEER'S INSTRUCTIONS.
15. THE CONTRACTOR SHALL LAY SEWER LINES AND CONSTRUCT MANHOLES AFTER CHECKING AND COORDINATING WITH EXTERNAL MANHOLES AND ALSO OBTAIN APPROVAL FROM THE ENGINEER BEFORE EXECUTION WORK.
16. PIPE SLOPE OF WASTE AND DRAIN SHALL BE AS PER INTERNATIONAL PLUMBING CODE.
17. ROOF DRAIN AND SLEEVES ON ROOF TO BE INSTALLED AFTER COORDINATING WITH OTHER SPECIALITIES.
18. THE CONTRACTOR SHALL COORDINATE ALL AC DRAIN CONNECTIONS BEFORE EXECUTION.
19. ALL PIPES PASSING THROUGH ROOF AND EXTERIOR WALLS SHALL BE PROPERLY SEALED AS PER THE STANDARD PRACTICES AND AS APPROVED BY THE ENGINEER.
20. DIELECTRIC UNIONS SHALL BE PROVIDED AT ALL PIPING CONNECTIONS OF DISSIMILAR METALS.
21. EXACT ROUTE AND LOCATION OF EACH PIPELINE SHALL BE DETERMINED IN COORDINATION WITH OTHER TRADES PRIOR TO INSTALLATION.
22. PROVIDE 14 SWG G.I SHEET SLEEVE FOR PIPE PASSING THROUGH ANY STRUCTURAL MEMBER OR WALL AS APPROVED BY THE ENGINEER. THE GAP BETWEEN THE PIPE AND SLEEVE SHOULD BE 15mm.
23. THE GAP BETWEEN SLEEVES / OPENINGS AND PIPE TO BE FILLED WITH SUITABLE FIRE RESISTANT SEALANT / FILLER AS PER THE RECOMMENDATIONS OF THE MANUFACTURER AND AS APPROVED BY THE ENGINEER.
24. ALL UNEXPOSED WATER SUPPLY PIPE (HOT & COLD) MATERIAL SHALL BE POLYPROPYLENE (PPR) PN-20. (ALL PPR PIPING DIAMETER FOR WATER SUPPLY SHOWN IN THE DRAWINGS ARE OUTER DIAMETERS)
25. ALL SANITARY DRAINAGE PIPING (SOIL, WASTE & VENT PIPE) & RAIN WATER PIPE MATERIAL SHALL BE uPVC ASTM D-1785, S.CH.40.
26. ALL EXPOSED WATER SUPPLY PIPE MATERIAL AT ROOF SHALL BE PPR WITH INSULATION OF FOAM & MASTIC TAPE AS APPROVED.

LEGENDS:

SYMBOL	DESCRIPTION
	WASH BASIN
	MUSLIM SHOWER / BIB TAP
CV/NRV	CHECK VALVE / NON-RETURN VALVE
CO	CLEAN OUT PLUG
	DIRECTION OF FLOW
EWC	EUROPAEN WATER CLOSET
FD	FLOOR DRAIN
FT	FLOOR TRAP
FV	FLOAT VALVE
FCO	FLOOR CLEANOUT
	ELECTRIC WATER HEATER
	GATE VALVE IN CHAMBER
GV / IV	GATE VALVE ON HORIZONTAL PIPE
GV / IV	GATE VALVE ON VERTICAL PIPE
	GULLY TRAP
	KITCHEN SINK
	SCUPPER SIDE WALL OUTLET
	MANHOLE
	PRESSURE REDUCING VALVE
RWP	RAIN WATER PIPE
SEW	SEWER PIPE
SP	SOIL PIPE
WP	WASTE PIPE
BCWP	BOOSTER COLD WATER SUPPLY PIPE
GCWP	GRAVITY WATER SUPPLY PIPE
HWP	HOT WATER PIPE
	RAIN WATER PIPE FREE DISCHARGE

ABBREVIATIONS:

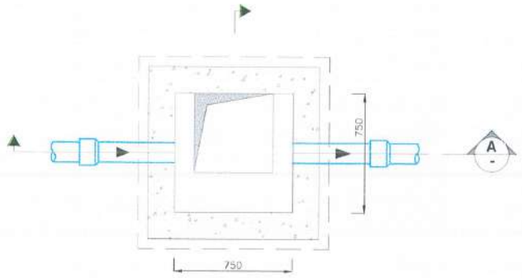
SYMBOL	DESCRIPTION
AV	AIR RELEASE VALVE
B.F.S	BELOW FLOOR SLAB
B/G	BELOW GROUND
HWP	HOT WATER PIPE
CWP	COLD WATER PIPE
CWR	COLD WATER RISER
CV	CHECK VALVE
COP	CLEAN OUT PLUG
ø	DIAMETER OF PIPE
EWH	ELECTRIC WATER HEATER
F/B	FROM BELOW
F/A	FROM ABOVE
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FT	FLOOR TRAP
GV	GATE VALVE
RWP	WATER PIPE
RWO	RAIN WATER OUTLET
SP	SOIL PIPE
WP	WASTE PIPE
T/B	TO BELOW
T/A	TO ABOVE
VP	VENT PIPE
A.F.C	ABOVE FALSE CEILING
A.F.F.L	ABOVE FINISH FLOOR LEVEL
GCWP	GRAVITY COLD WATER SUPPLY PIPE
BCWP	BOOSTER COLD WATER SUPPLY PIPE
SVP	SOIL VENT PIPE
WVP	WASTE VENT PIPE

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

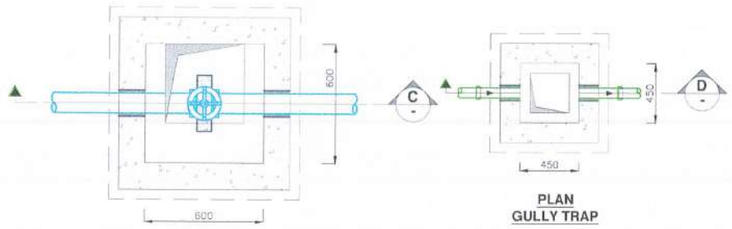
NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101
2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	04			DRAWN: AD
				03			SUBMITTED: HS
				02			RECOMMENDED: SAM
				01	MAR.2026	ISSUED FOR TENDER	CHD./AER: AN
				REV.	DATE	DESCRIPTION / APPROVED	APPROVED:
PROJECT	JSMU	ADMIN & ACADEMIC BUILDING					SCALE: N.T.S
		LEGEND & NOTES					
		DATE: MARCH, 2026	DRAWING No: 4596/50J/TD/M101				REV: 0

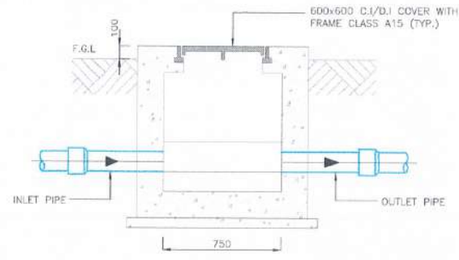


PLAN
SEWER MANHOLE

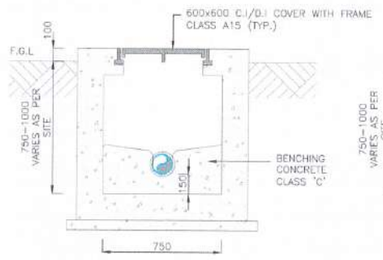


PLAN
GATE VALVE CHAMBER

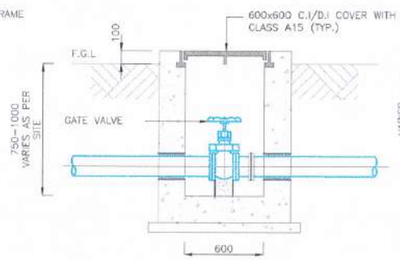
PLAN
GULLY TRAP



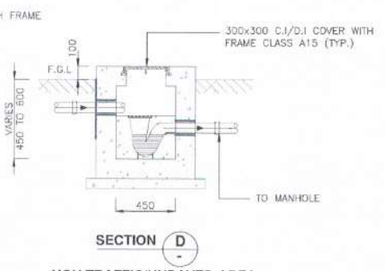
SECTION A
NON TRAFFIC/UNPAVED AREA



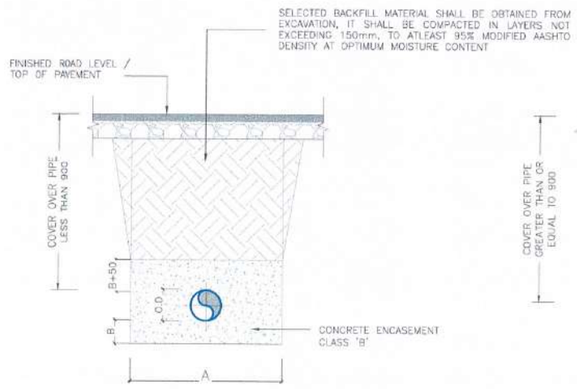
SECTION B
NON TRAFFIC/UNPAVED AREA



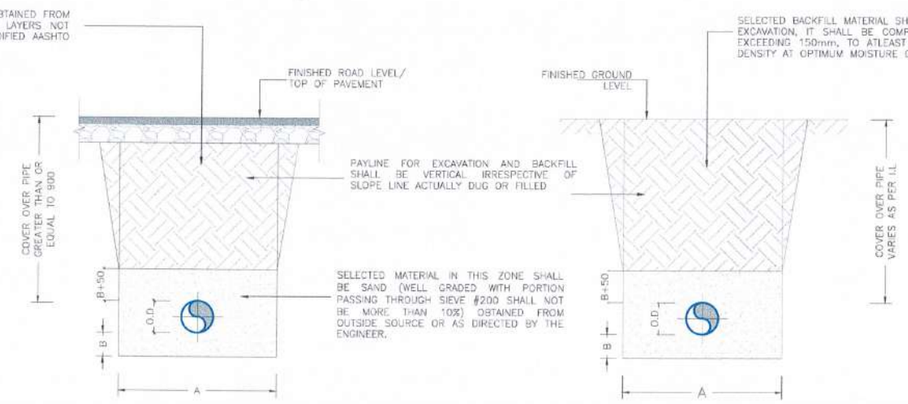
SECTION C
NON TRAFFIC/UNPAVED AREA



SECTION D
NON TRAFFIC/UNPAVED AREA



TYPICAL TRENCH DETAIL
IN TRAFFIC AREA



TYPICAL TRENCH DETAIL
IN NON TRAFFIC AREA

PIPE DIA. (mm)	'A' (mm)	'B' (mm)
150	900	75
200	900	75
250	1000	100
300	1200	100

TABLE OF TRENCH DIMENSIONS

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI.
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225439-34

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01	MAR 2026	ISSUED FOR TENDER	

DRAWN	AD
SUBMITTED	HS
RECOMMENDED	SAM
CHD./VER.	AN
APPROVED	

PROJECT: JSMU

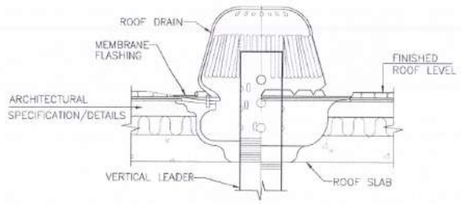
ADMIN & ACADEMIC BUILDING
MISCELLANEOUS
DETAILS

SCALE: N.T.S

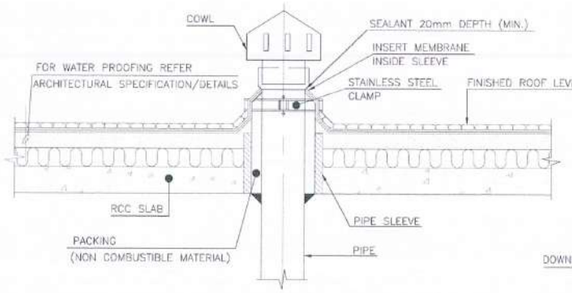
DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M102

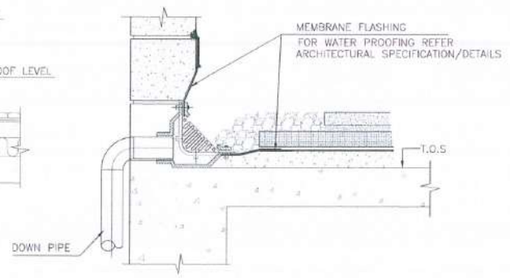
REV.: 0



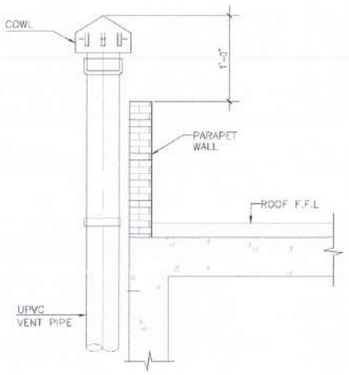
ROOF DRAIN (DOME TYPE)
DETAIL (TYP)



VENT PIPE THROUGH ROOF DETAIL

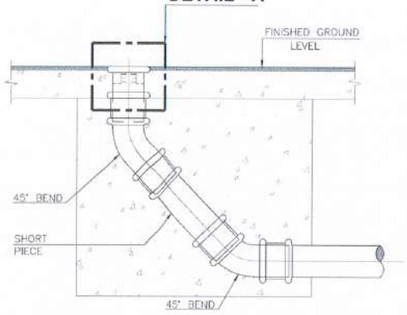


SCUPPER DRAIN (SIDE INLET TYPE)
DETAIL (TYP)

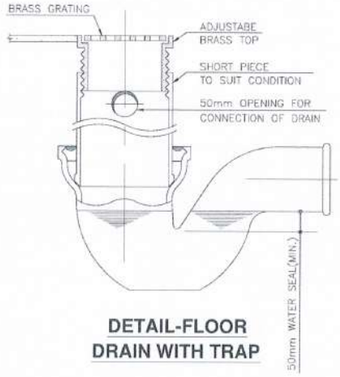


VENT PIPE DETAIL AT PARAPET WALL

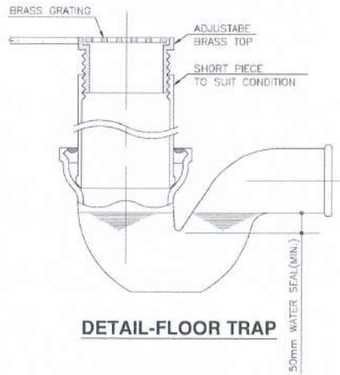
DETAIL - A



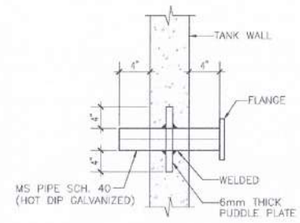
FLOOR CLEAN OUT DETAIL



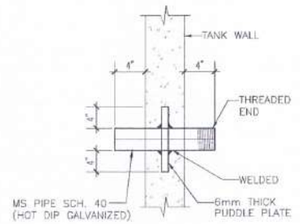
DETAIL-FLOOR DRAIN WITH TRAP



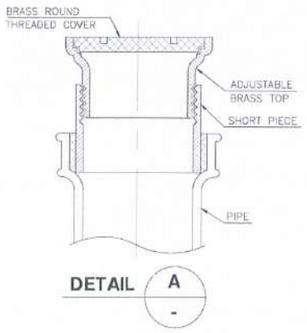
DETAIL-FLOOR TRAP



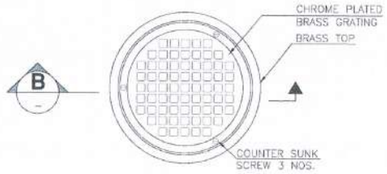
PUDDLE FLANGE DETAIL
(FOR PIPE DIA. ABOVE 50mm)



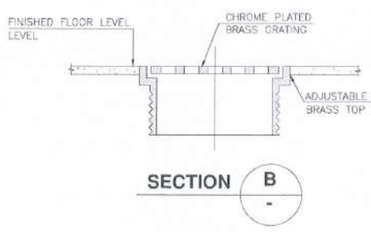
PUDDLE FLANGE DETAIL
(FOR PIPE DIA. UP TO 50mm)



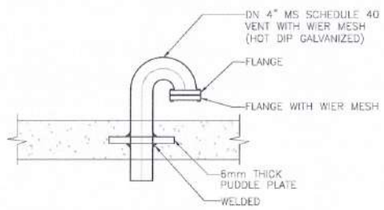
DETAIL A / -



PLAN
CHROME PLATED BRASS GRATING COVER



SECTION B / -



GOOSE NECK DETAIL TYPICAL

National Engineering Services Pakistan LLC. A&P DIVISION Karachi

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04		DRAWN: AB	PROJECT: JSMU
		03		SUBMITTED: RS	
		02		RECOMMENDED: SAM	
		01 MAR 2026	ISSUED FOR TENDER	CHD./VER: AN	
		REV. DATE	DESCRIPTION APPROVED	APPROVED	

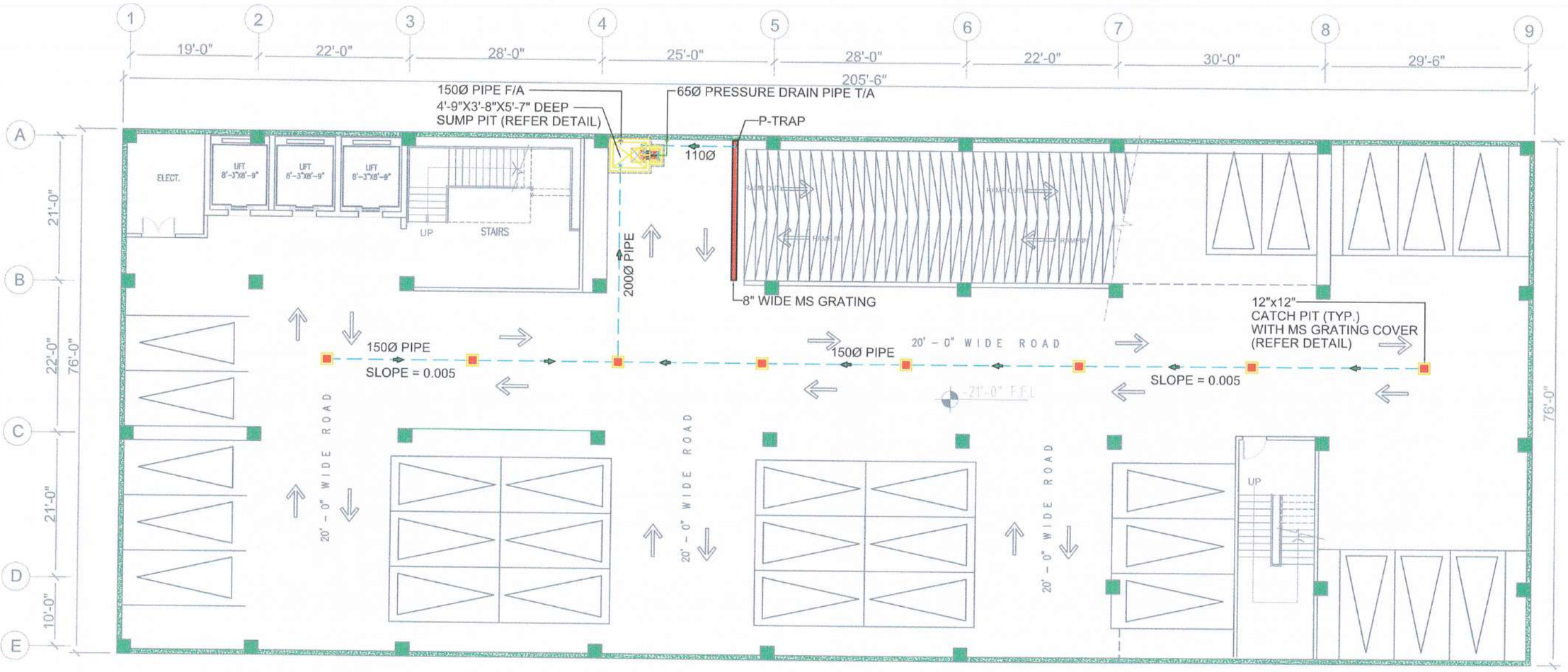
ADMIN & ACADEMIC BUILDING
MISCELLANEOUS DETAILS

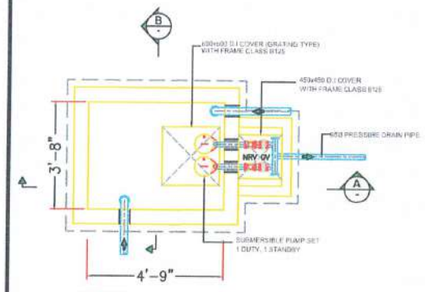
SCALE: N.T.S.

DATE: MARCH, 2026

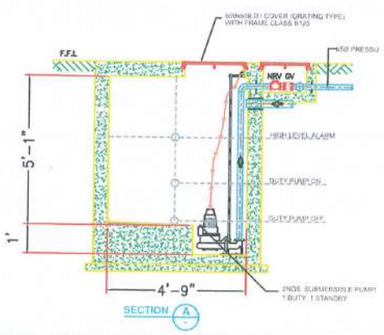
DRAWING No: 4596/50J/TD/ M103

REV: 0

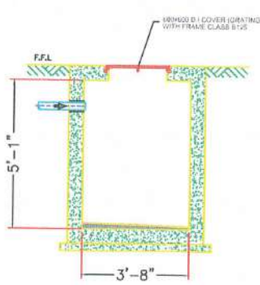




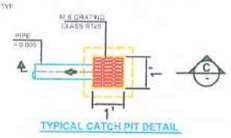
SUMP PIT PLAN



SECTION A



SECTION B



TYPICAL CATCH PIT DETAIL

SECTION C-C

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

National Engineering Services Pakistan (Pvt.) Ltd. ★ A&P Division Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	04			DRAWN	AD	PROJECT: JSMU
		03			SUBMITTED	HS	
		02			RECOMMENDED	SAM	
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER.	AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

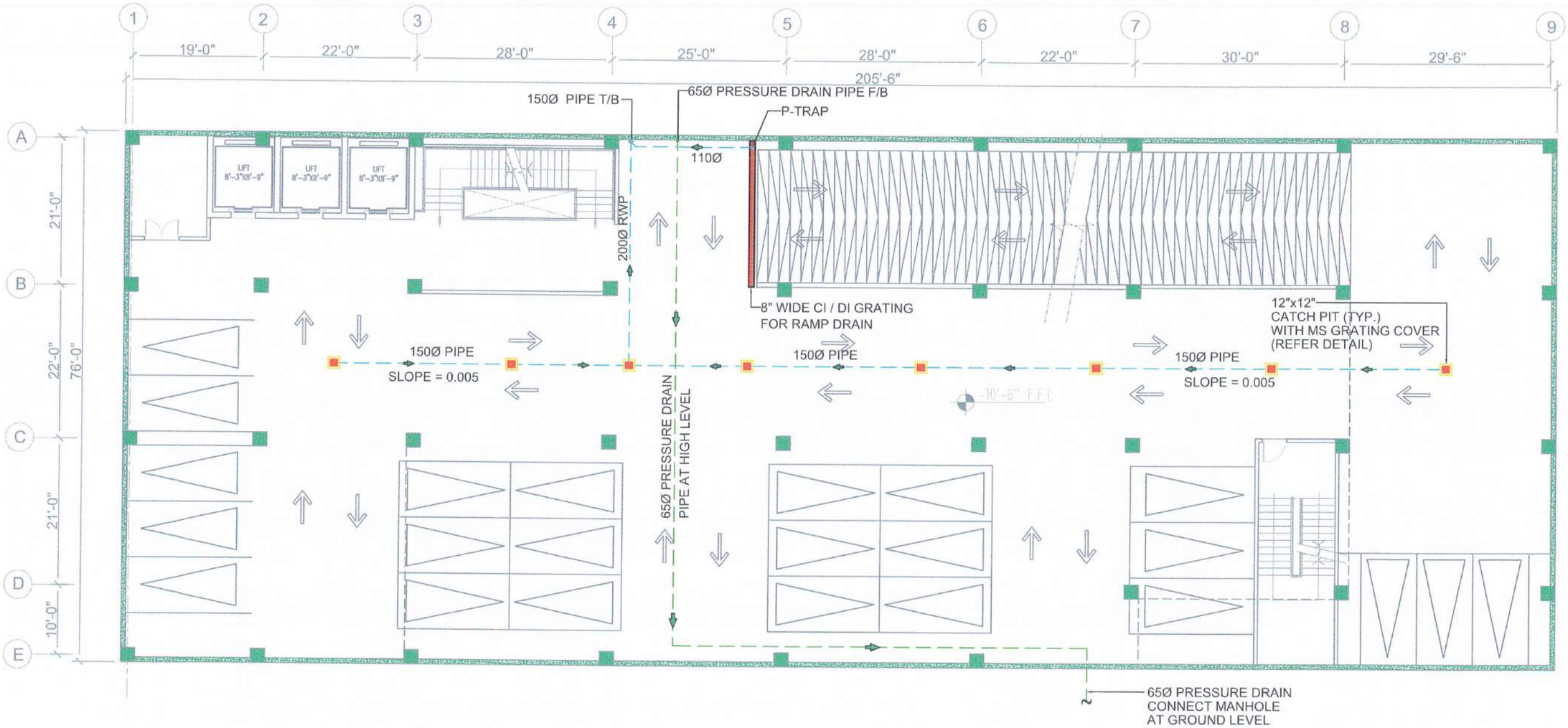
ADMIN & ACADEMIC BUILDING
BASEMENT-02 PLAN
DRAINAGE LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No: 4596/50J/TD/ M104

REV: 0



COVERED ARAE = 15056 SQ.FT

TOTAL CARS PARKING B1 +B2 = 52

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

NOTES:

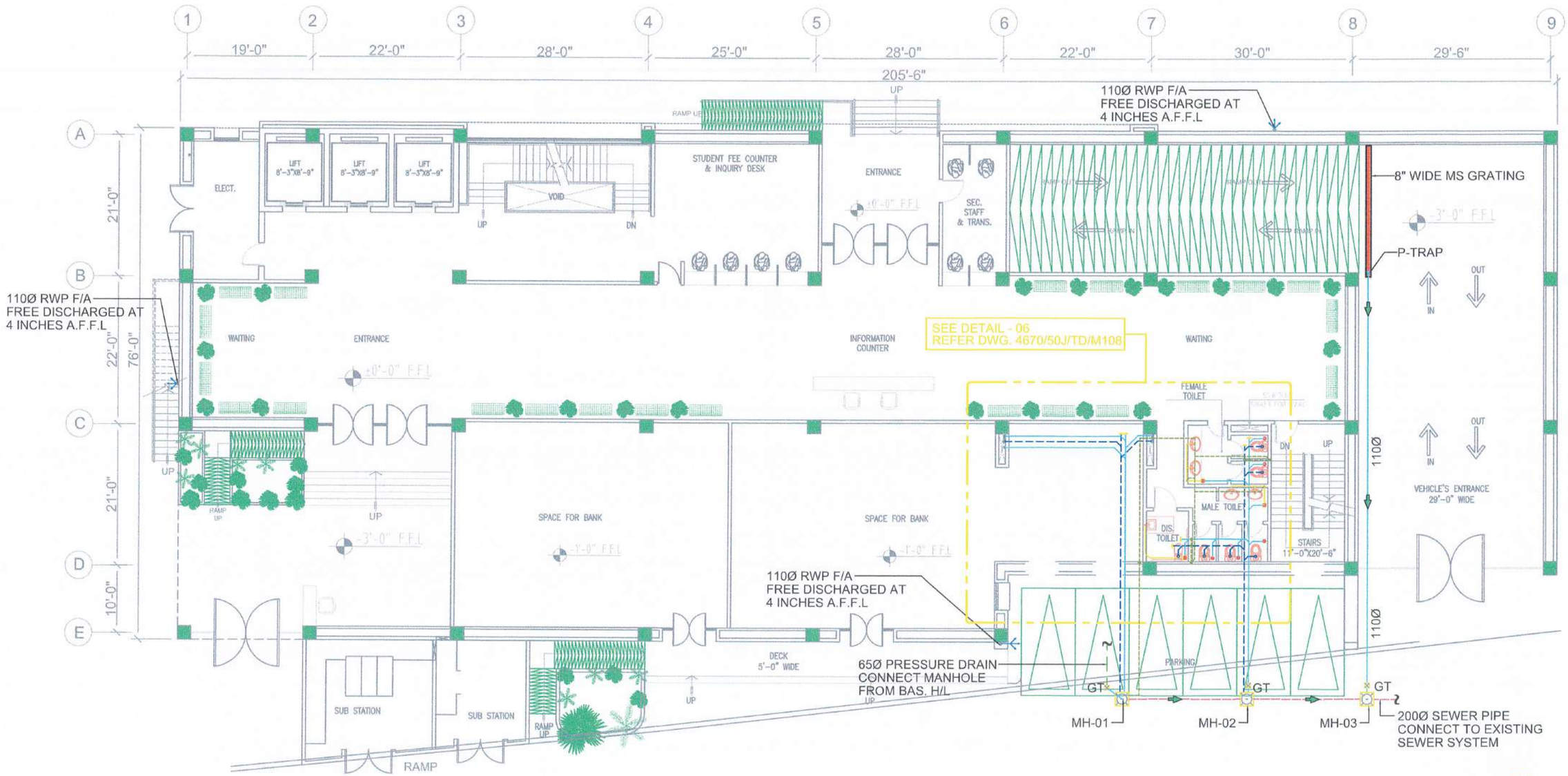
1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

COORDINATION DRAWING

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04				DRAWN: AD	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING BASEMENT - 01 PLAN DRAINAGE LAYOUT
		03				SUBMITTED: HS		
		02				RECOMMENDED: SAM		
		01	MAR.2026	ISSUED FOR TENDER		CHD./VER: AN		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

SCALE	DATE	DRAWING No.	REV.
1/16"=1'-0"	MARCH, 2026	4596/50J/TD/ M105	0



GROUND FLOOR PLAN
MAIN ENTRANCE
GROUND COVERAGE = 12832 SQ.FT

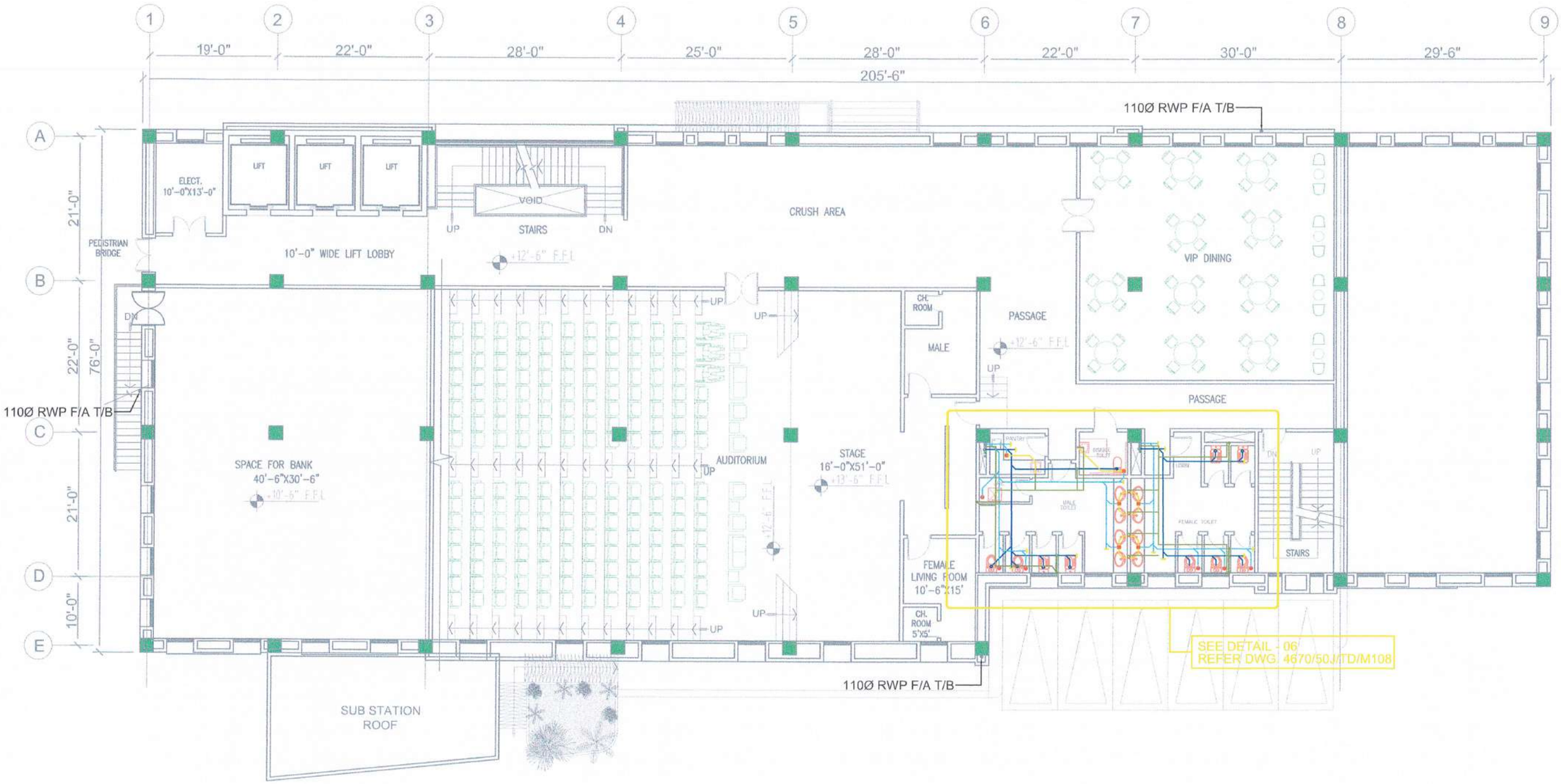
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101
2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi, Tel: 99225438-34	04			DRAWN: MD	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING GROUND FLOOR PLAN DRAINAGE LAYOUT
		03			SUBMITTED: HS		
		02			RECOMMENDED: SAM		
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER.: AN		DATE: MARCH, 2026
		REV.	DATE	DESCRIPTION	APPROVED / APPROVED		DRAWING No.: 4596/50J/TD/ M106

SCALE: 1/16"=1'-0"
REV.: 0



1ST FLOOR PLAN

VIP DINE AND AUDITORIUM

COVERED AREA 10712 SQ.FT

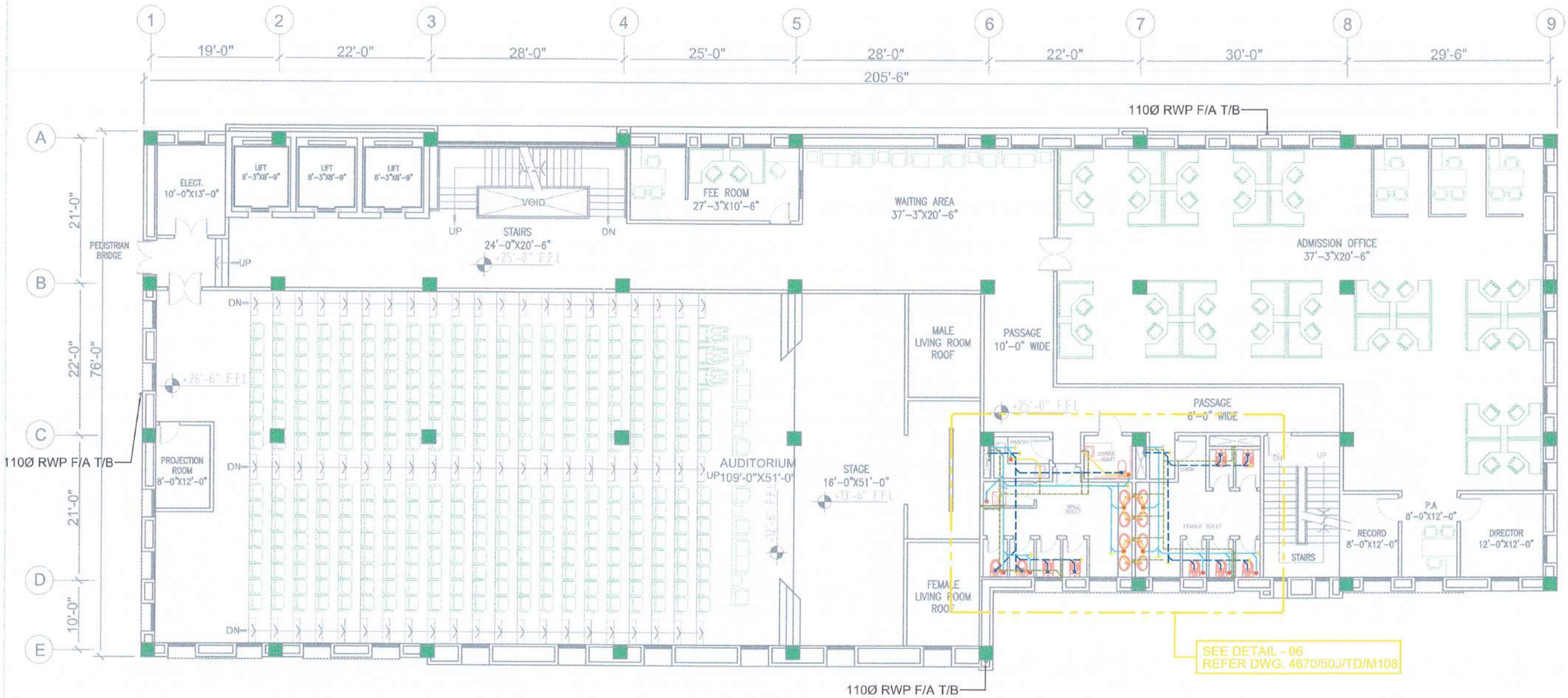
NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34						
	04				DRAWN	AD	PROJECT: JSMU
	03				SUBMITTED	HS	ADMIN & ACADEMIC BUILDING 1ST FLOOR PLAN DRAINAGE LAYOUT
	02				RECOMMENDED	SAM	SCALE: 1/16"=1'-0"
	01	MAR.2026	ISSUED FOR TENDER		CHD./VER.	AN	
	REV.	DATE	DESCRIPTION	APPROVED	APPROVED		DATE: MARCH. 2026 / DRAWING No.: 4596/50J/TD/ M107 / REV.: 0



2ND FLOOR PLAN

ADMIN AND AUDITORIUM
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

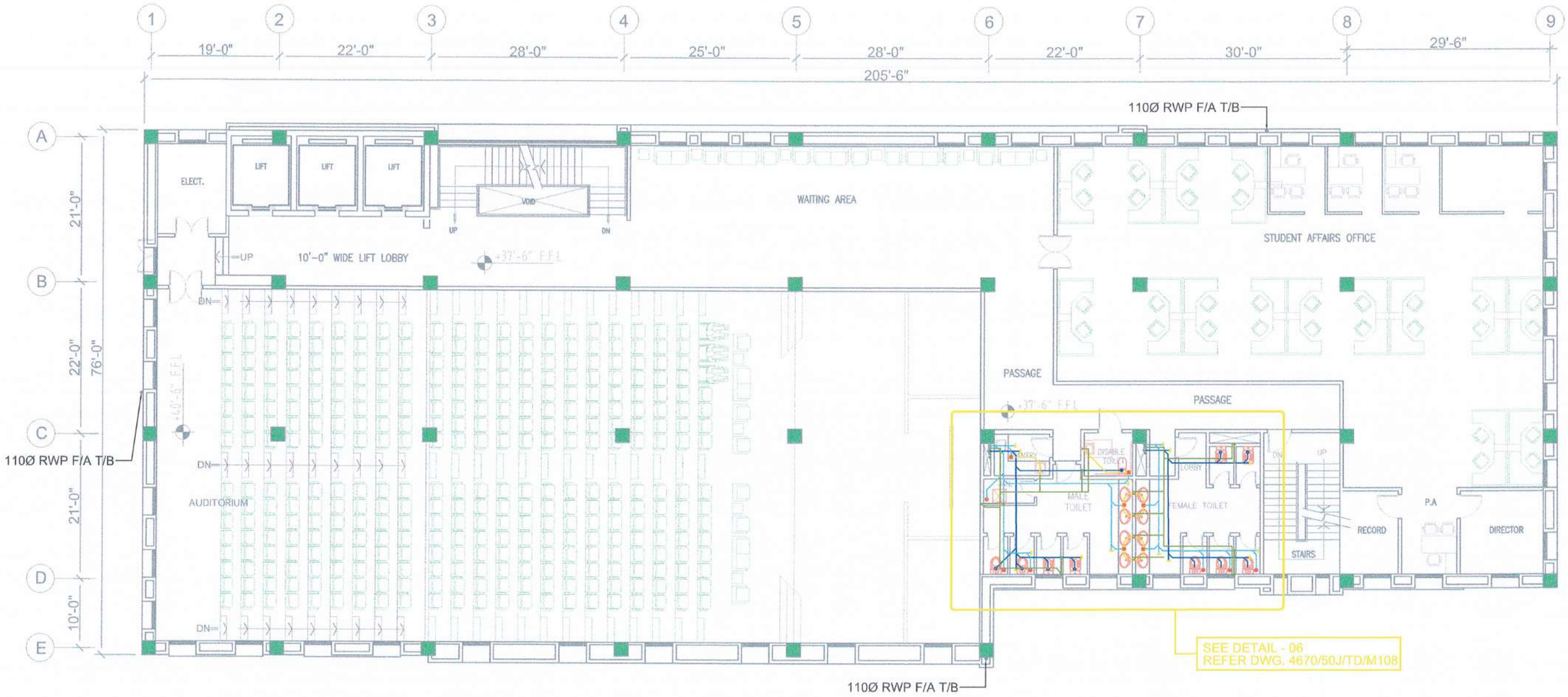
NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101
2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	04				DRAWN:	AD	PROJECT: JSMU
		03				SUBMITTED:	HS	
		02				RECOMMENDED:	SAM	
		01	MAR.2026	ISSUED FOR TENDER		CHD./VER.	AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

ADMIN & ACADEMIC BUILDING
2ND FLOOR PLAN
DRAINAGE LAYOUT

SCALE: 1/16"=1'-0"
DATE: MARCH, 2026
DRAWING No.: 4596/50J/TD/ M108
REV.: 0



3RD FLOOR PLAN

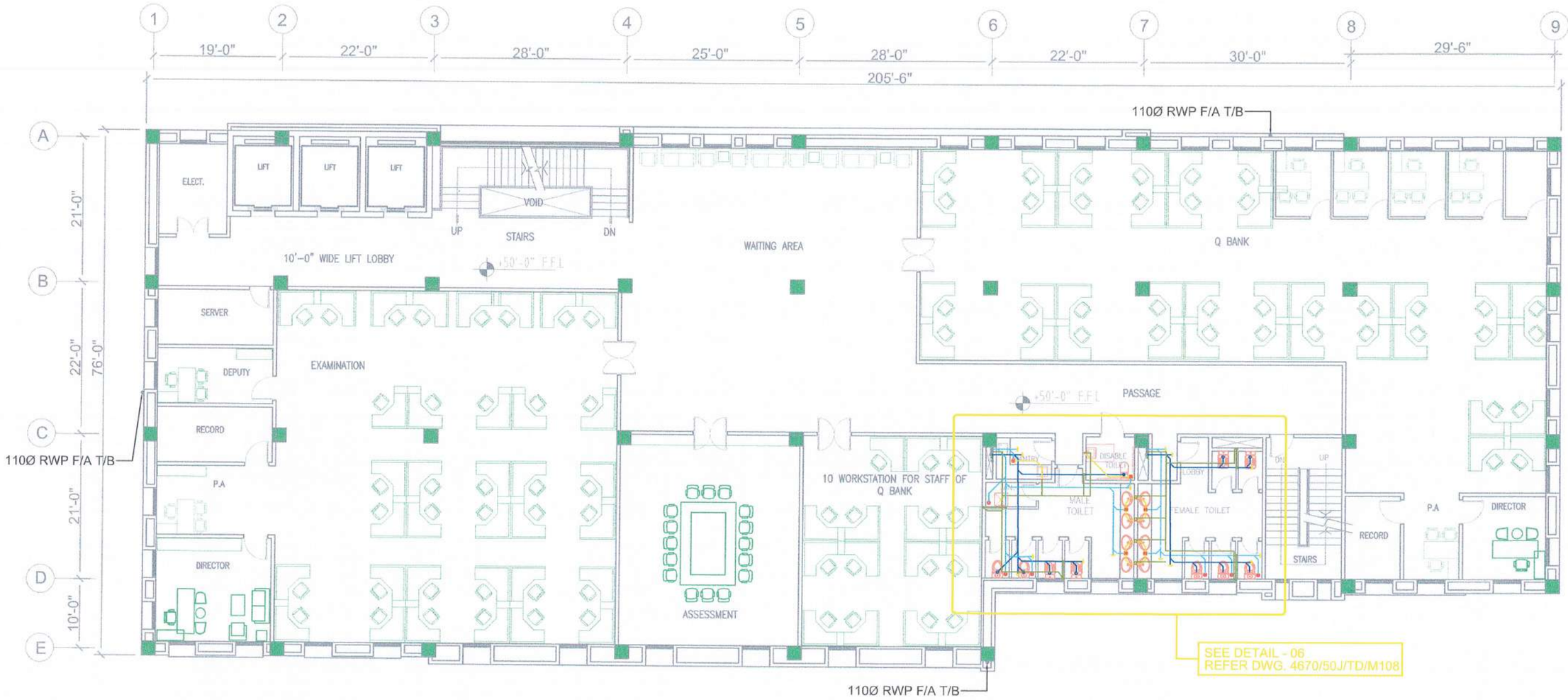
STUDENT AFFAIRS AND AUDITORIUM
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101
2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04				DRAWN	AD	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING 3RD FLOOR PLAN DRAINAGE LAYOUT	SCALE: 1/16"=1'-0"
		03				SUBMITTED	HS			
		02				RECOMMENDED	SAM			
		01	MAR.2026	ISSUED FOR TENDER		CHD./VER.	AN		DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/ M109
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				REV.: 0



4TH FLOOR PLAN

Q. BANK/EXAMINATION
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04			DRAWN	AD	PROJECT: JSMU
		03			SUBMITTED	HS	
		02			RECOMMENDED	SAM	
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER.	AM	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

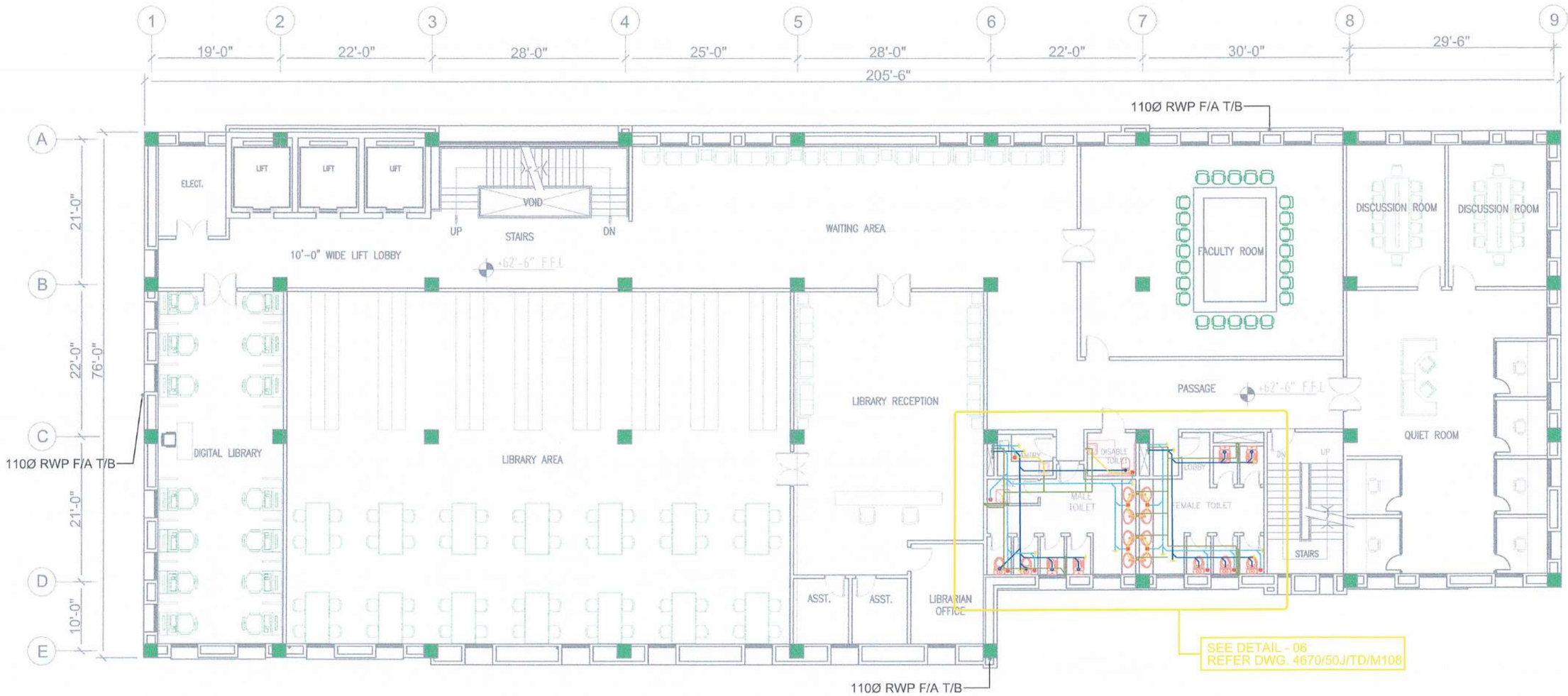
ADMIN & ACADEMIC BUILDING
4TH FLOOR PLAN
DRAINAGE LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M110

REV.: 0



5TH FLOOR PLAN
LIBRARY
COVERED AREA 10712 SQ.FT

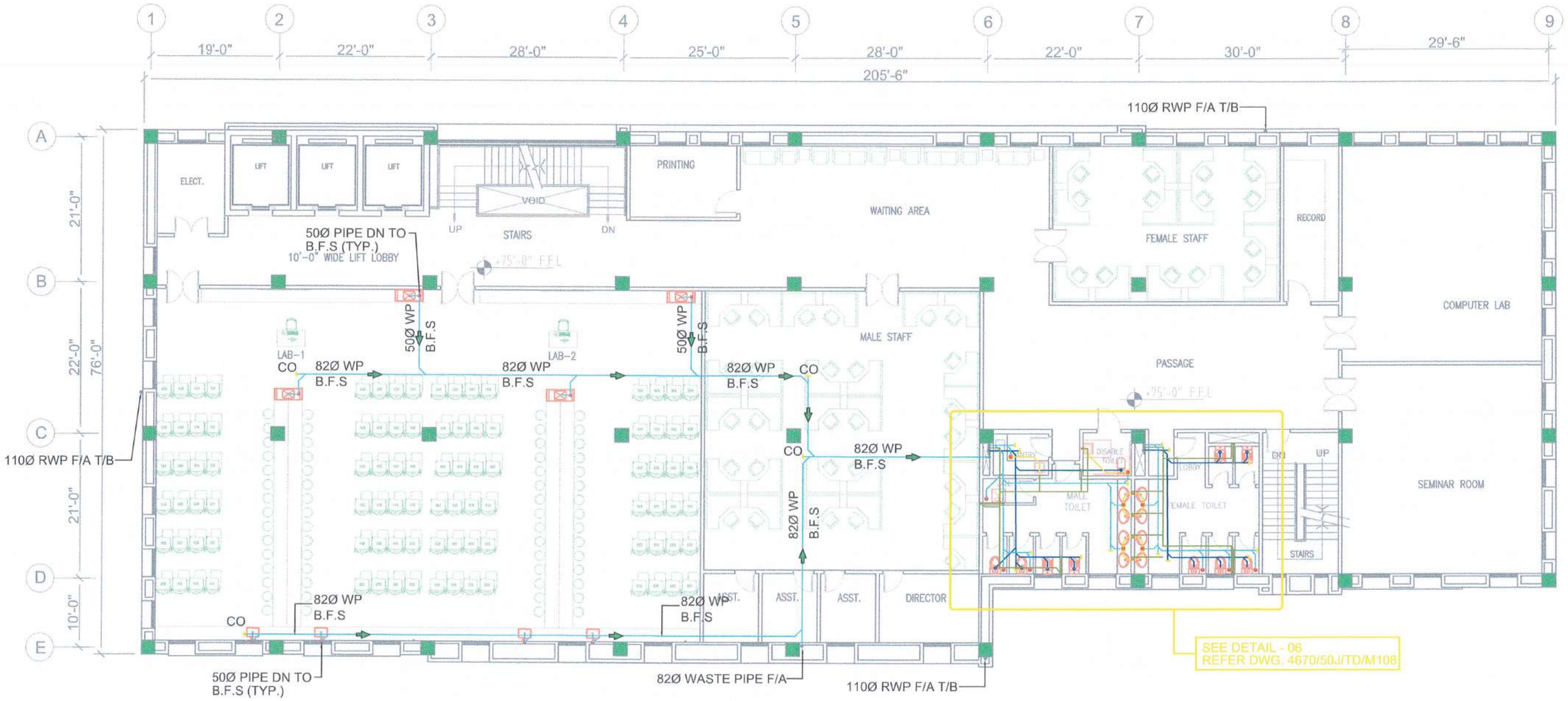
National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101
2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	04			DRAWN: AD	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING 5TH FLOOR PLAN DRAINAGE LAYOUT
		03			SUBMITTED: HS		
		02			RECOMMENDED: SAM		
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER. AN		
		REV.	DATE	DESCRIPTION APPROVED	APPROVED		

SCALE: 1/16"=1'-0"
DATE: MARCH, 2026
DRAWING No.: 4596/50J/TD/ M111
REV.: 0



6TH FLOOR PLAN

DPT

COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225439-34	PROJECT	JSMU
		04		DRAWN	AD
		03		SUBMITTED	HS
		02		RECOMMENDED	SAM
		01	MAR.2026 ISSUED FOR TENDER	CHD./VER.	AN
		REV.	DATE DESCRIPTION APPROVED	APPROVED	

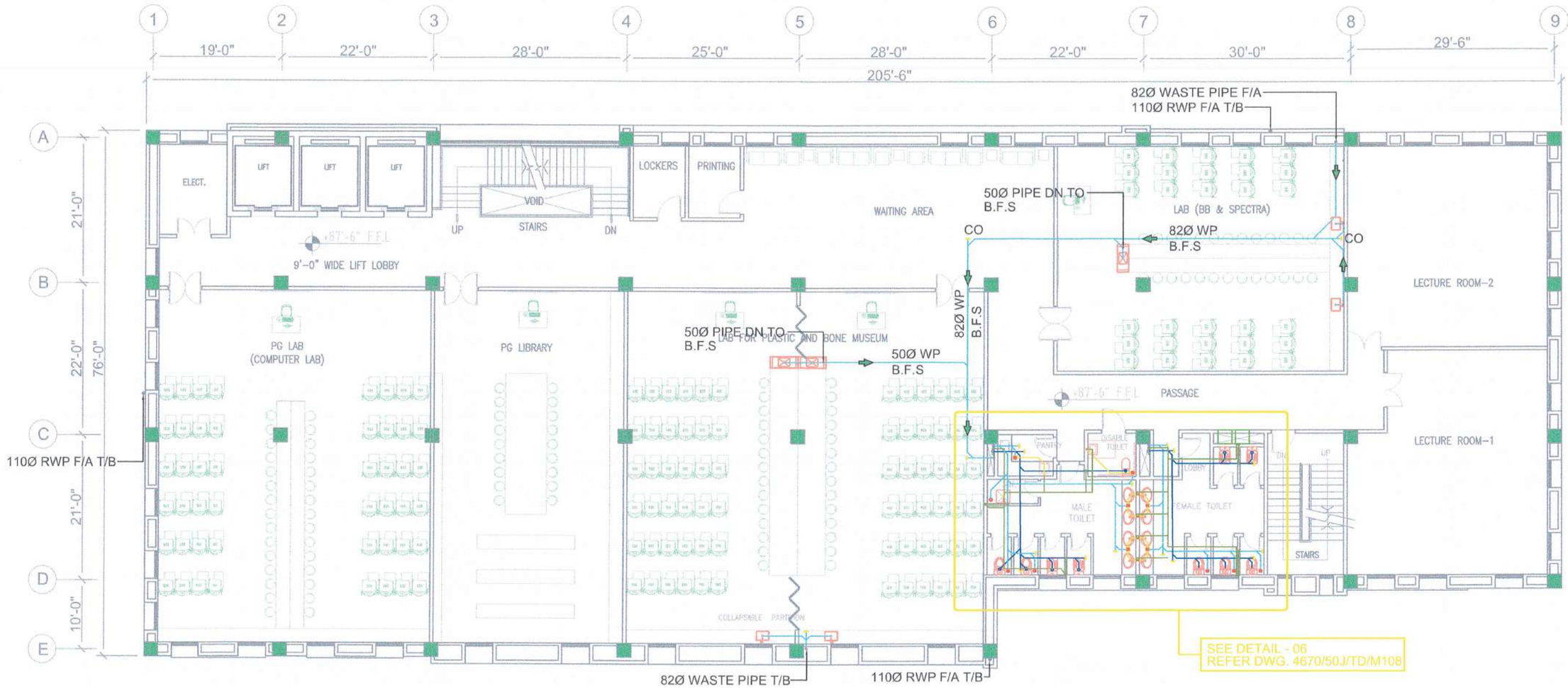
ADMIN & ACADEMIC BUILDING
6TH FLOOR PLAN
DRAINAGE LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M112

REV.: 0



7TH FLOOR PLAN

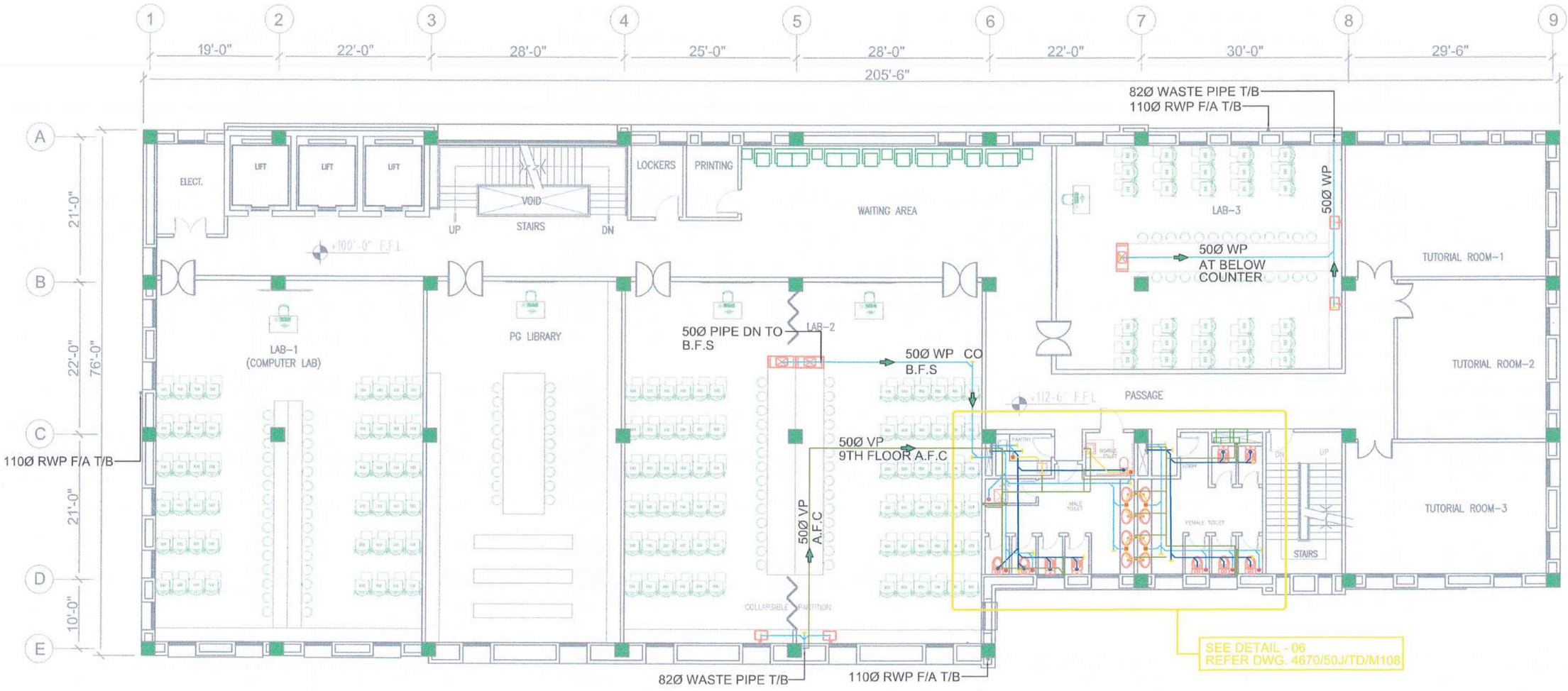
LABS AND TUTORIAL ROOMS
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101
2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225439-34	04			DRAWN	AD
				03			SUBMITTED	HS
				02			RECOMMENDED	SAM
				01	MAR.2026	ISSUED FOR TENDER	CHD./VER.	AN
				REV.	DATE	DESCRIPTION	APPROVED	APPROVED
PROJECT	JSMU	ADMIN & ACADEMIC BUILDING 7TH FLOOR PLAN DRAINAGE LAYOUT					SCALE	1/16"=1'-0"
							DATE	MARCH, 2026
							DRAWING No.	4596/50J/TD/ M113
							REV.	0



8TH AND 9TH FLOOR PLANS ARE TYPICAL

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 9922543-34	04				DRAWN	AD	PROJECT: JSMU
		03				SUBMITTED	HS	
		02				RECOMMENDED	SAM	
		01	MAR,2026	ISSUED FOR TENDER		CHD./VER.	AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

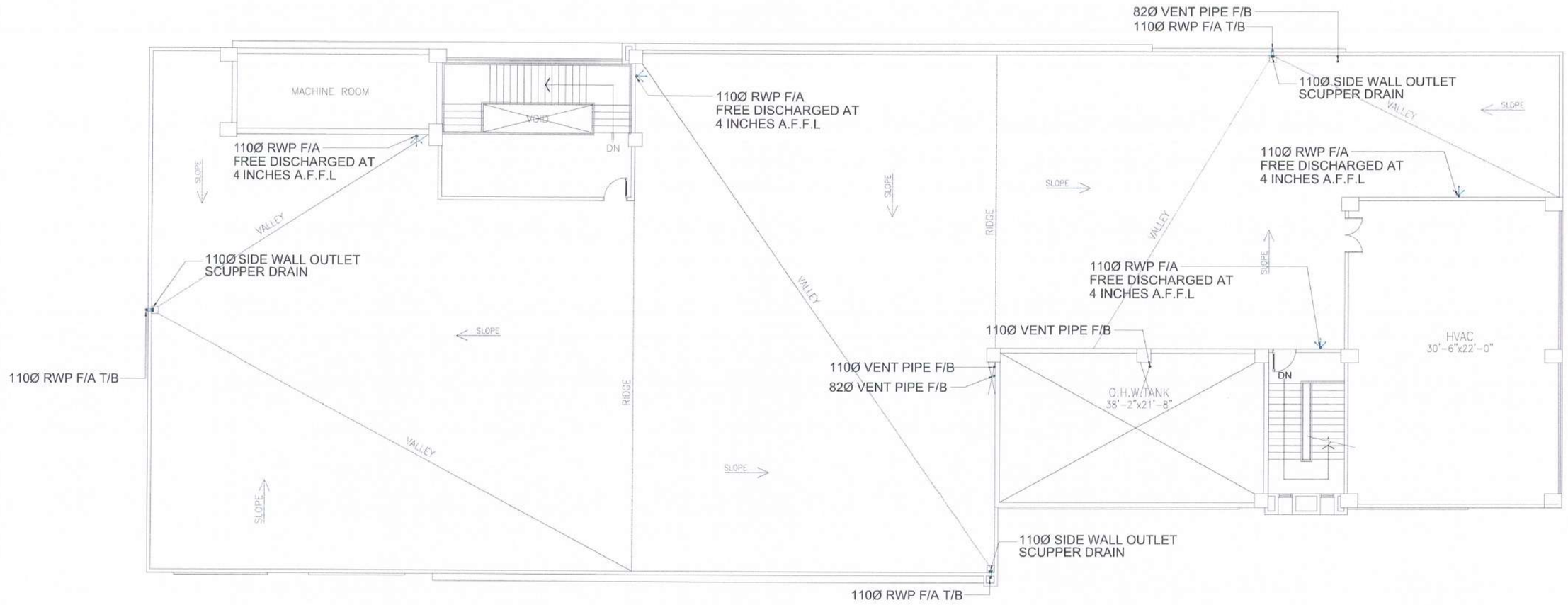
ADMIN & ACADEMIC BUILDING
8TH & 9TH FLOOR PLAN
DRAINAGE LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M114

REV.: 0



NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	04			DRAWN	AD	PROJECT: JSMU
		03			SUBMITTED	HS	
		02			RECOMMENDED	SAM	
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER.	AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

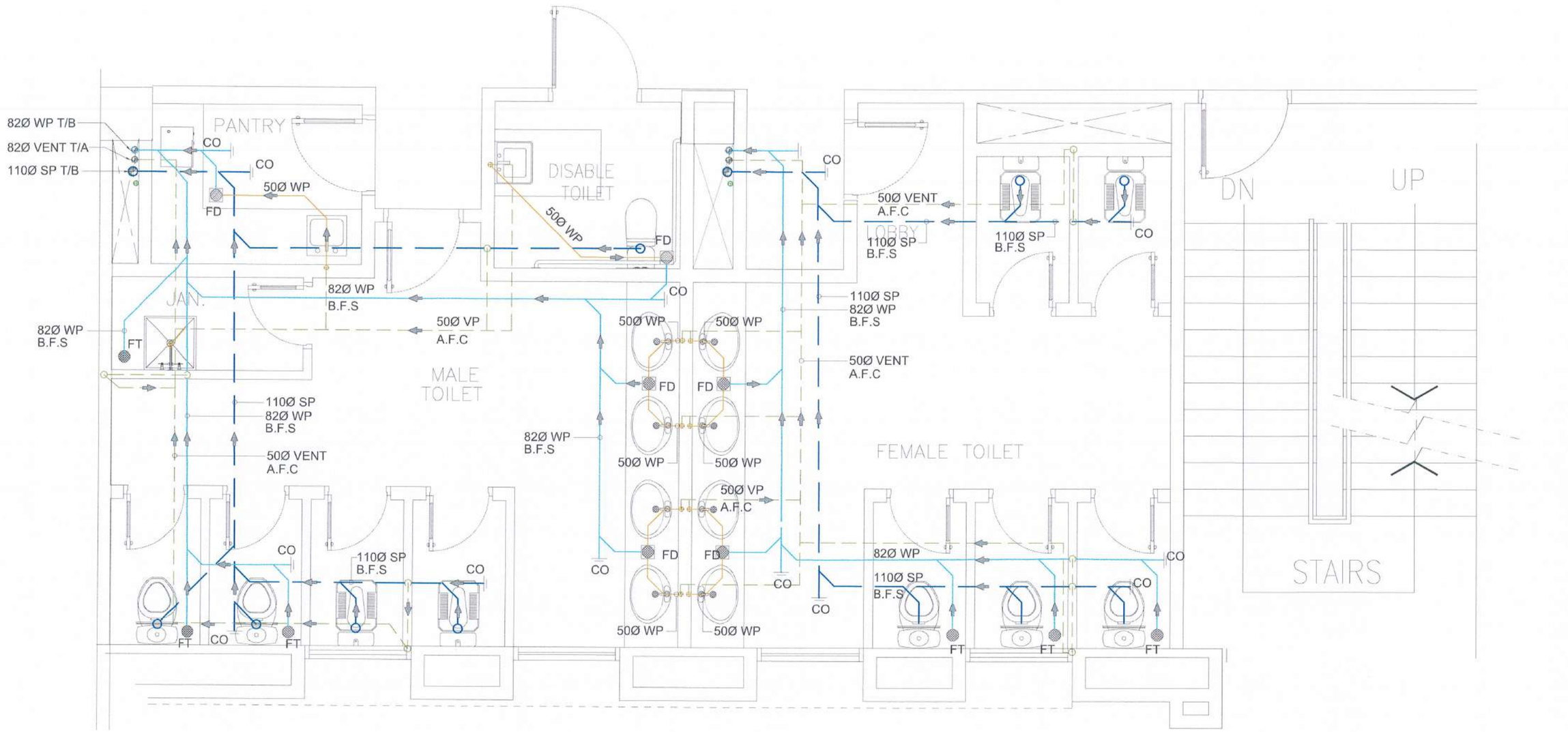
ADMIN & ACADEMIC BUILDING
ROOF PLAN
DRAINAGE LAYOUT

SCALE:

DATE: MARCH, 2026

DRAWING No: 4596/50J/TD/M115

REV: 0



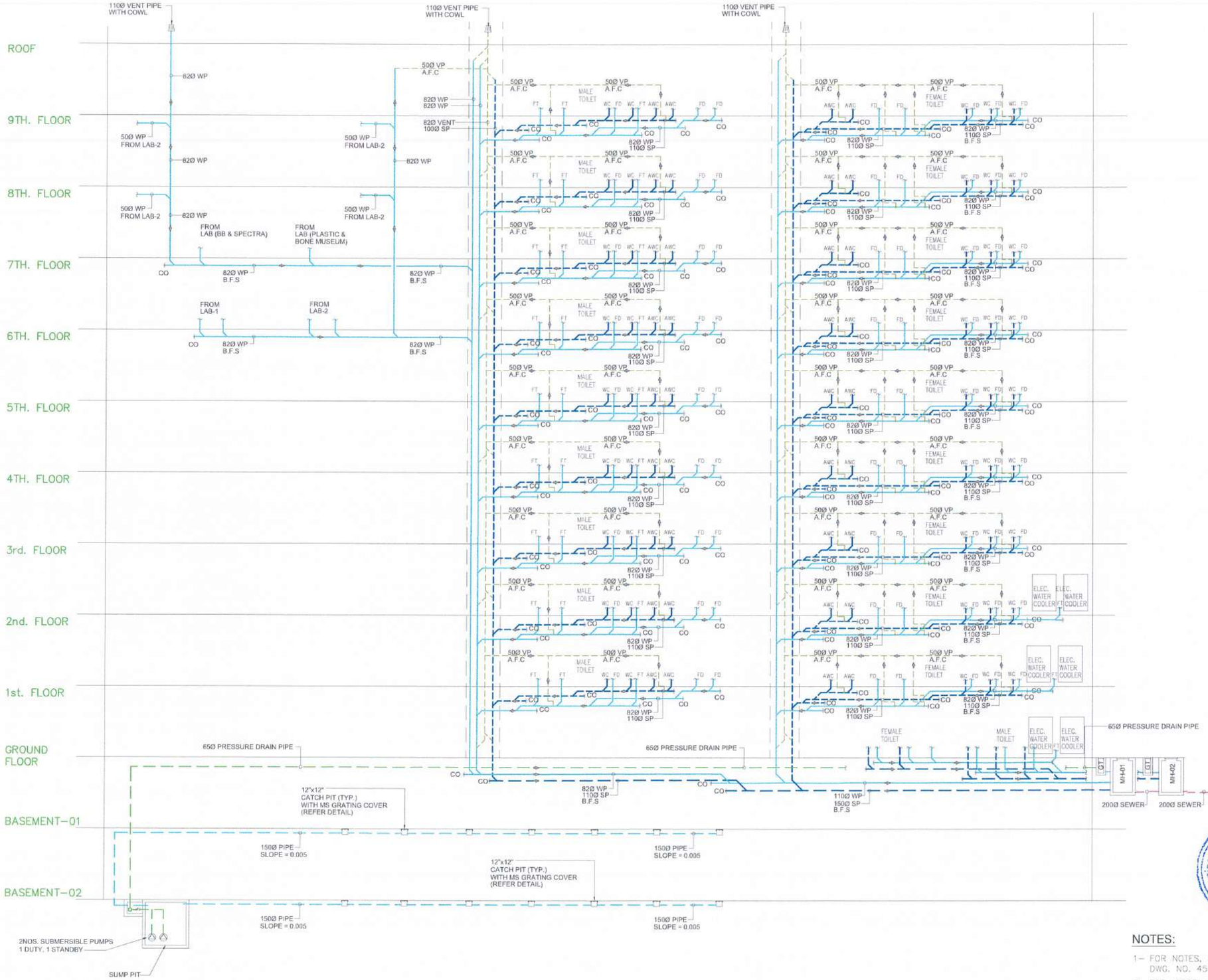
NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

National Engineering Services Pakistan Ltd. A & P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	PROJECT	JSMU
04			DRAWN: AD	ADMIN & ACADEMIC BUILDING	SCALE: 1/4"=1'-0"
03			SUBMITTED: NS	TYPICAL TOILET ENLARGED DETAIL DRAINAGE LAYOUT	
02			RECOMMENDED: SAM		
01	MAR.2026	ISSUED FOR TENDER	CHD./VER: AN	DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/M117
REV.	DATE	DESCRIPTION / APPROVED	APPROVED		REV: 0



National Engineering Services Pakistan (Pvt.) Ltd. A & P Division Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	PROJECT	JSMU
04			DRAWN	AD	
03			SUBMITTED	HS	
02			RECOMMENDED	SAM	
01	MAR.2026	ISSUED FOR TENDER	CHD./VER.	AN	
REV.	DATE	DESCRIPTION / APPROVED	APPROVED		

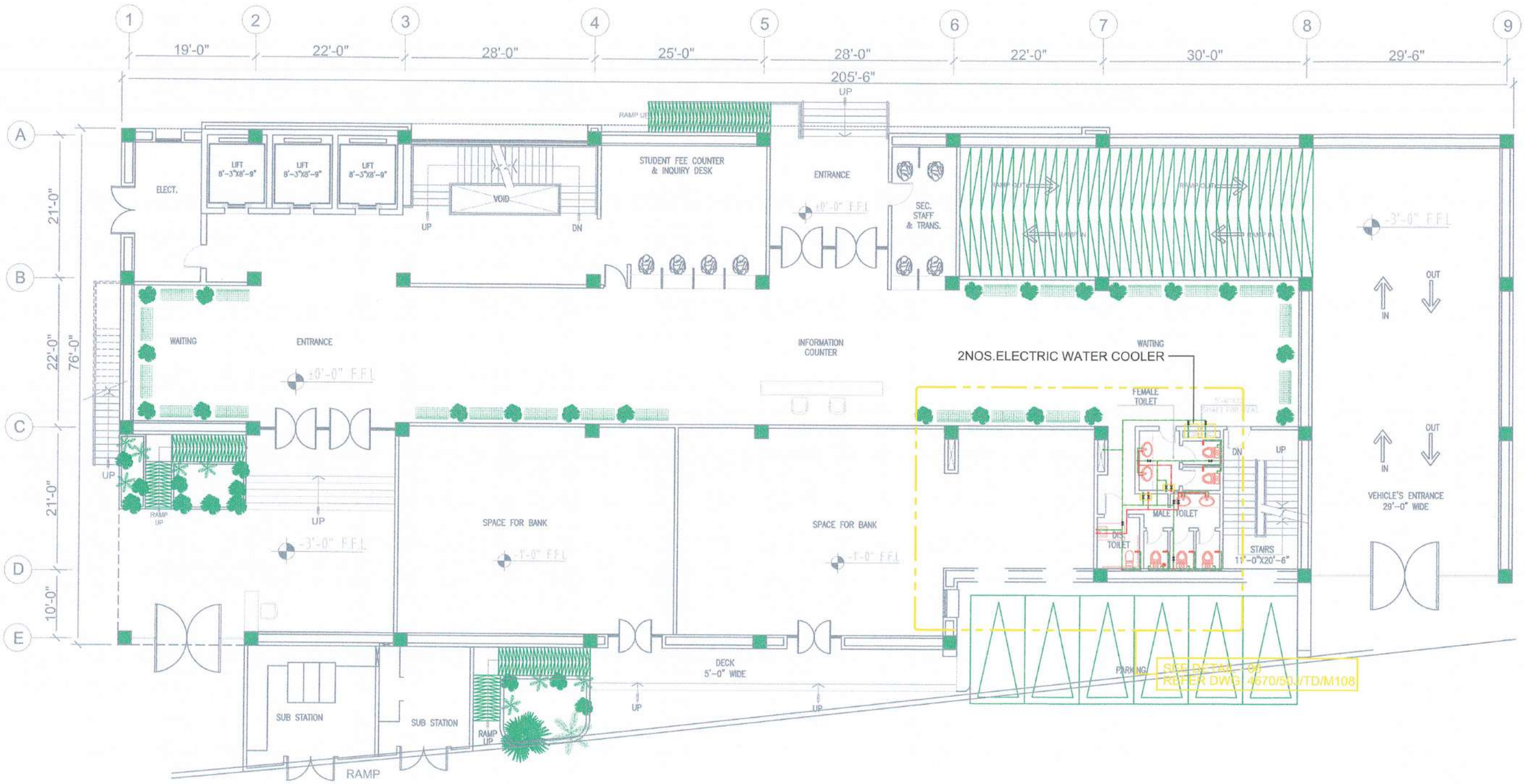
ADMIN & ACADEMIC BUILDING
DRAINAGE SCHEMATIC LAYOUT

SCALE

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/M118

REV.: 0



GROUND FLOOR PLAN
MAIN ENTRANCE
GROUND COVERAGE = 12832 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	04			
				03			
				02			
				01	MAR.2026	ISSUED FOR TENDER	
				REV.	DATE	DESCRIPTION	APPROVED

DRAWN	AD
SUBMITTED	HS
RECOMMENDED	SAM
CHD./VER.	AN
APPROVED	

PROJECT: JSMU

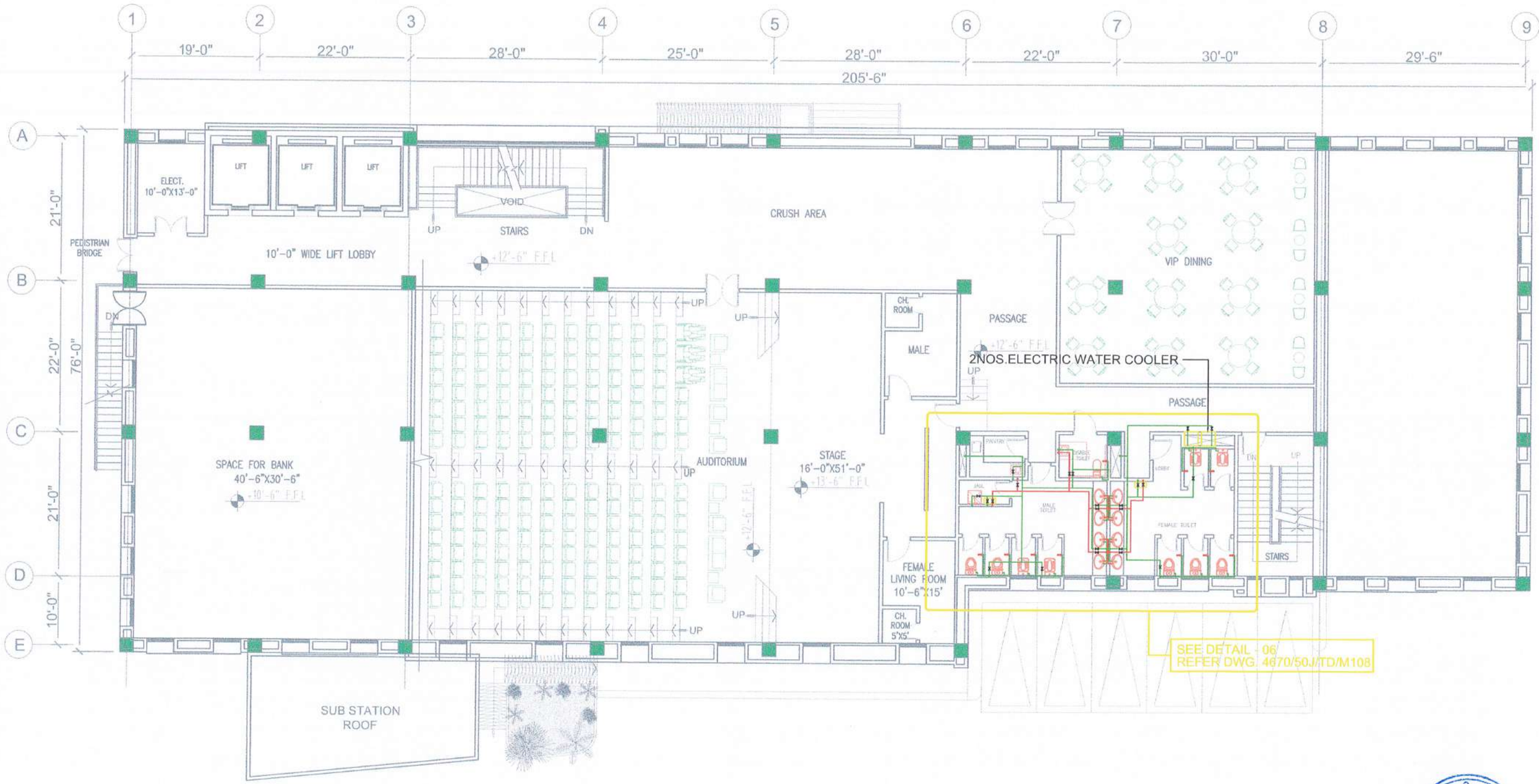
ADMIN & ACADEMIC BUILDING
GROUND FLOOR PLAN
WATER SUPPLY LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M116

REV.: 0



1ST FLOOR PLAN

VIP DINE AND AUDITORIUM

COVERED AREA 10712 SQ.FT

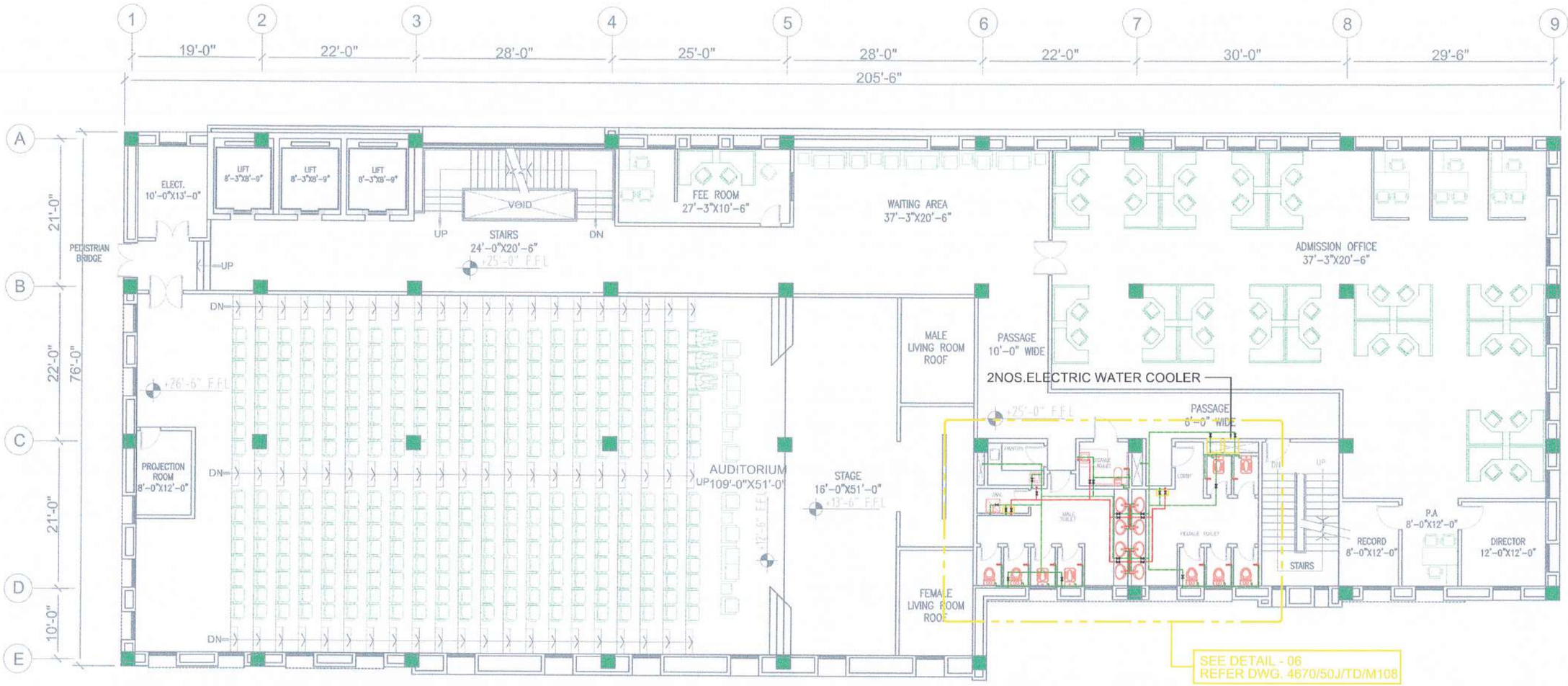
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34				
				04		DRAWN	AD
				03		SUBMITTED	HS
				02		RECOMMENDED	SAM
				01	MAR.2026 ISSUED FOR TENDER	CHD./VER.	AN
				REV.	DATE DESCRIPTION APPROVED	APPROVED	
PROJECT	JSMU	ADMIN & ACADEMIC BUILDING 1ST FLOOR PLAN WATER SUPPLY LAYOUT				SCALE	1/16"=1'-0"
						DATE	MARCH, 2026
						DRAWING No.	4596/50J/TD/ M117
						REV.	0



2ND FLOOR PLAN

ADMIN AND AUDITORIUM
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

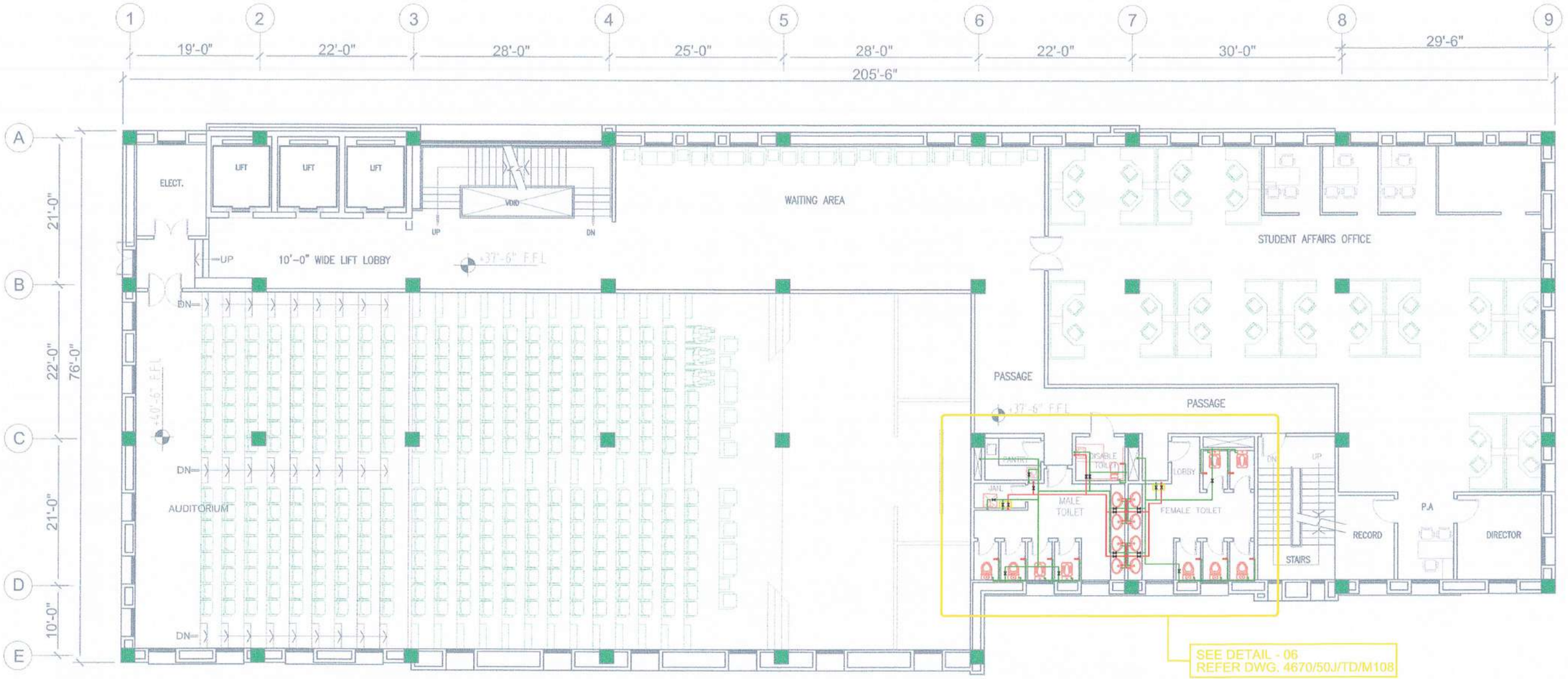
NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04			DRAWN:	AD	PROJECT: JSMU
		03			SUBMITTED:	HS	
		02			RECOMMENDED:	SAM	
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER:	AN	
		REV.	DATE	DESCRIPTION	APPROVED:	APPROVED:	

ADMIN & ACADEMIC BUILDING 2ND FLOOR PLAN WATER SUPPLY LAYOUT		SCALE: 1/16"=1'-0"	
DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/ M118	REV.: 0	



3RD FLOOR PLAN

STUDENT AFFAIRS AND AUDITORIUM

COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

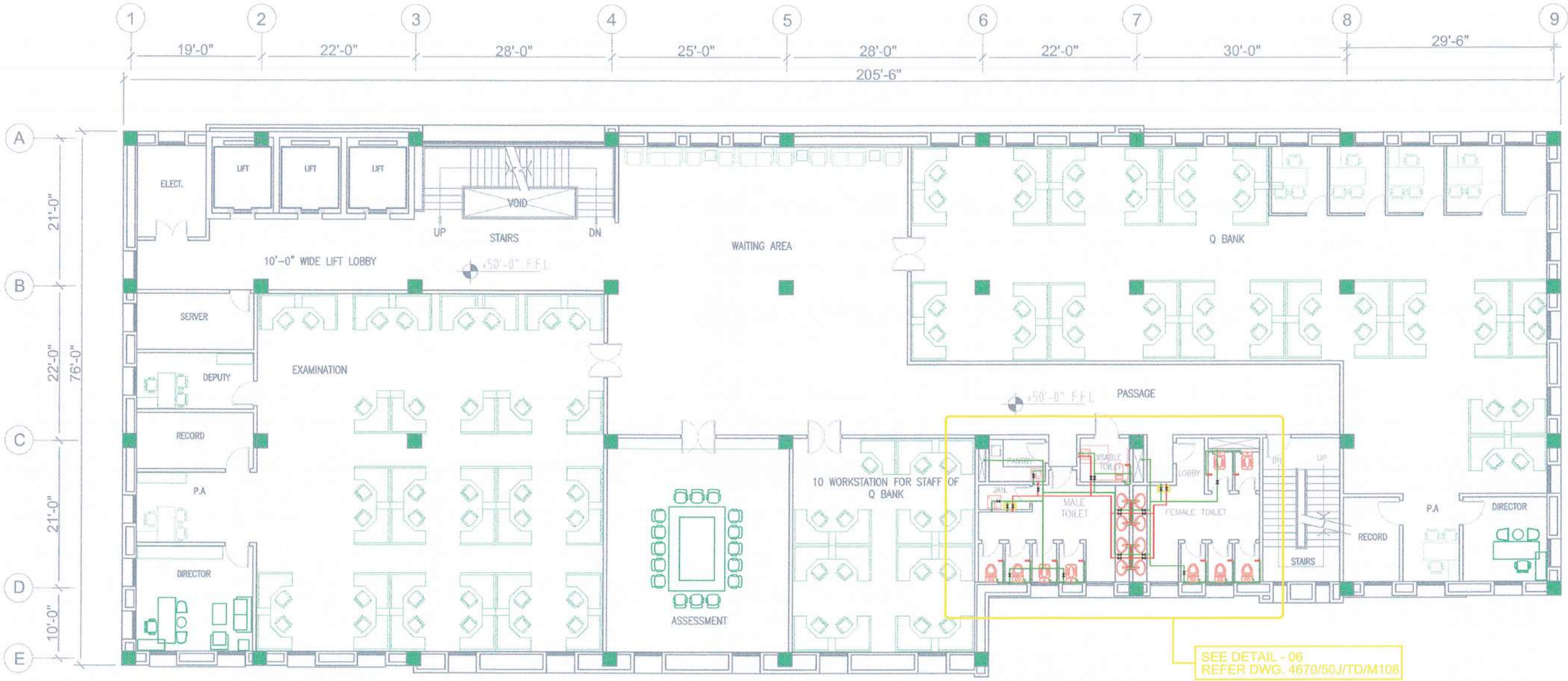
CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04			DRAWN: AD	PROJECT: JSMU	ADMIN & ACADEMIC BUILDING 3RD FLOOR PLAN WATER SUPPLY LAYOUT
		03			SUBMITTED: HS		
		02			RECOMMENDED: SAM		
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER: AN		
		REV.	DATE	DESCRIPTION / APPROVED	APPROVED		

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M119

REV.: 0



4TH FLOOR PLAN

Q. BANK/EXAMINATION

COVERED AREA 10712 SQ.FT

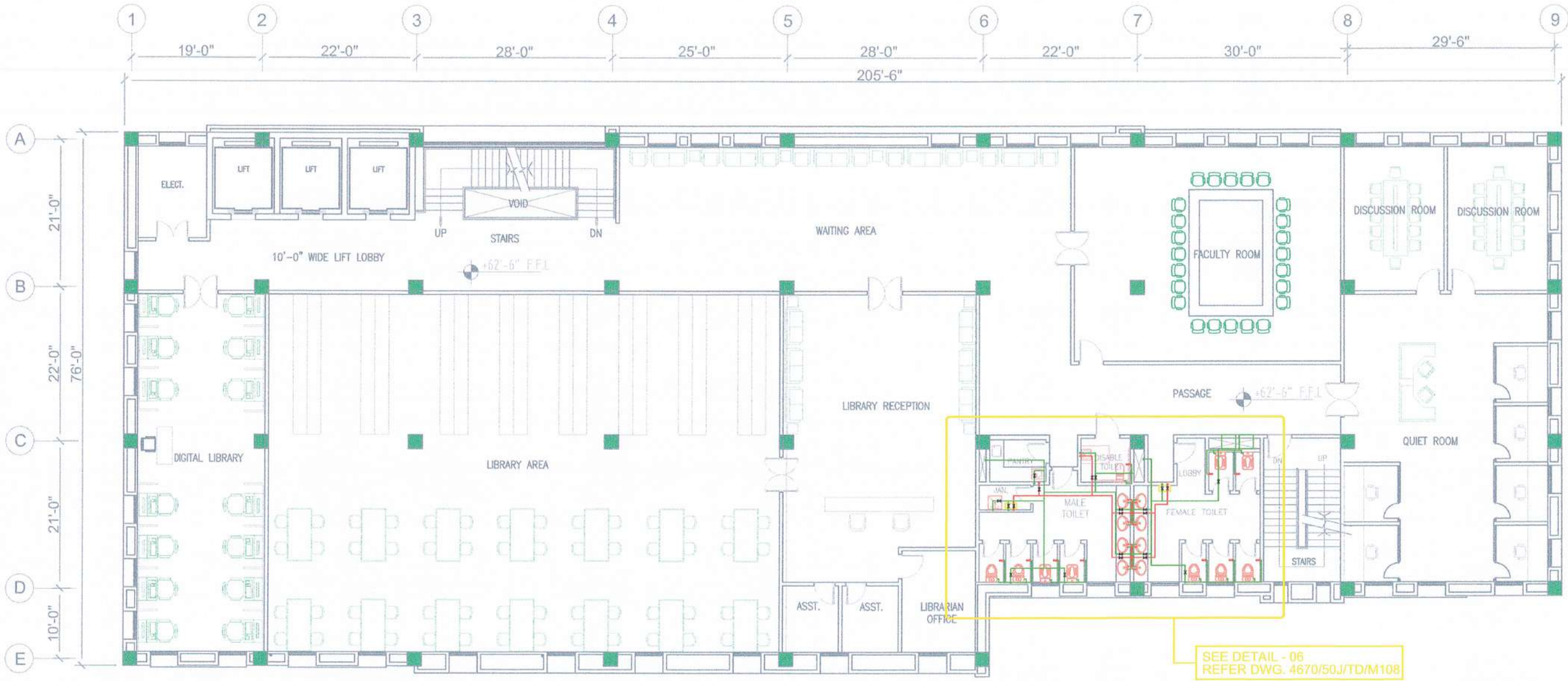
National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	04				DRAWN	AD
		03				SUBMITTED	HS
		02				RECOMMENDED	SAM
		01	MAR.2026	ISSUED FOR TENDER		CHD./VER.	AN
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	
PROJECT: JSMU	ADMIN & ACADEMIC BUILDING 4TH FLOOR PLAN WATER SUPPLY LAYOUT					SCALE: 1/16"=1'-0"	
	DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/ M120				REV.: 0	



5TH FLOOR PLAN

LIBRARY

COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

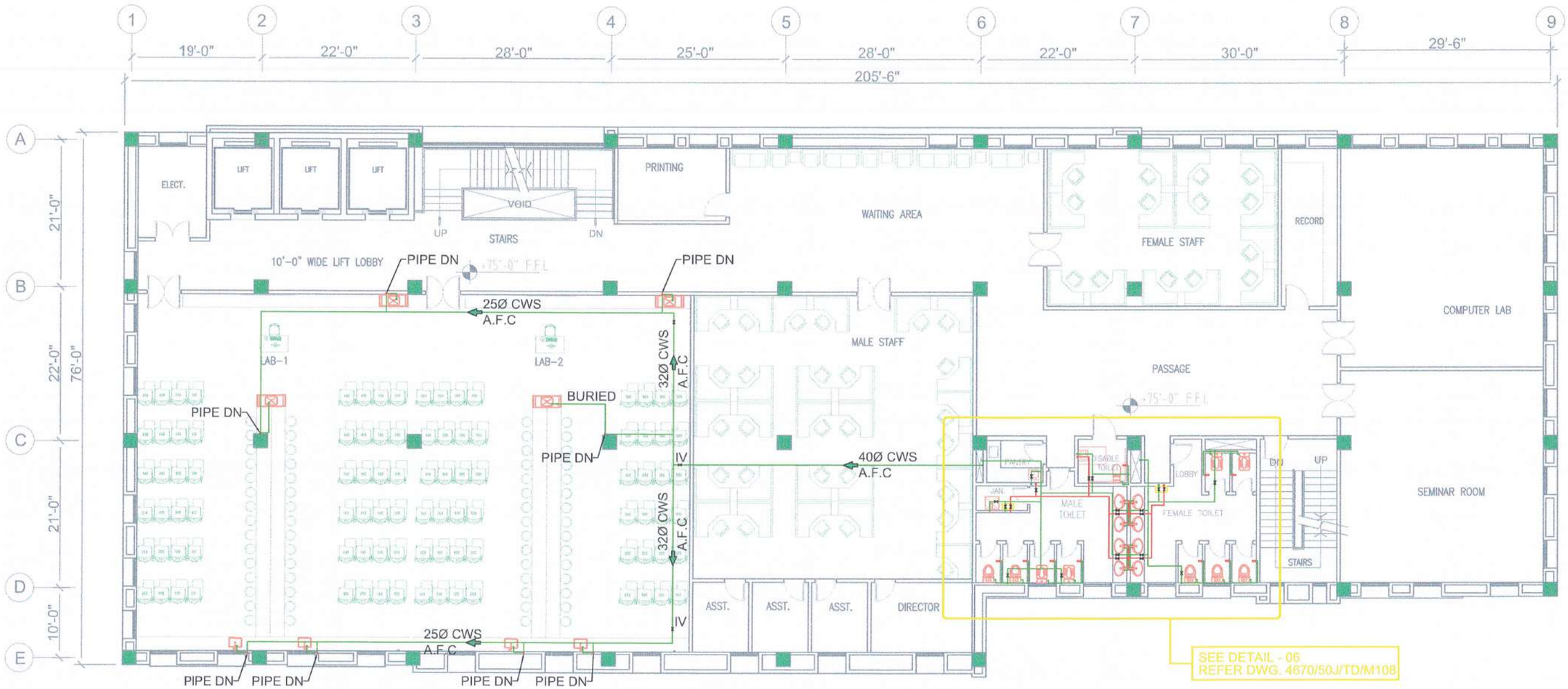
NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34	04				DRAWN	AD
				03				SUBMITTED	HS
				02				RECOMMENDED	SAM
				01	MAR.2026	ISSUED FOR TENDER		CHD./VER.	AN
				REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

PROJECT	ADMIN & ACADEMIC BUILDING	SCALE	
JSMU	5TH FLOOR PLAN WATER SUPPLY LAYOUT	1/16"=1'-0"	
	DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/ M121	REV.: 0



6TH FLOOR PLAN

DPT

COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

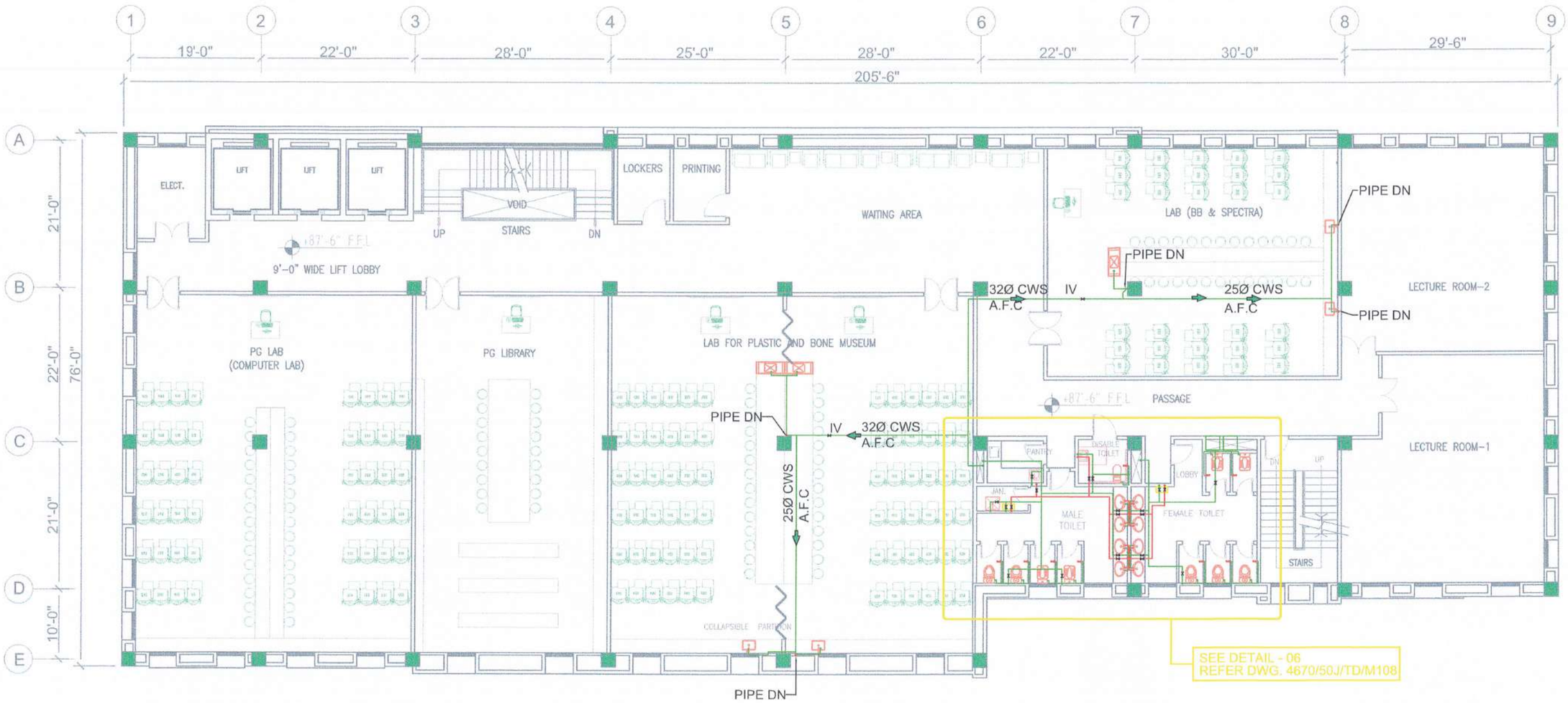
NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04				DRAWN:	AD	PROJECT: JSMU
		03				SUBMITTED:	HS	
		02				RECOMMENDED:	SAM	
		01	MAR.2026	ISSUED FOR TENDER		CHD./VER:	AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED:		

ADMIN & ACADEMIC BUILDING 6TH FLOOR PLAN WATER SUPPLY LAYOUT	SCALE: 1/16"=1'-0"	
DATE: MARCH. 2026	DRAWING No. 4596/50J/TD/ M122	REV. 0



7TH FLOOR PLAN

LABS AND TUTORIAL ROOMS

COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	04				DRAWN: AD	PROJECT: JSMU
		03				SUBMITTED: HS	
		02				RECOMMENDED: SAM	
		01	MAR,2026	ISSUED FOR TENDER		CHD./VER: AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED:	

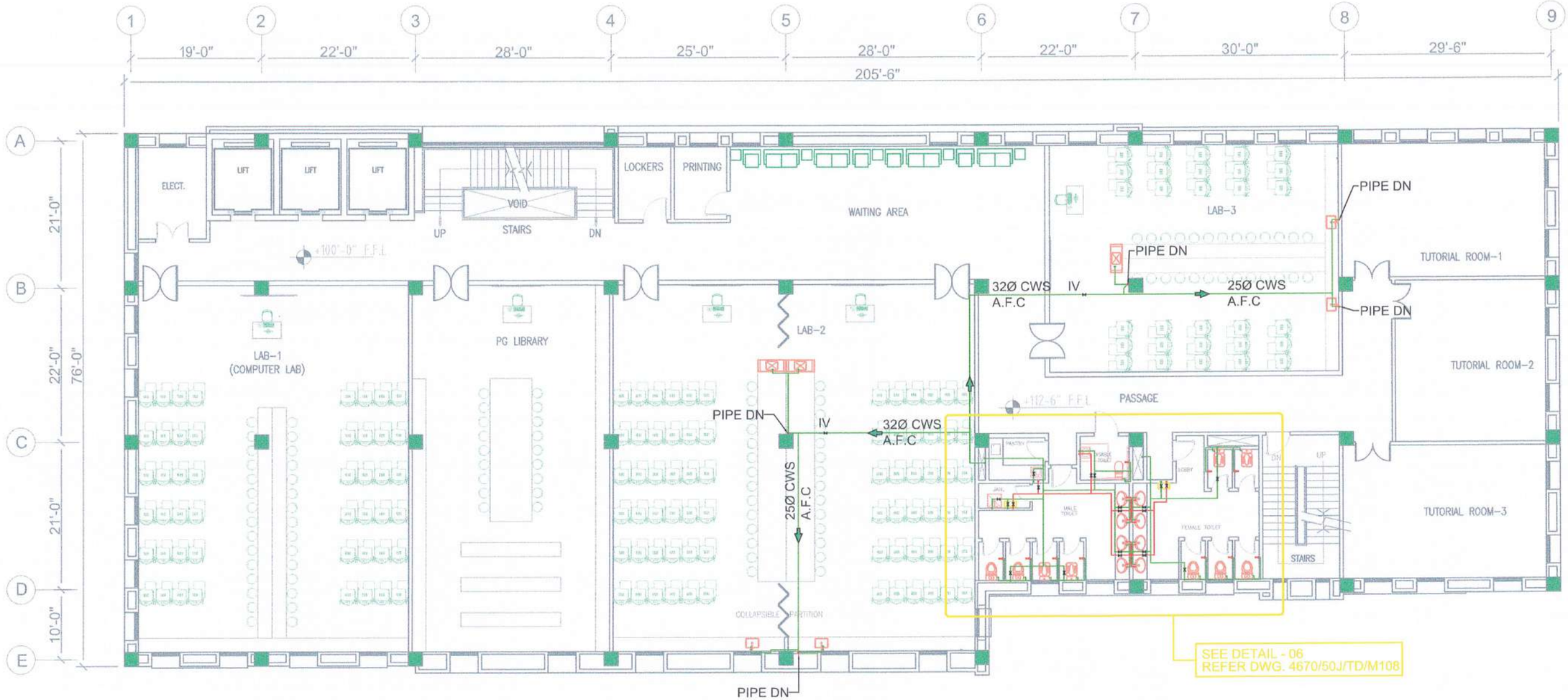
ADMIN & ACADEMIC BUILDING
7TH FLOOR PLAN
WATER SUPPLY LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M121

REV.: 0



8TH AND 9TH FLOOR PLANS ARE TYPICAL

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34	04			DRAWN	AD	PROJECT: JSMU
		03			SUBMITTED	HS	
		02			RECOMMENDED	SAM	
		01	MAR.2026	ISSUED FOR TENDER	CHD./VER.	AN	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

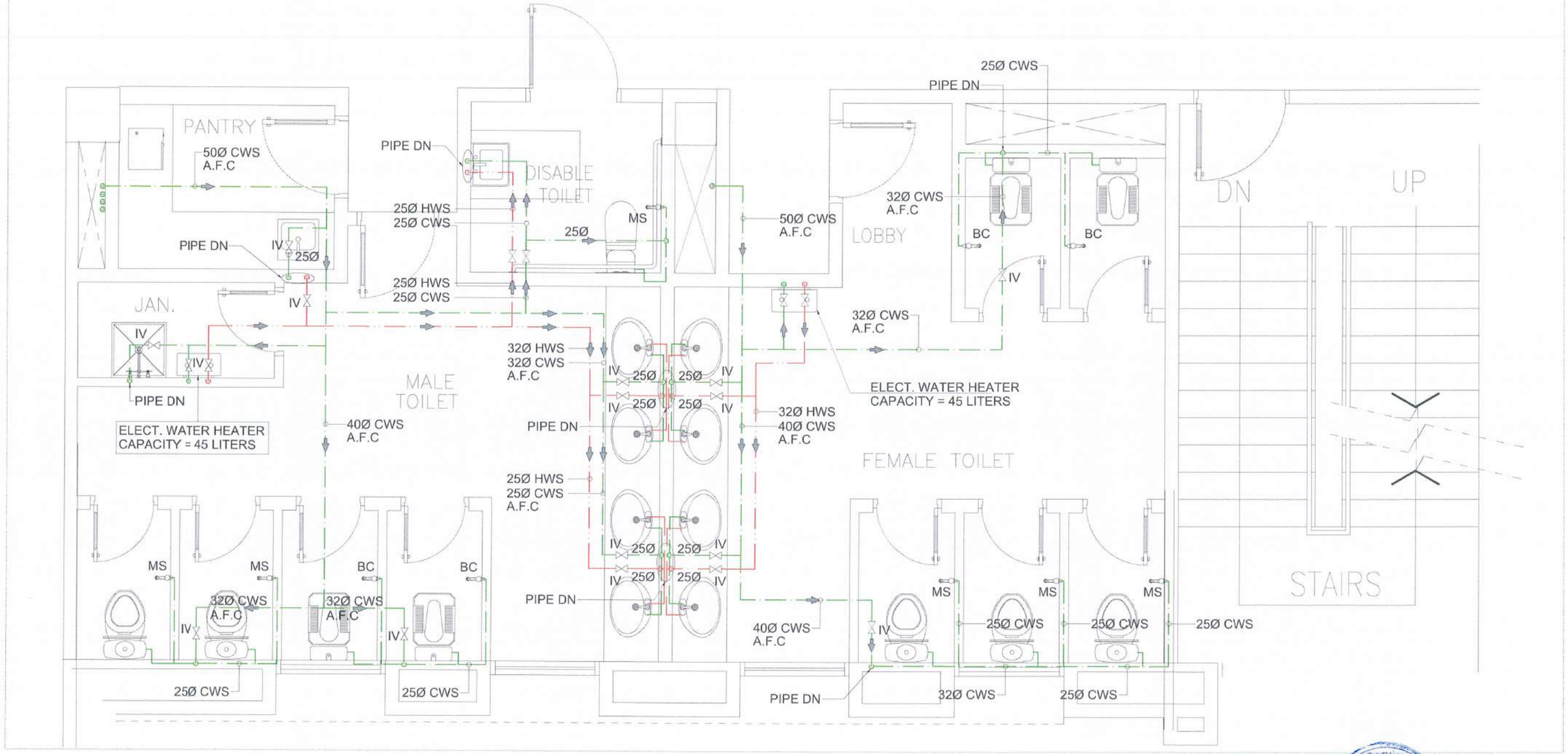
ADMIN & ACADEMIC BUILDING
8TH & 9TH FLOOR PLAN
DRAINAGE LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH. 2026

DRAWING No.: 4596/50J/TD/ M122

REV.: 0

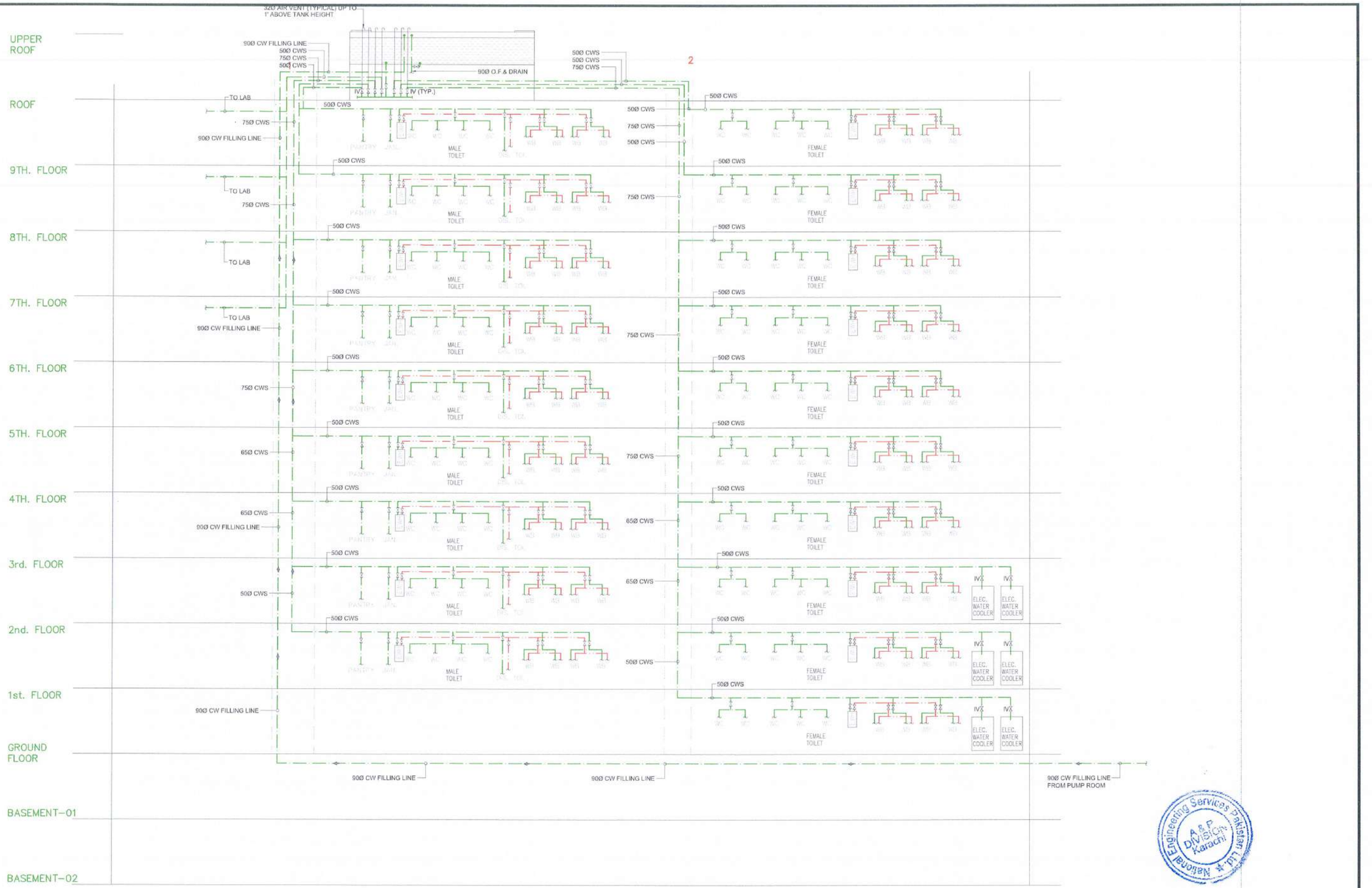


NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel. 99225439-34				
	04			DRAWN	AD
	03			SUBMITTED	HS
	02			RECOMMENDED	SAM
	01	MAR 2026	ISSUED FOR TENDER	CHD./VER.	AN
	REV.	DATE	DESCRIPTION / APPROVED	APPROVED	
PROJECT: JSMU	ADMIN & ACADEMIC BUILDING TYPICAL TOILET ENLARGED DETAIL WATER SUPPLY LAYOUT			SCALE: 1/4"=1'-0"	
	DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/ M124		REV.: 0	



NOTES:

1– FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2– FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

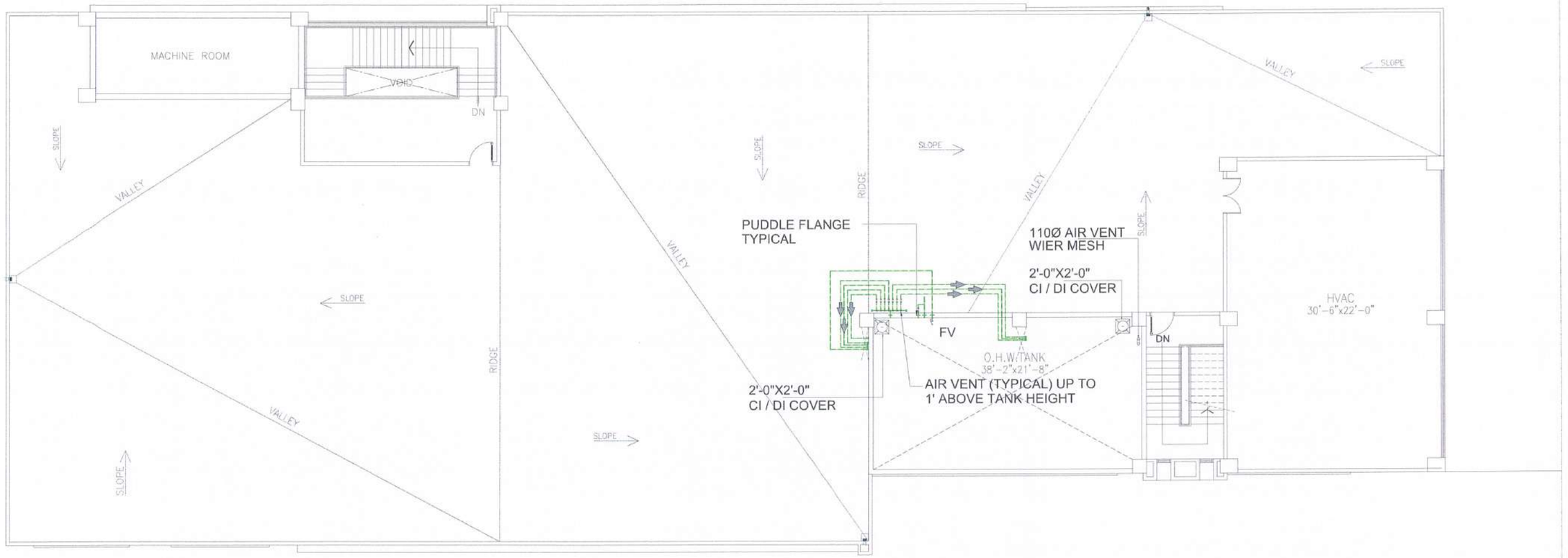
CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	PROJECT	JSMU
			ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34		

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01	MAR.2026	ISSUED FOR TENDER	

DRAWN	AD
SUBMITTED	HS
RECOMMENDED	SAM
CHD./VER.	AN
APPROVED	

ADMIN & ACADEMIC BUILDING
WATER SUPPLY SCHEMATIC LAYOUT

DATE	MARCH, 2026	DRAWING No.	4596/50J/TD/ M125
SCALE	NTS	REV.	0



NOTES:

1- FOR NOTES, LEGEND & ABBREVIATIONS REFER DWG. NO. 4596/50J/TD/M101

2- FOR MISCELLANEOUS DETAILS REFER DWG. NO. 4596/50J/TD/M102 & M103

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI.
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01	MAR.2026	ISSUED FOR TENDER	

DRAWN	AD
SUBMITTED	HS
RECOMMENDED	SAM
CHD./VER.	AN
APPROVED	

PROJECT: JSMU

ADMIN & ACADEMIC BUILDING
ROOF PLAN
WATER SUPPLY LAYOUT

SCALE: 1/16"=1'-0"

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M128

REV.: 0

JINNAH SINDH MEDICAL UNIVERSITY

ADMIN & ACADEMIC BUILDING

BIDDING DRAWINGS

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

ELECTRICAL DRAWINGS

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

LEGEND

S.#	SYMBOL	DESCRIPTION
1		415 VOLTS, 50Hz 3 PHASE DIESEL GENERATOR.
2	MCO	MANUAL CHANGE OVER (MCO)
3		MAIN PANEL BOARD (MPB) OR SUB MAIN PANEL BOARD (SMPB)
4		DISTRIBUTION BOARD (DB) 'LDB' – LIGHTING DISTRIBUTION BOARD, 'PDB' – POWER DISTRIBUTION BOARD 'E' – INDICATES FOR POWER SUPPLY FROM EMERGENCY SOURCE 'U' – INDICATES FOR POWER SUPPLY FROM UPS SOURCE
5		UNINTERRUPTED POWER SUPPLY (UPS)
6	Adj.	TRIPLE POLE, 500 VOLTS, MOULDED CASE CIRCUIT BREAKER (RUPTURING CAPACITY INDICATED ON THE DRAWINGS) Adj.–INDICATES ADJUSTABLE TYPE
7		SINGLE POLE, 250 VOLTS, MINIATURE CIRCUIT BREAKER (RUPTURING CAPACITY INDICATED ON THE DRAWINGS)
8		DOUBLE POLE, 250 VOLTS, MINIATURE CIRCUIT BREAKER (RUPTURING CAPACITY INDICATED ON THE DRAWINGS)
9		TRIPLE POLE, 500 VOLTS, MINIATURE CIRCUIT BREAKER (RUPTURING CAPACITY AND RATING INDICATED ON THE DRAWINGS)
10	VSS	VSS – VOLTMETER SELECTOR SWITCH (7–POSITION)
11	V	AC VOLTMETER (MEASURING RANGE INDICATED ON DRAWING)
12	ASS	AMMETER SELECTOR SWITCH (4–POSITION)
13	A	AC AMMETER (MEASURING RANGE INDICATED ON DRAWING)
14	M O A	AUTO–OFF–MANUAL SELECTOR SWITCH
15	1P/R1	ON–OFF PUSH BUTTON 1P/R1 INDICATES 1 NO. PUSH BUTTON FED FROM CIRCUIT NO. 1 OF RED PHASE
16		PHASE INDICATION LAMPS R – RED Y – YELLOW B – BLUE
17	3S/2D/R1	10A LIGHT CONTROL GANG SWITCH WITH DIMMER, '3S' INDICATES 3 Nos. SWITCH, '2DM' INDICATES 2 Nos. FAN DIMMER + 2 Nos. SWITCHES & 'R1' INDICATES CIRCUIT NO.1 FROM 'RED' PHASE
18		10A LIGHT CONTROL 2 WAY SWITCH, '2ST' INDICATES FOR 2 Nos. TWO WAY SWITCH, & 'R1' INDICATES CIRCUIT NO.1 FROM 'RED' PHASE
19		13 AMPS, 250 VOLTS, 3 PIN UNIVERSAL, SWITCH SOCKET OUTLET TV – INDICATES "TELEVISION", "WIFI" – INDICATES "WIFI DEVICE" MW – INDICATES "MICRO WAVE"
20		13 AMPS, 250 VOLTS, 3 PIN UNIVERSAL, SWITCH SOCKET OUTLET (SUPPLIED FROM UPS) TV – INDICATES "TELEVISION", "WIFI" – INDICATES "WIFI DEVICE"
21		13 AMPS, 250 VOLTS, 3 PIN DUPLEX UNIVERSAL, SWITCH OUTLET (SUPPLIED FROM UPS)
22		13 AMPS, 250 VOLTS, SPUR OUTLET (SUPPLIED FROM UPS) DC – INDICATES "DOOR CONTROLLER" CCTV–INDICATES "CLOSED CIRCUIT TELEVISION" WAP – INDICATED " WIRELESS ACCESS POINT"
23	FB/TB	1 NO. 13 AMPS, 250 VOLTS, 3 PIN UNIVERSAL, SWITCH SOCKET OUTLET (SUPPLIED FROM NORMAL) 1 NO. 13 AMPS, 250 VOLTS, 3 PIN UNIVERSAL, SWITCH SOCKET OUTLET (SUPPLIED FROM UPS) IN FLOOR BOX/ TECHNOLOGY BOX
24	FB/TB	1 NO. 13 AMPS, 250 VOLTS, 3 PIN UNIVERSAL, SWITCH SOCKET OUTLET (SUPPLIED FROM NORMAL) 1 NO. DUPLEX 13 AMPS, 250 VOLTS, 3 PIN UNIVERSAL, SWITCH SOCKET OUTLET (SUPPLIED FROM UPS) IN FLOOR BOX/ TECHNOLOGY BOX
25		15 AMPS, 250 VOLTS, 2 PIN+EARTH, SCHUKO SOCKET OUTLET
26		15 AMPS, 250 VOLTS, 3 PIN, SWITCH SOCKET OUTLET WP – INDICATES "WATER PUMPS" PC – INDICATES "PHOTOCOPY MACHINE"
27		20 AMPS, 250 VOLTS, DP SWITCH WITH NEON INDICATION EWH – INDICATES "ELECTRIC WATER HEATER" HD – INDICATES "HAND DRYER"
28		13A SHAVER SOCKET
29		INDUSTRIAL SOCKET SINGLE PHASE, 3 PIN, L+N+E
30		INDUSTRIAL SOCKET THREE PHASE, 5 PIN, L+N+E
31		EARTH CABLE/EARTHING LEAD/EARTH CONTINUITY CONDUCTOR (ECC) FOR EARTHING SYSTEM
32	ECP	EARTH CONNECTING POINT (ECP)
33		ROD TYPE EARTH ELECTRODE
34		PLATE TYPE EARTH ELECTRODE
35	FB	FLOOR BOX
36	MH	RCC MAINHOLE

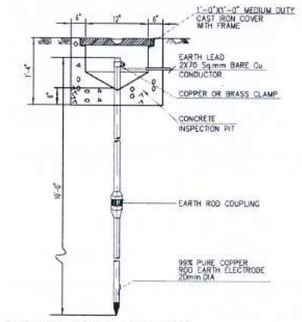
GENERAL NOTES

1. FOLLOWING NOTES SHALL IN GENERAL APPLY TO ALL ELECTRICAL DRAWINGS. THE INSTRUCTIONS IN THESE NOTES SHALL BE FOLLOWED UNLESS STATED OTHERWISE.
2. THESE NOTES SHALL BE APPLICABLE TO THE ENTIRE ELECTRICAL WORKS. IF THE SITE CONDITIONS NECESSITATE ANY ALTERATIONS OR DEVIATIONS THE DIRECTIONS OF THE ENGINEER SHALL BE OBSERVED AS FINAL INSTRUCTIONS.
3. ALL ELECTRICAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH BOQ, TECHNICAL SPECIFICATIONS, ARCHITECTURAL, STRUCTURAL, PLUMBING AND HVAC DRAWINGS & ALL OTHER RELEVANT DETAILS.
4. DIMENSIONS/MEASUREMENTS GIVEN IN LAYOUT AND DETAILED DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE TO CALCULATE THE ACTUAL DIMENSIONS/ MEASUREMENTS ACCORDING TO STRUCTURAL AND ARCHITECTURAL DRAWINGS.
5. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS WITH ALL RELEVANT DETAILS TO THE ENGINEER FOR APPROVAL ACCORDING TO THE GENERAL CONDITIONS OF CONTRACT WELL IN TIME BEFORE COMMENCEMENT OF THAT WORK.
6. PROPER CO–ORDINATION OF ELECTRICAL WORKS WITH OTHER SERVICES SHALL BE CARRIED OUT AT SITE.
7. ALL NON – CURRENT CARRYING PARTS i.e. OUTER CASINGS OF EQUIPMENT SUCH AS HT & LT PANELS, DISTRIBUTIONS BOARDS, CABLE TRAYS, AUXILIARY CONSTRUCTIONS FOR EQUIPMENT ETC. SHALL BE CONNECTED TO THE GROUNDING/ EARTHING SYSTEM AT REQUIRED NUMBER OF POINTS WITH SPECIFIED SIZES OF CONDUCTORS. WATER PIPES ALONG ELECTRICAL LINE SHALL BE BONDED TO THE EARTHING SYSTEM WITH 10 Sq.mm. SINGLE CORE, COPPER CONDUCTOR PVC CABLE.
8. ELECTRICAL POINTS FOR EQUIPMENT SHALL BE INSTALLED IN CO–ORDINATION WITH THE RELEVANT EQUIPMENT DRAWINGS OF OTHER SERVICES SUCH AS COMMUNICATION SYSTEMS, HVAC, PLUMBING ETC. THE LOCATION ON ELECTRICAL DRAWINGS IS ONLY INDICATIVE.
9. ARRANGEMENT OF ELECTRICAL EQUIPMENTS ON ELECTRICAL DRAWINGS ARE TENTATIVE. EXACT ARRANGEMENT OF EQUIPMENTS SHALL BE MADE IN VIEW OF ITS PHYSICAL DIMENSIONS AND EASE OF MAINTENANCE.
10. LOADS ON ALL PHASES SHALL BE BALANCED AT THE TESTING/ COMMISSIONING STAGE.
11. CONDUIT/DUCT RUN UNDER FLOOR SHALL HAVE A MINIMUM COVER OF 2" FROM TOP OF CONDUIT/DUCT TO FINISH FLOOR LEVEL.
12. RUN GREEN–YELLOW OR GREEN SINGLE CORE PVC INSULATED COPPER CONDUCTOR CABLE OF SPECIFIED SIZES AS EARTH CONTINUITY CONDUCTOR (ECC) ALL ALONG LIGHT AND POWER WIRING. WHEREVER THE SIZE IS NOT SPECIFIED THE FOLLOWING CRITERIA SHALL BE OBSERVED TO DETERMINE MINIMUM CROSS SECTIONAL AREA OF EARTH CONTINUITY CONDUCTOR (ECC) IN RELATION TO THE AREA OF ITS PHASE CONDUCTORS. RUN SEPARATE ECC FOR EACH CIRCUIT.
    - ECC & PHASE CONDUCTOR OF SAME SIZE FOR UPTO AND INCLUDING 16 Sqmm CABLES.
    - 16 Sqmm ECC FOR PHASE CONDUCTOR OF 16 Sqmm, 25 Sqmm & 35 Sqmm CABLES.
    - FOR CABLES OF 50 Sqmm AND ABOVE SIZES, ECC IS HALF SIZE OF PHASE CONDUCTOR.
    - MAXIMUM SIZE OF ECC IS 70 Sqmm (IF NOT MENTIONED OTHERWISE).
13. ALL WIRING TO LIGHT AND SOCKET CIRCUITS & FOR CONTROLS SHALL BE CARRIED OUT WITH SINGLE CORE PVC INSULATED COPPER CONDUCTOR CABLE OF SPECIFIED VOLTAGE GRADE IN SURFACE GI CONDUIT OF SPECIFIED SIZE. UNLESS SPECIFICALLY STATED ON DRAWINGS/BOQ.
14. LIGHT CONTROL SWITCH BOARD SHALL BE INSTALLED 6" AWAY FROM THE SIDE OF DOOR IN ROOMS.
15. BEFORE DETERMINING THE CUT LENGTHS OF CABLE,THE ACTUAL MEASUREMENT AT SITE SHALL BE MADE WITH PROVISION FOR SLACK AT LT PANELS/ DISTRIBUTION BOARDS AND SPARE LENGTH FOR LOOPS AS REQUIRED.
16. ALL UNDERGROUND PIPES AFTER INSTALLATION SHALL BE PLUGGED AND SEALED AT BOTH ENDS AND JOINTS TO AVOID INGRESS OF WATER INTO PIPES.
17. APPROPRIATE SIZE CLASS 'D' PVC PIPES SHALL BE LAID ALL ALONG THE CROSSINGS OF CABLES UNDER ROADS OR PAVED AREAS.
18. THE No. OF SINGLE CORE CABLES IN ANY CONDUIT SHALL BE DETERMINED SUCH THAT THE RATIO OF CABLE AREA INCLUDING PROTECTIVE EARTH CONDUCTOR TO CONDUIT AREA IS NOT MORE THAN 0.4:1.0. WHERE DIFFERENT SIZES OF CABLES RUN IN SAME CONDUIT.THE SIZE SHALL BE BASED ON ACTUAL CABLE AREA. WHEREVER CONDUIT SIZE IS NOT SPECIFIED, 25mm. DIA CONDUIT SHALL BE INSTALLED PROVIDED IT MEETS THE ABOVE CRITERIA.THE FOLLOWING TABLE IS GIVEN AS GENERAL GUIDELINE.

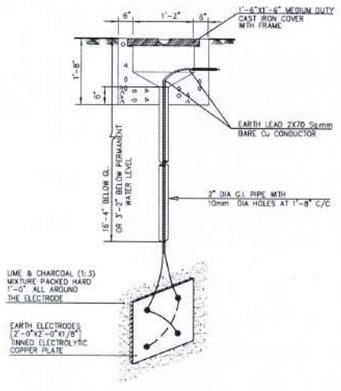
S.NO	NOMINAL CONDUCTOR SIZE(SQMM)	NO. & DIA OF WIRES	NOMINAL OVERALL DIA	20 MM DIA (3/4" DIA)	25 MM DIA (1" DIA)	32 MM DIA (1¼ " DIA)
1	1.5	1/1.38	3.1	10	18	30
2	2.5	1/1.78	3.5	8	14	23
3	2.5	7/0.67	3.8	7	12	20
4	4	7/0.85	4.3	5	9	15
5	6	7/1.04	4.9	4	7	12
6	10	7/1.35	6.2	2	4	7
7	16	7/1.70	7.3	–	3	5
8	25	7/2.14	9.0	–	2	3
9	35	19/1.53	10.3	–	–	2

19. EACH CIRCUIT NORMAL OR EMERGENCY SHALL BE LAID IN A SEPARATE CONDUITS OF APPROPRIATE SIZE AS MENTIONED IN ABOVE TABLE.
20. ALL WIRING FOR CONTROLS SHALL BE CARRIED OUT WITH MULTI CORE PVC CABLES OF SPECIFIED REQUIRED VOLTAGE GRADE AND SIZES.
21. THE WIRING SHALL BE CONTINUOUS LOOPING–IN AND LOOPING –OUT TYPE AND NO JOINT IN WIRES SHALL BE ALLOWED.
22. THE WIRING SYSTEM SHALL BE CARRIED OUT ONLY AFTER THE CONDUIT SYSTEM IS COMPLETELY INSTALLED AND ALL OUTLET BOXES, ETC. ARE FIXED IN POSITION. ALL ROUGH EDGES OF CONDUITS / ACCESSORIES SHALL BE SMOOTH BEFORE WIRING.
23. MOUNTING HEIGHTS OF ELECTRICAL FITTINGS WHEN MEASURED FROM FINISHED FLOOR LEVEL (F.F.L.) TO THE BOTTOM OF FITTINGS SHALL BE AS UNDER, UNLESS OTHERWISE SHOWN OR INSTRUCTED.

DISTRIBUTION BOARD/ISOLATED POWER PANEL	1200mm
ON/OFF PUSH BUTTON	1200mm
LIGHT CONTROL SWITCH (ONE WAY/TWO WAY)	1200mm
15A/16A/20A/GROUNDING JACK MODULES	250mm / REFER ARCH. DRAWINGS.
OUTLETS	
EXHAUST FAN	REFER ARCH DWG.
TELECOM OUTLET	250 mm
TELECOM OUTLET FOR WIRELESS ACCESS POINT	2400 mm
TV OUTLET	250 mm



EARTH ELECTRODE (ROD TYPE)
N.T.S.



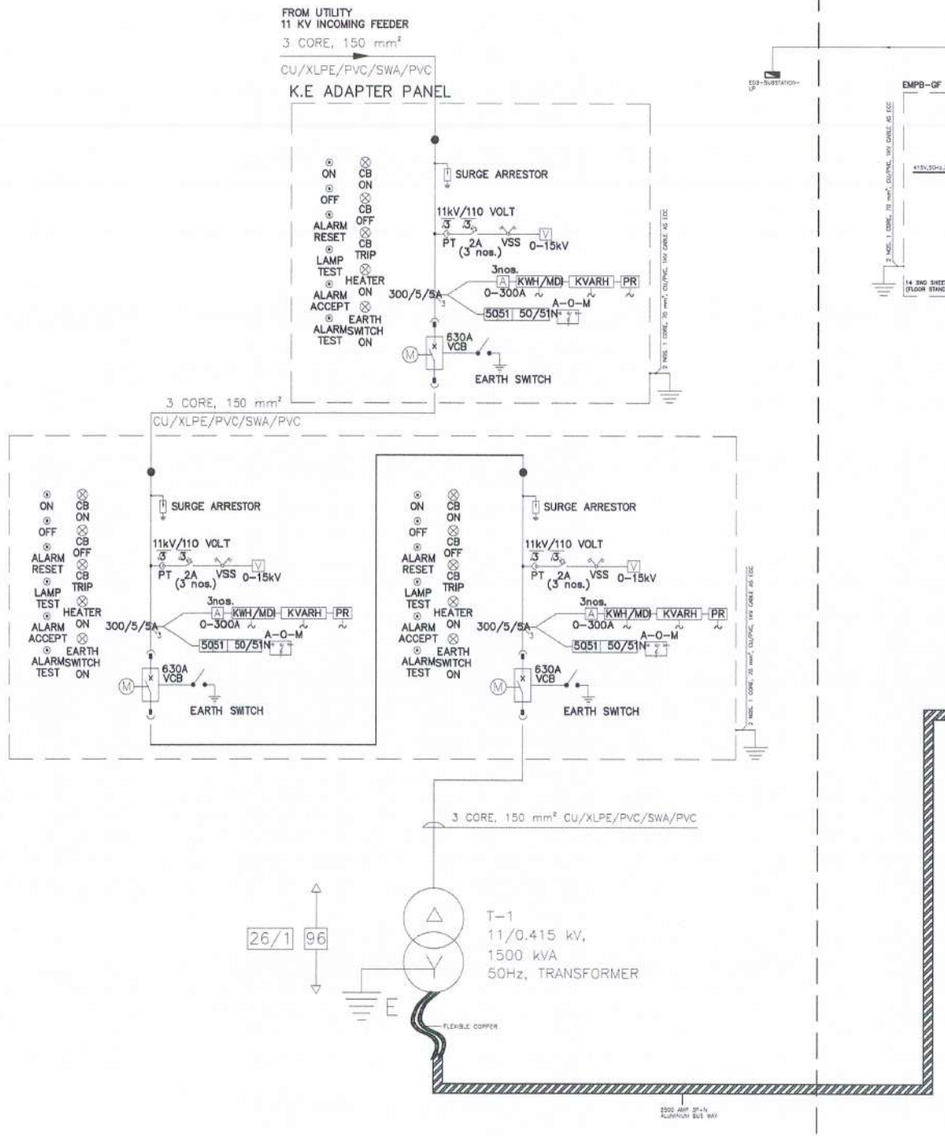
EARTH ELECTRODE (PLATE TYPE)
N.T.S.

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

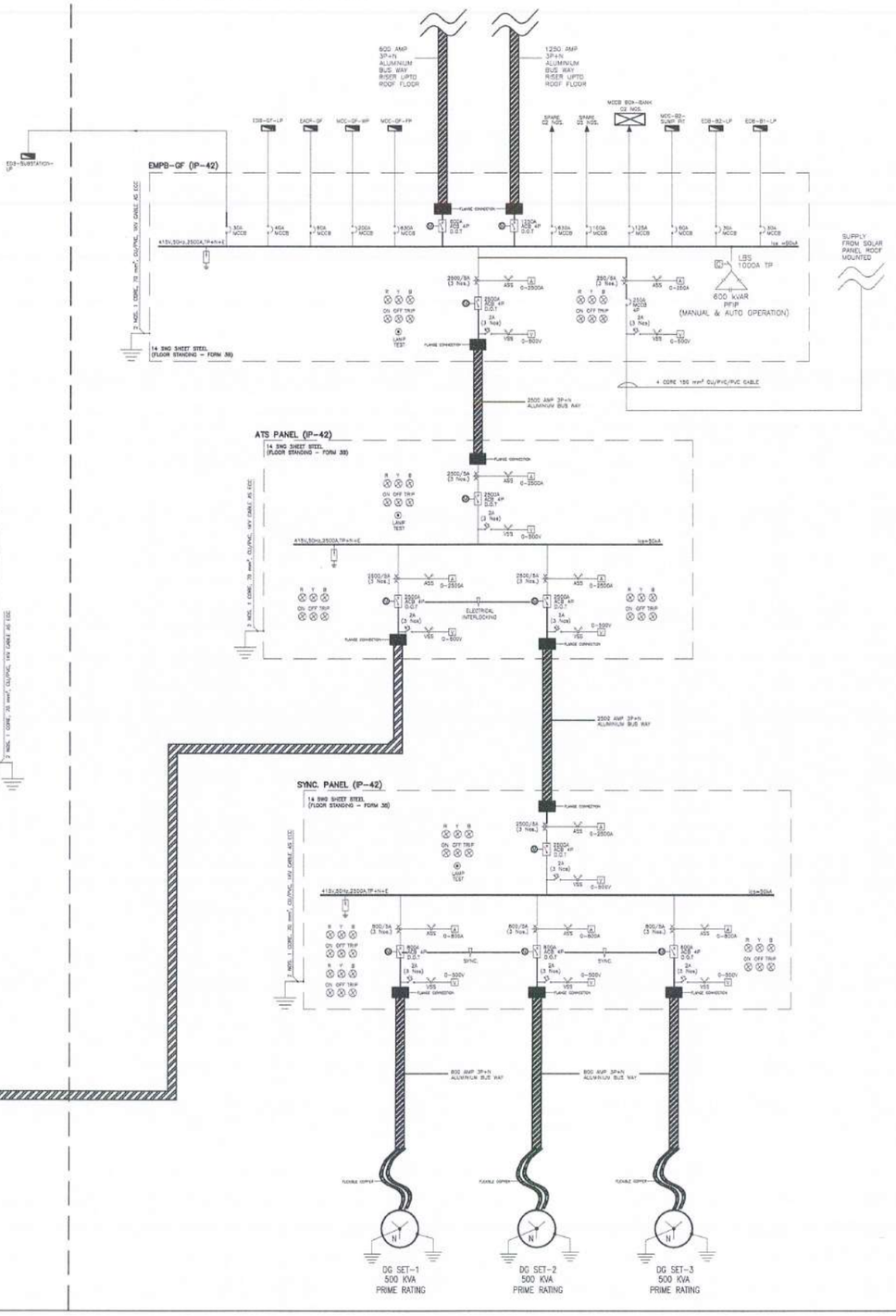
BIDDING DRAWINGS

CLIENT	CONSULTANT			PROJECT	SCALE
JINNAH SINDH MEDICAL UNIVERSITY	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99205470-74			JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING	N.T.S
		03	DRAWN: TM	ELECTRICAL LEGEND AND GENERAL NOTES	
		02	SUBMITTED: SA		
		01	RECOMMENDED: SA		
		00 MARCH, 2026 ISSUED FOR BIDDING DRAWINGS	CHD./VER: AMS	DATE: MARCH , 2026	DRAWING No: 4596/08/TD/E001
		REV DATE DESCRIPTION APPROVED	APPROVED: AMS		REV: 0

GROUND FLOOR–SUBSTATION ROOM–JSMU



GROUND FLOOR–ELECTRICAL ROOM–JSMU



DRAWING NOTES

1. FOR LEGEND & GENERAL NOTES REFER DRAWING NO. EG01.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH OTHER TENDER/CONSTRUCTION DRAWINGS. ANY CONTRADICTION, CLASHES, COORDINATION ISSUES ETC., WITH OTHER TRADES/SERVICES/SITE CONDITIONS SHALL BE BROUGHT TO THE ENGINEER NOTICE FOR NECESSARY ACTION(S) BEFORE EXECUTION OF WORK(S).
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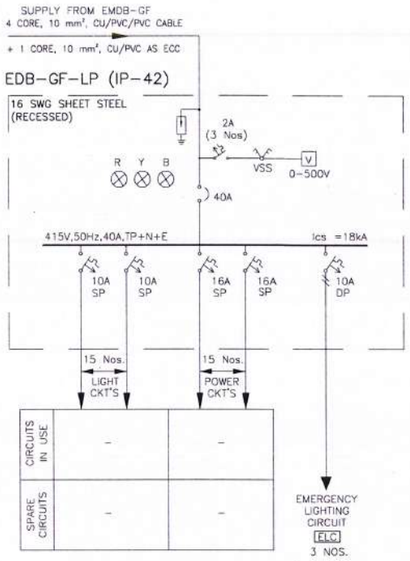
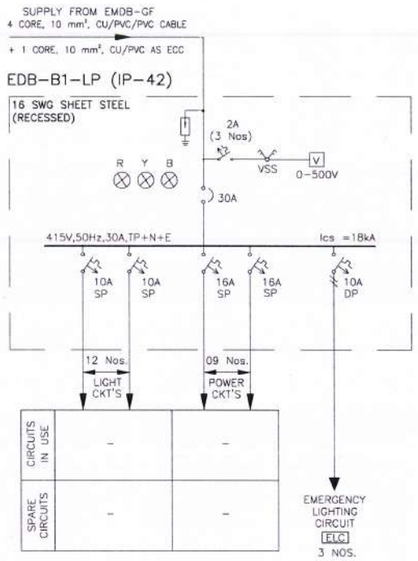
8. 12 INCHES BLOCK MASONRY WALL REQUIRED FOR DB WALL IN ELECTRICAL ROOM.

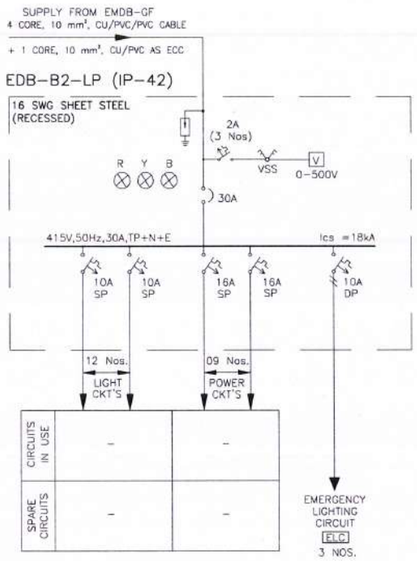
BIDDING DRAWINGS

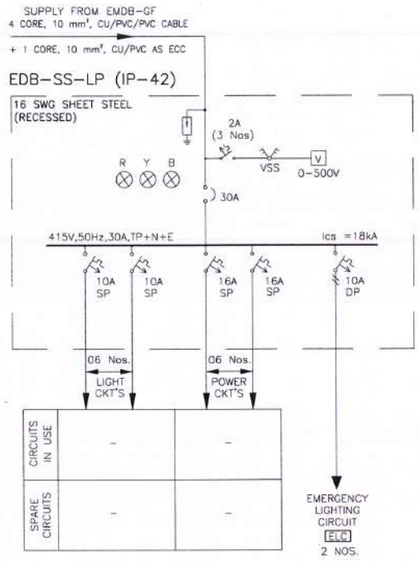
CLIENT	CONSULTANT	03		DRAWN	TM
JINNAH SINDH MEDICAL UNIVERSITY	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	02		SUBMITTED	SA
	ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	01		RECOMMENDED	SA
		00	MARCH, 2026 ISSUED FOR BIDDING DRAWINGS	CHD./VER.	AMS
		REV.	DATE DESCRIPTION APPROVED	APPROVED	AMS

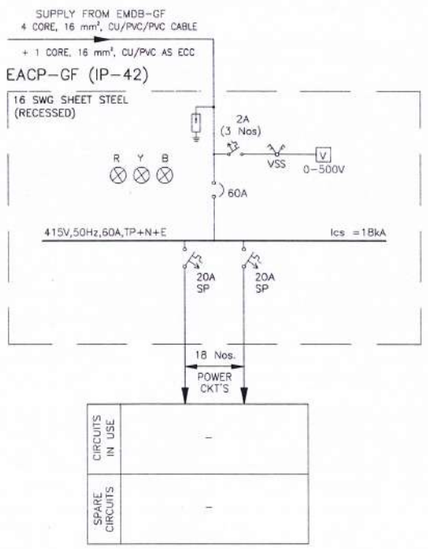
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING
MAIN SINGLE LINE DIAGRAM & DB's DETAIL SHEET 01 OF 11	
DATE	MARCH , 2026
DRAWING No.	4596/08/TD/0000
SCALE	N.T.S
REV.	0

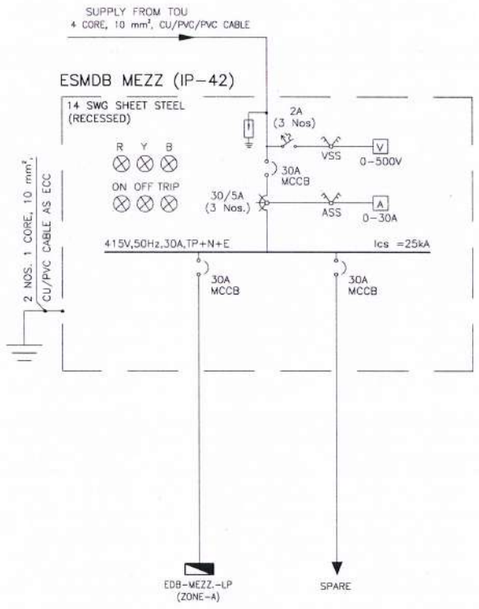


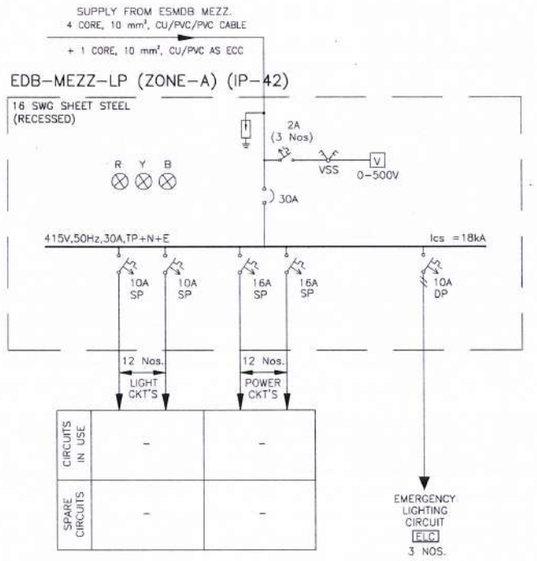


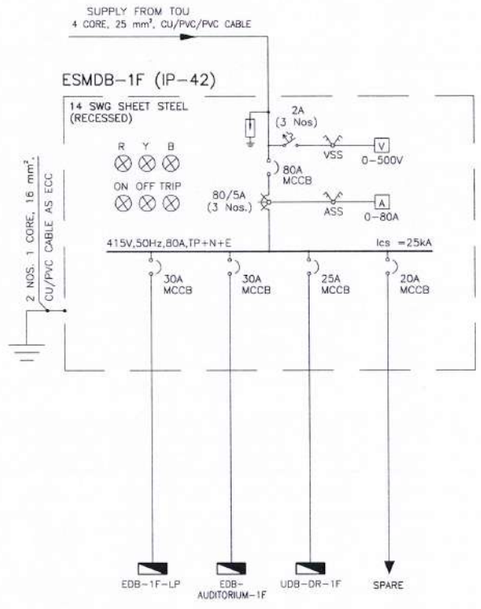












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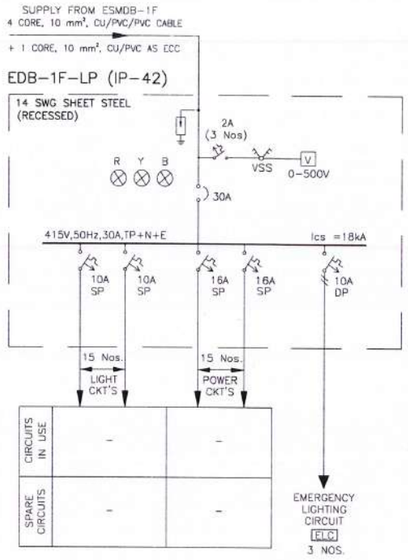
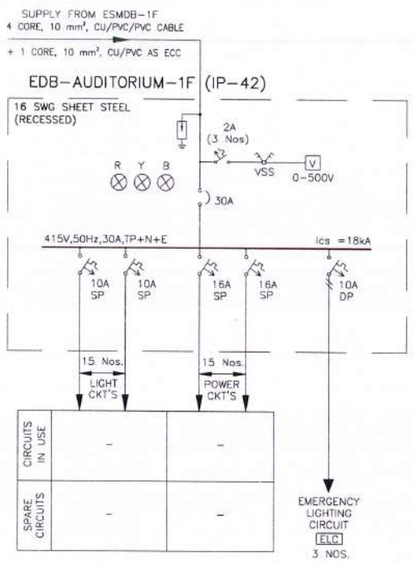
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

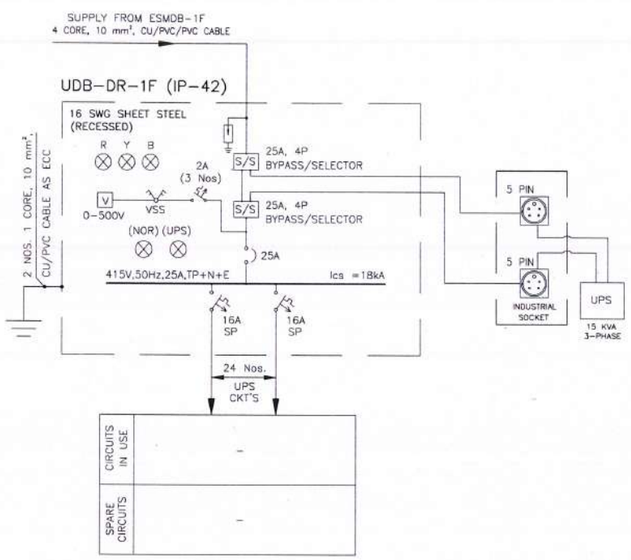
BIDDING DRAWINGS

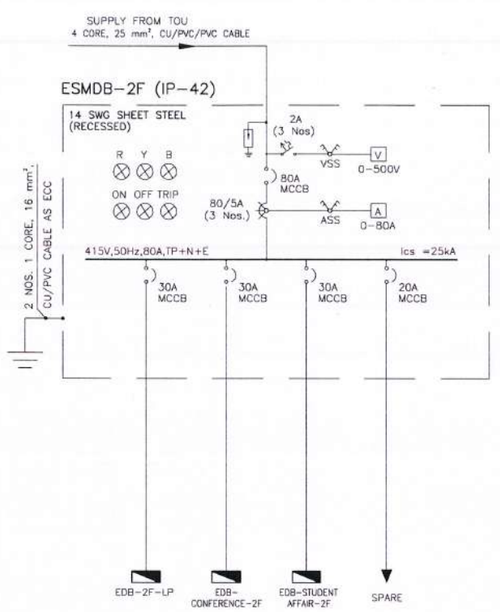
CLIENT	CONSULTANT	03		DRAWN	TM
JINNAH SINDH MEDICAL UNIVERSITY	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	02		SUBMITTED	SA
	ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 35225430-34	01		RECOMMENDED	SA
		00 MARCH, 2026	ISSUED FOR BIDDING DRAWINGS	CHD./VER.	AMS
		REV. DATE	DESCRIPTION APPROVED	APPROVED	AMS

PROJECT	SINGLE LINE DIAGRAM & DB's DETAIL SHEET 02 OF 11	SCALE N.T.S
JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING	DATE MARCH, 2026	DRAWING No. 4596/08/TD/0000
		REV 0









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National Engineering Services Pakistan Ltd. ★ A & P DIVISION Karachi

BIDDING DRAWINGS

CLIENT
JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT
NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99215490-94

REV	DATE	DESCRIPTION	APPROVED		
03				DRAWN	TM
02				SUBMITTED	SA
01				RECOMMENDED	SA
00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS		CHD./VER.	AMS
				APPROVED	AMS

PROJECT
JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

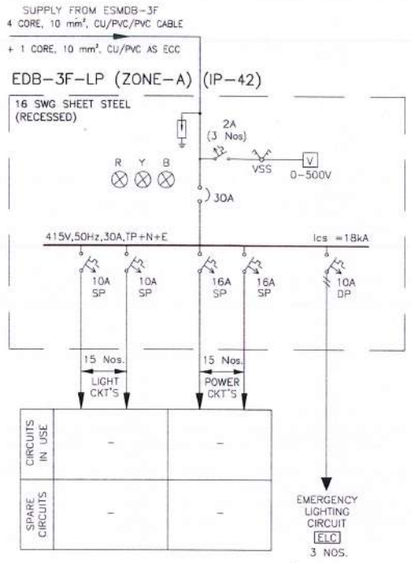
SINGLE LINE DIAGRAM & DB's DETAIL SHEET 03 OF 11

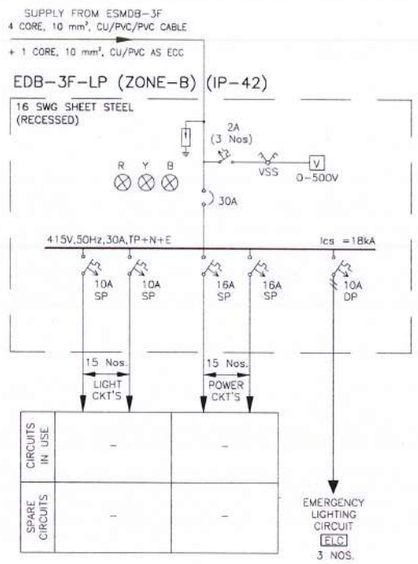
DATE: MARCH , 2026

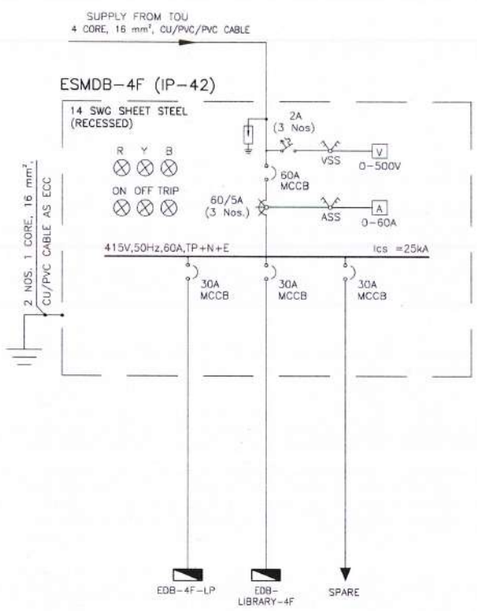
DRAWING No.: 4596/08/TD/0000

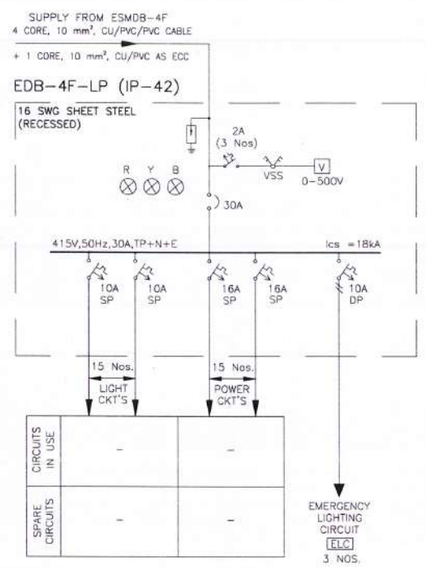
SCALE: N.T.S

REV: 0









BIDDING DRAWINGS

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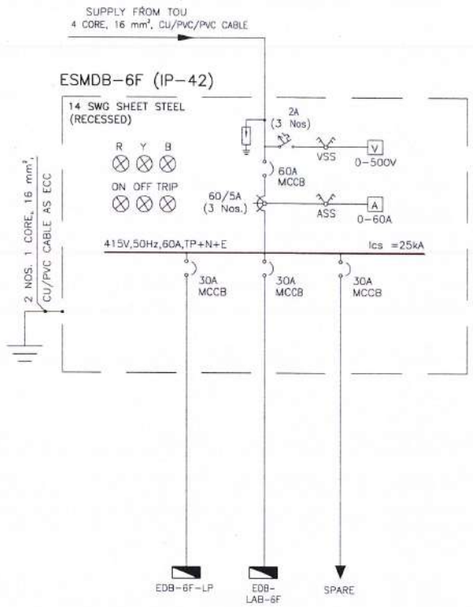
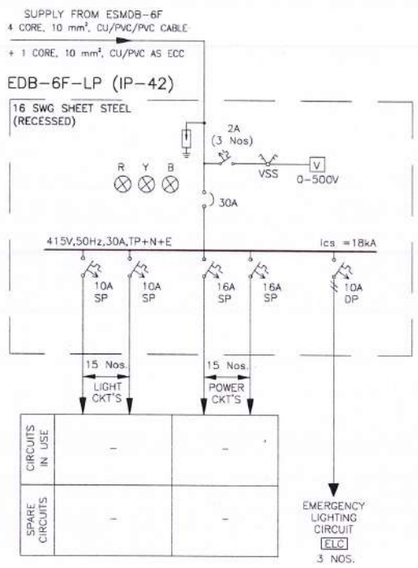
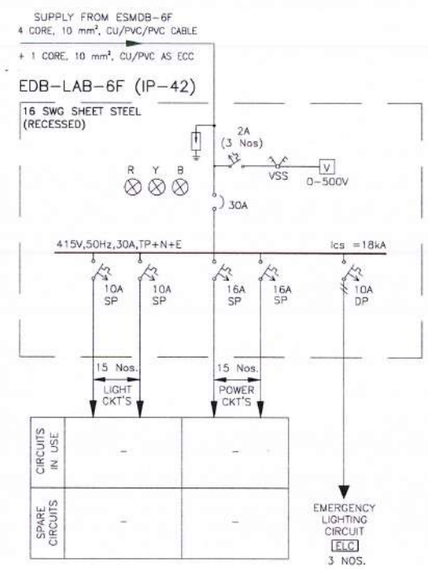
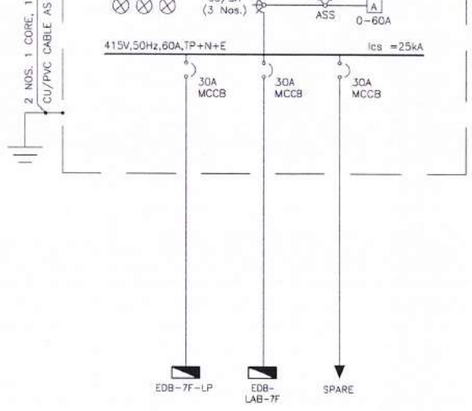
National Engineering Services Pakistan (Pvt.) Ltd. A & E DIVISION Karachi

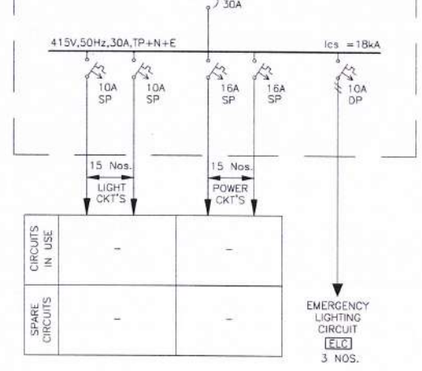
CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 99225400-14				
03				DRAWN	TM
02				SUBMITTED	SA
01				RECOMMENDED	SA
00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS		CHD./VER	AMS
REV	DATE	DESCRIPTION	APPROVED	APPROVED	AMS
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING				
	SINGLE LINE DIAGRAM & DB's DETAIL SHEET 04 OF 11				
DATE	MARCH , 2026	DRAWING No.	4596/08/TD/0000		
SCALE	N.T.S	REV.	0		

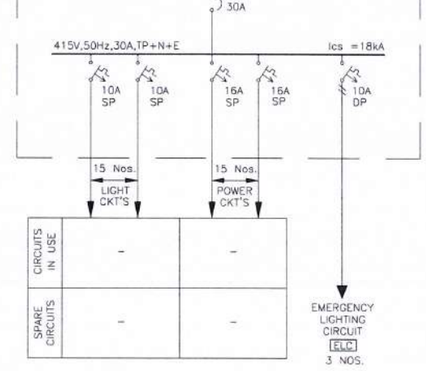


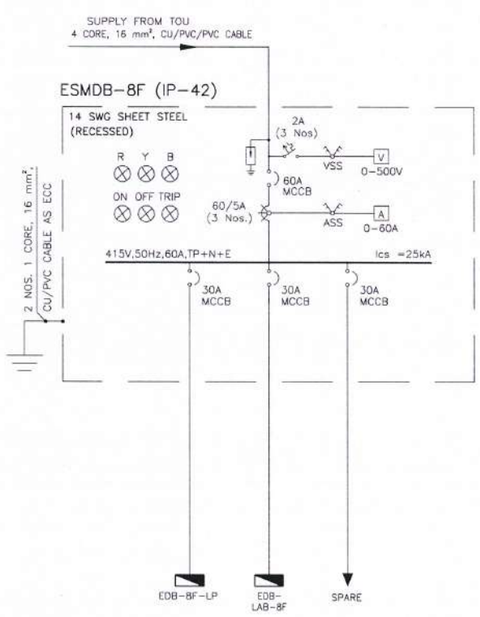












DRAWING NOTES

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8. 12 INCHES BLOCK MASONRY WALL REQUIRED FOR DB WALL IN ELECTRICAL ROOM.

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

BIDDING DRAWINGS

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI,
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99205400-04

REV.	DATE	DESCRIPTION	APPROVED
03			
02			
01			
00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS	

DRAWN	TM
SUBMITTED	SA
RECOMMENDED	SA
CHD./VER.	AMS
APPROVED	AMS

PROJECT: JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

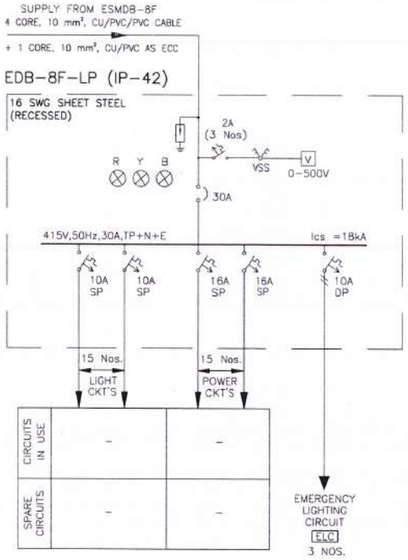
SINGLE LINE DIAGRAM & DB's DETAIL SHEET 05 OF 11

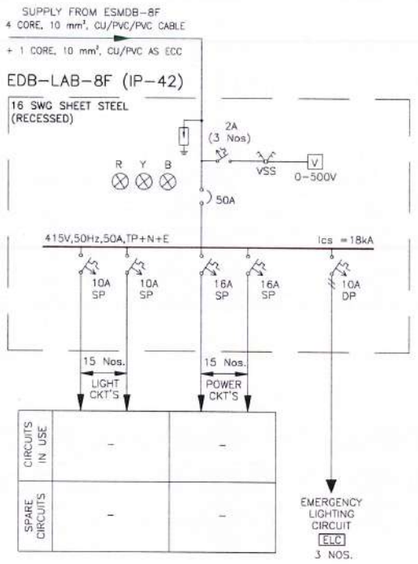
DATE: MARCH, 2026

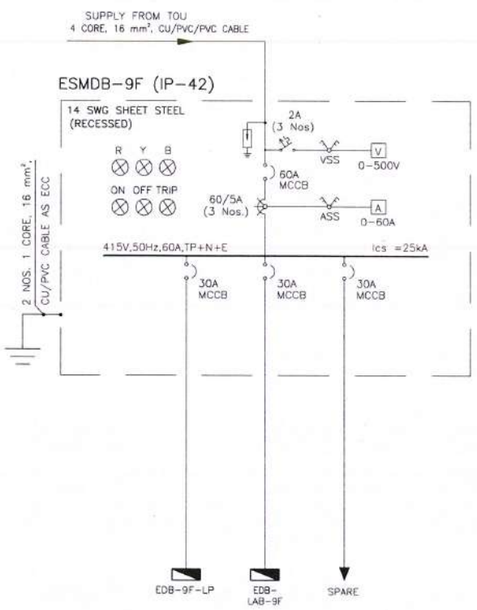
DRAWING No.: 4596/08/TD/0000

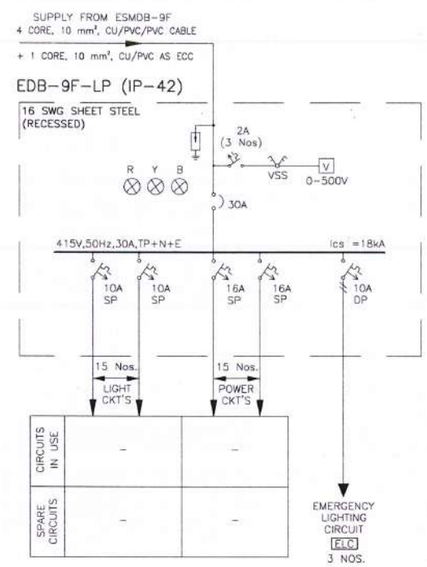
SCALE: N.T.S

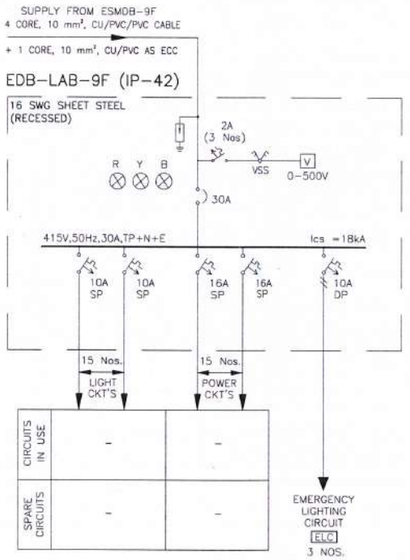
REV.: 0

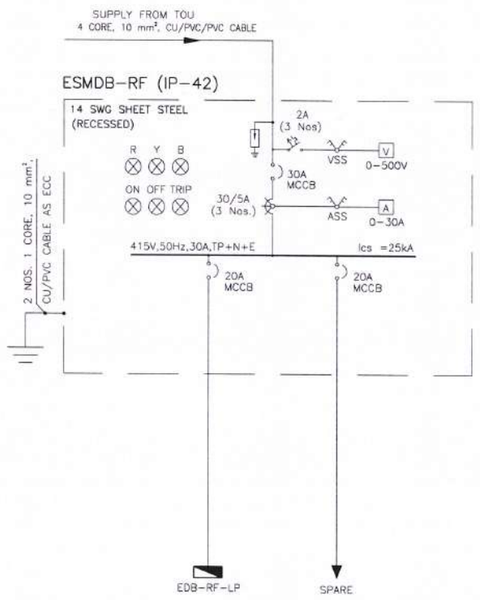


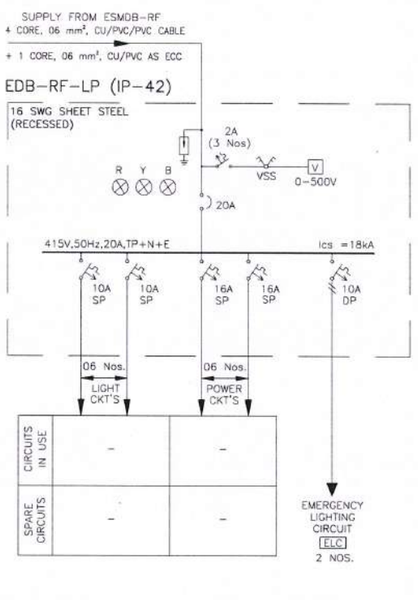


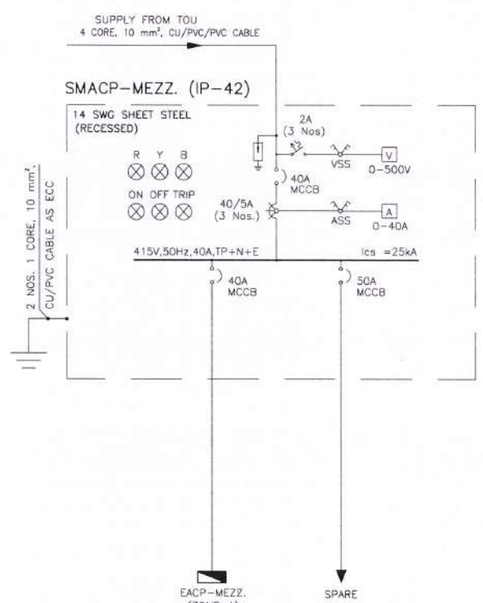












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National Engineering Services Pakistan Ltd. A&E DIVISION Karachi

BIDDING DRAWINGS

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI
4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 35216438-44

REV.	DATE	DESCRIPTION	APPROVED
03			
02			
01			
00	MARCH 2026	ISSUED FOR BIDDING DRAWINGS	

DRAWN	TM
SUBMITTED	SA
RECOMMENDED	SA
CHD /VER.	AMS
APPROVED	AMS

PROJECT: JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

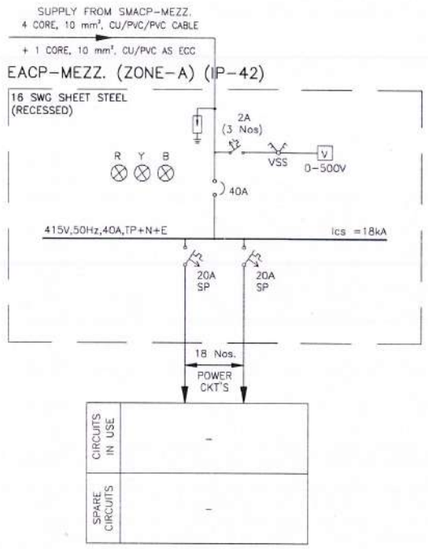
SINGLE LINE DIAGRAM & DB's DETAIL SHEET 06 OF 11

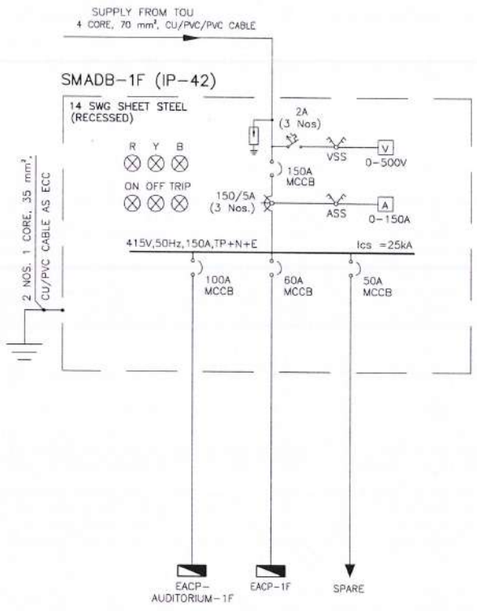
DATE: MARCH, 2026

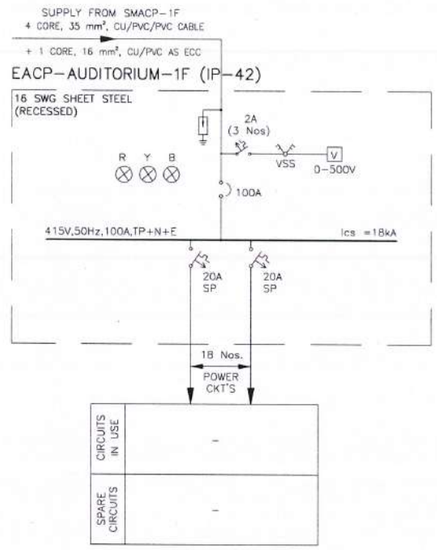
DRAWING No: 4596/08/TD/0000

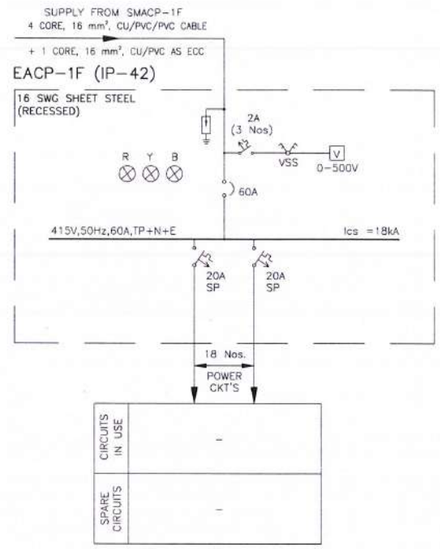
SCALE: N.T.S

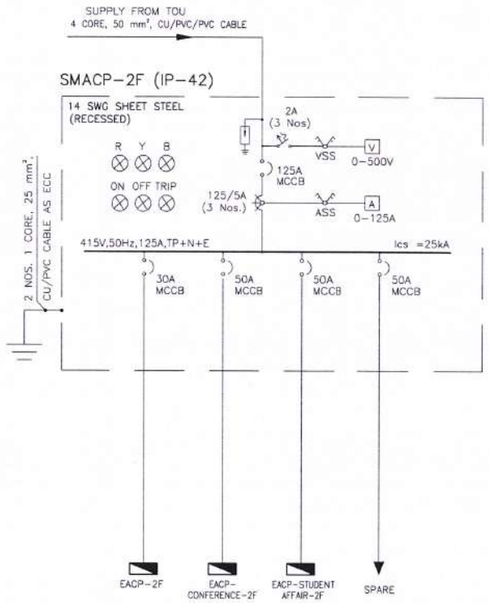
REV: 0

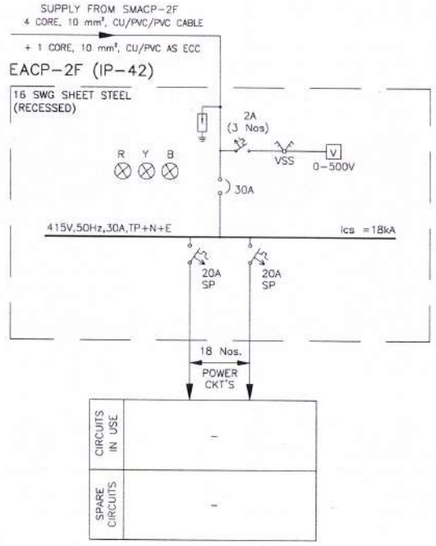


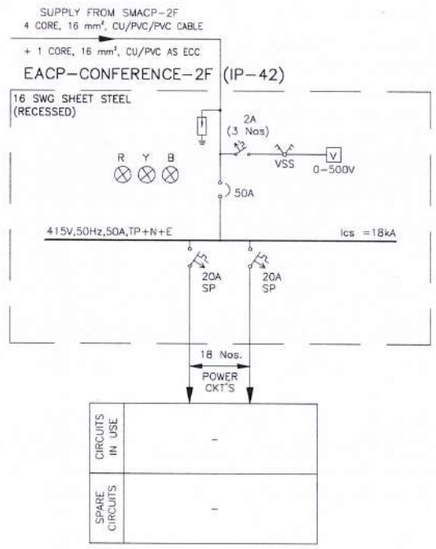


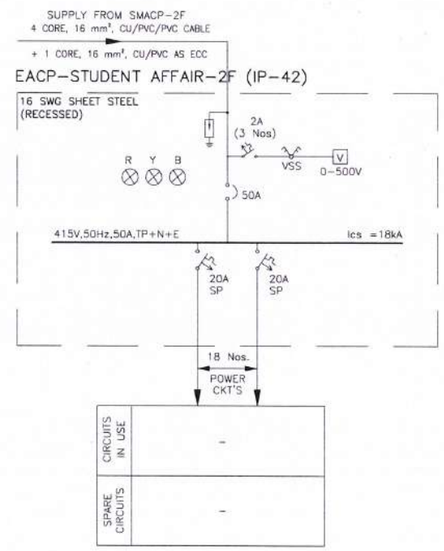












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8. 12 INCHES BLOCK MASONRY WALL REQUIRED FOR DB WALL IN ELECTRICAL ROOM.

National Engineering Services Pakistan (Pvt.) Ltd. ★ A&P DIVISION Karachi

BIDDING DRAWINGS

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99235430-36

REV.	DATE	DESCRIPTION	APPROVED		
03				DRAWN	TM
02				SUBMITTED	SA
01				RECOMMENDED	SA
00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS		CHD./VER	AMS
				APPROVED	AMS

PROJECT: JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

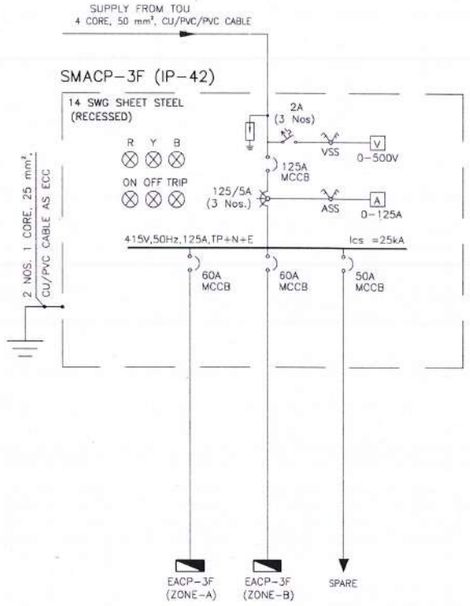
SINGLE LINE DIAGRAM & DB's DETAIL SHEET 07 OF 11

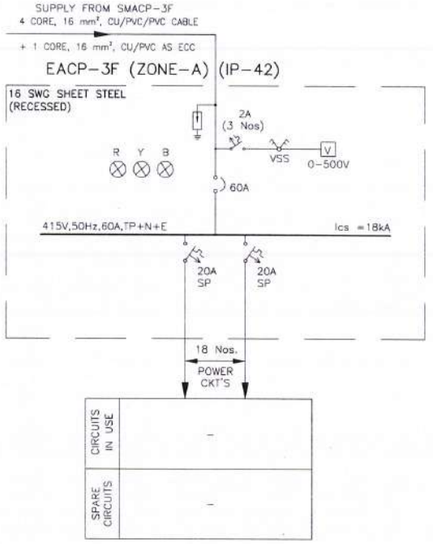
DATE: MARCH, 2026

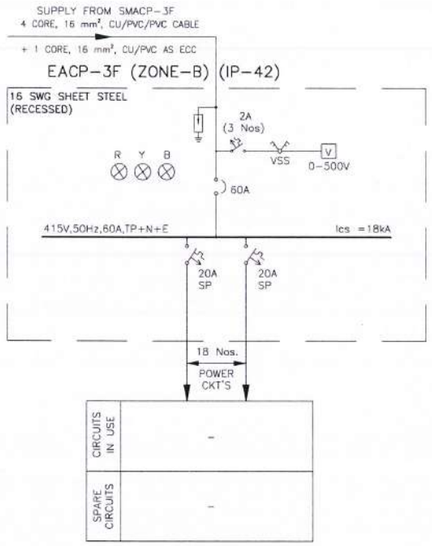
DRAWING No.: 4596/08/TD/0000

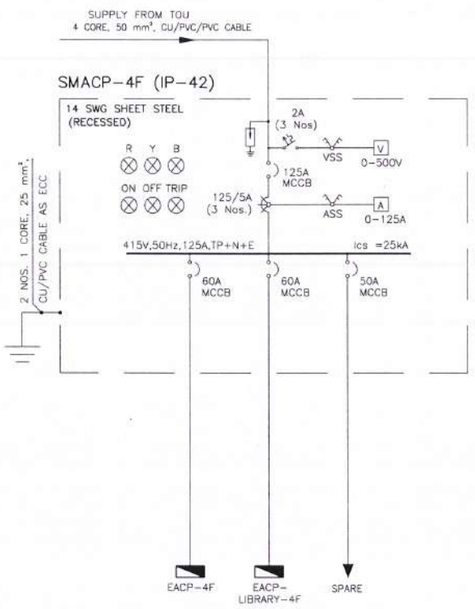
SCALE: N.T.S

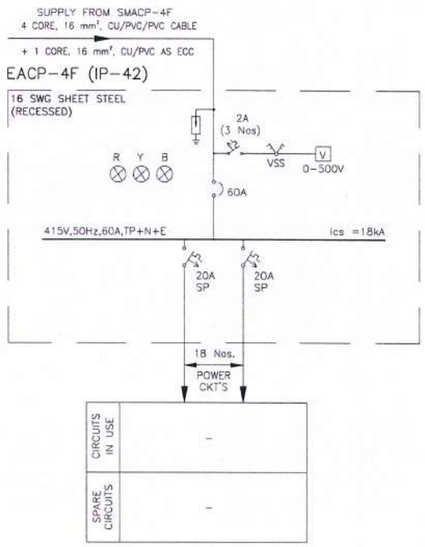
REV.: 0

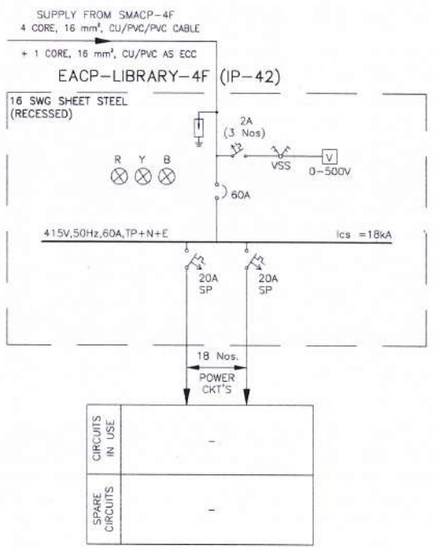


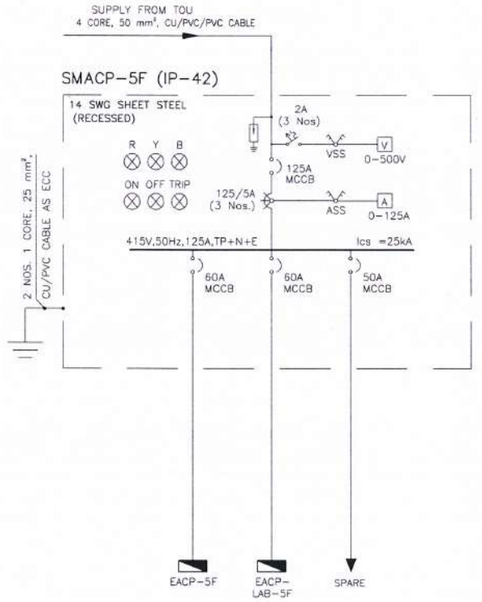


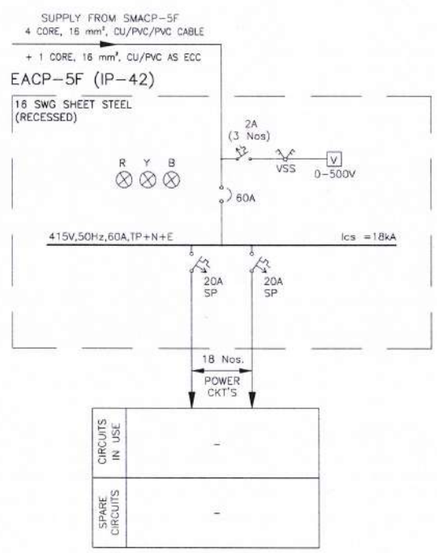












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National Engineering Services Pakistan Ltd. ★ A & E DIVISION Karachi

BIDDING DRAWINGS

CLIENT
JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT
NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI
4TH FLOOR 'NESPAK' Building, Abbas Shaheed Road, Karachi. Tel: 99204304-14

REV.	DATE	DESCRIPTION	APPROVED
03			
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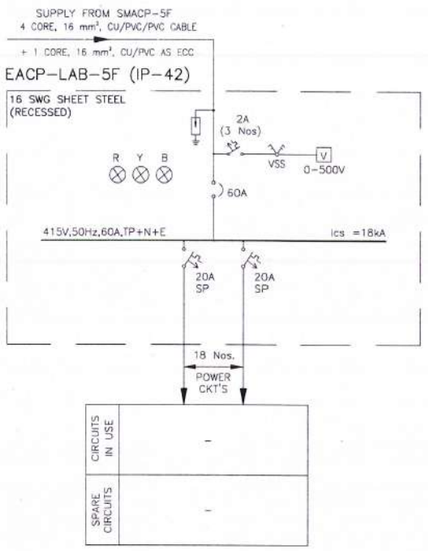
01			
00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS	

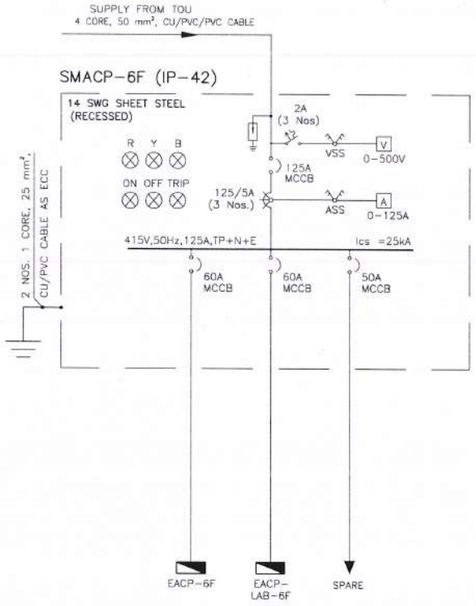
DRAWN	TM
SUBMITTED	SA
RECOMMENDED	SA
CHD /VER	AMS
APPROVED	AMS

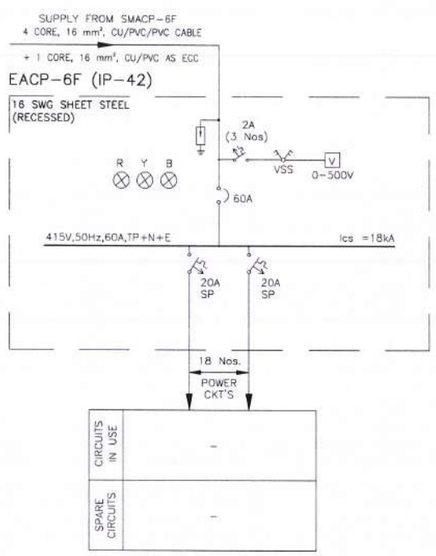
PROJECT
JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

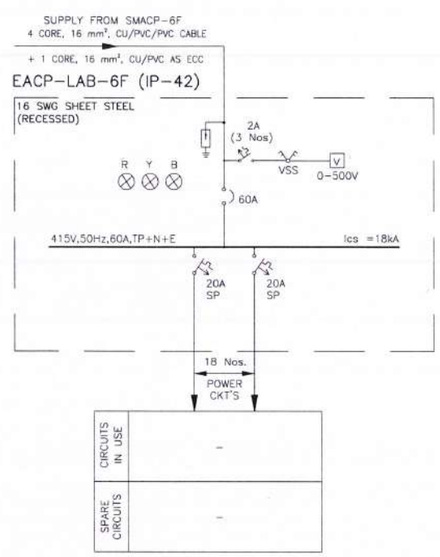
SINGLE LINE DIAGRAM & DB's
DETAIL SHEET 08 OF 11

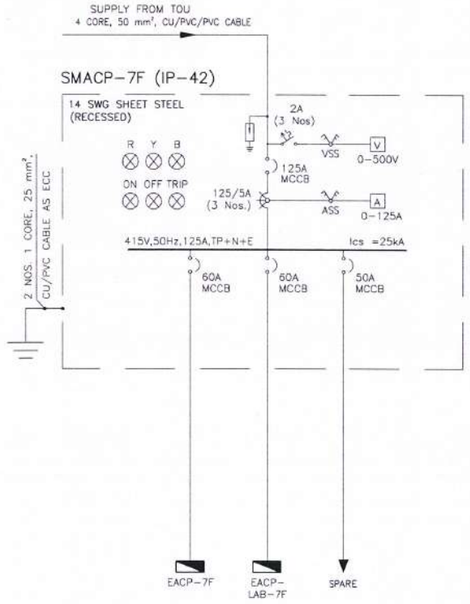
DATE: MARCH , 2026
DRAWING No.: 4596/08/TD/0000
SCALE: N.T.S
REV.: 0

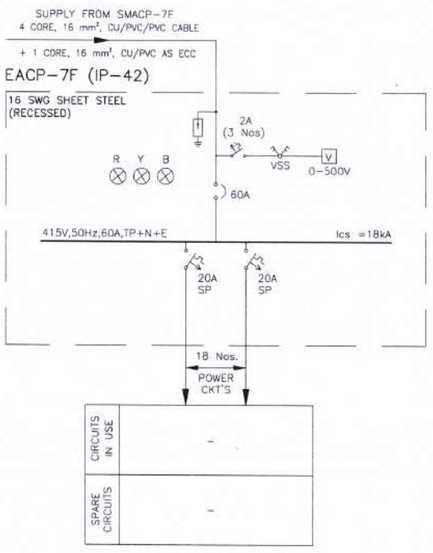


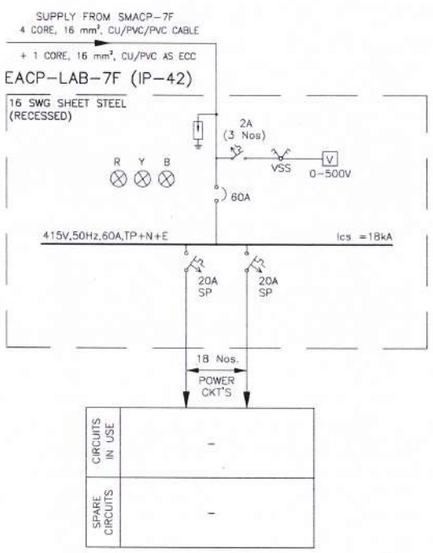


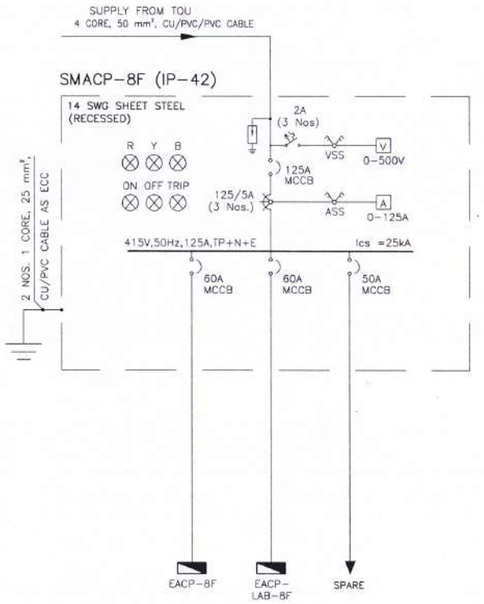












DRAWING NOTES

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2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH OTHER TENDER/CONSTRUCTION DRAWINGS. ANY CONTRADICTION, CLASHES, COORDINATION ISSUES ETC., WITH OTHER TRADES/SERVICES/SITE CONDITIONS SHALL BE BROUGHT TO THE ENGINEER NOTICE FOR NECESSARY ACTION(S) BEFORE EXECUTION OF WORK(S).
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8. 12 INCHES BLOCK MASONRY WALL REQUIRED FOR DB WALL IN ELECTRICAL ROOM.

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

BIDDING DRAWINGS

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI, 4TH FLOOR, N.I.C.L. Building, Abbas Shaheed Road, Karachi. Tel: 99225410-14	03			DRAWN: TM
		02			SUBMITTED: SA
		01			RECOMMENDED: SA
		00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS	CHD./VER.: AMS
		REV	DATE	DESCRIPTION / APPROVED	APPROVED: AMS

PROJECT: JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

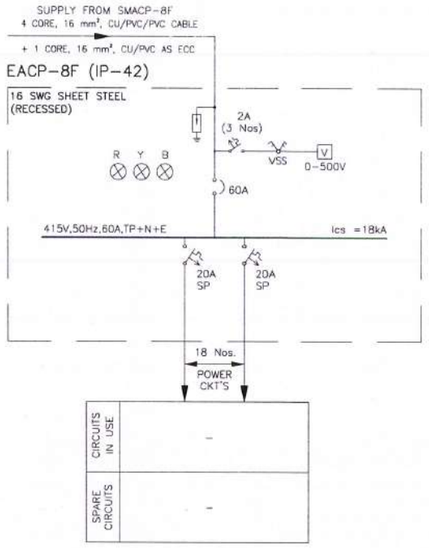
SINGLE LINE DIAGRAM & DB's DETAIL SHEET 09 OF 11

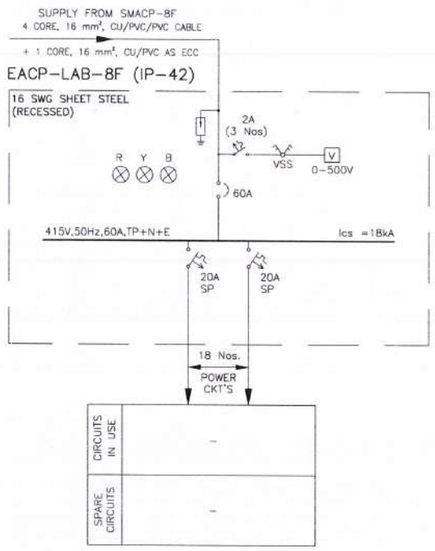
SCALE: N.T.S

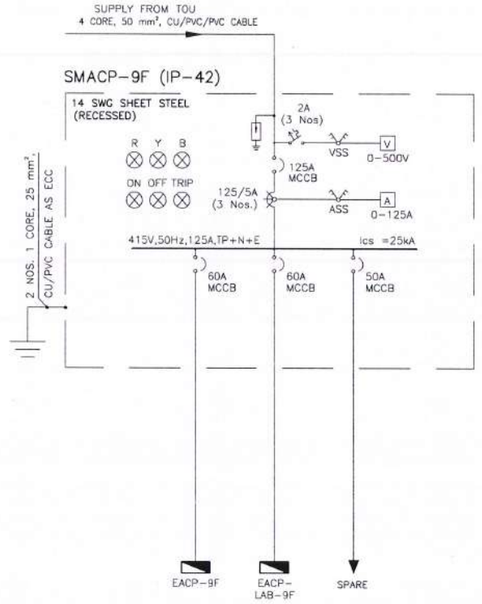
DATE: MARCH , 2026

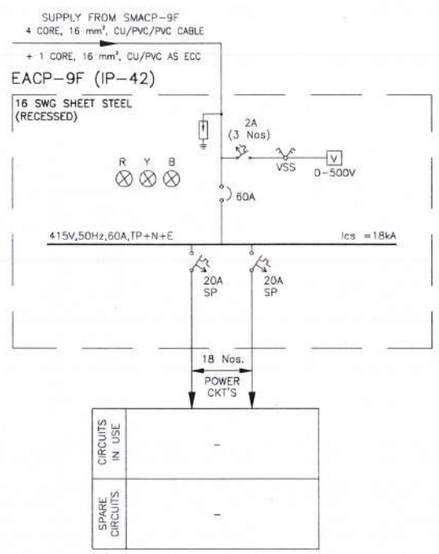
DRAWING No.: 4596/08/TD/0000

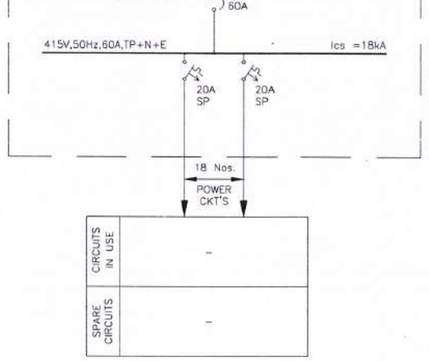
REV.: 0

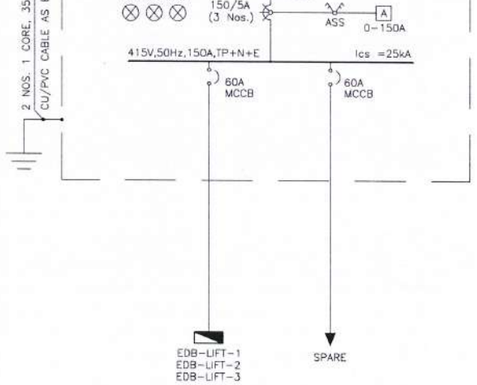


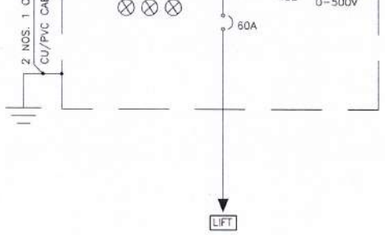


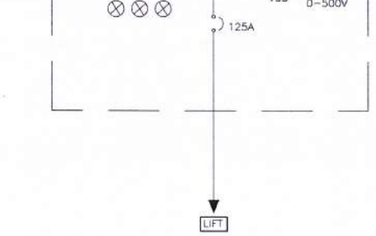












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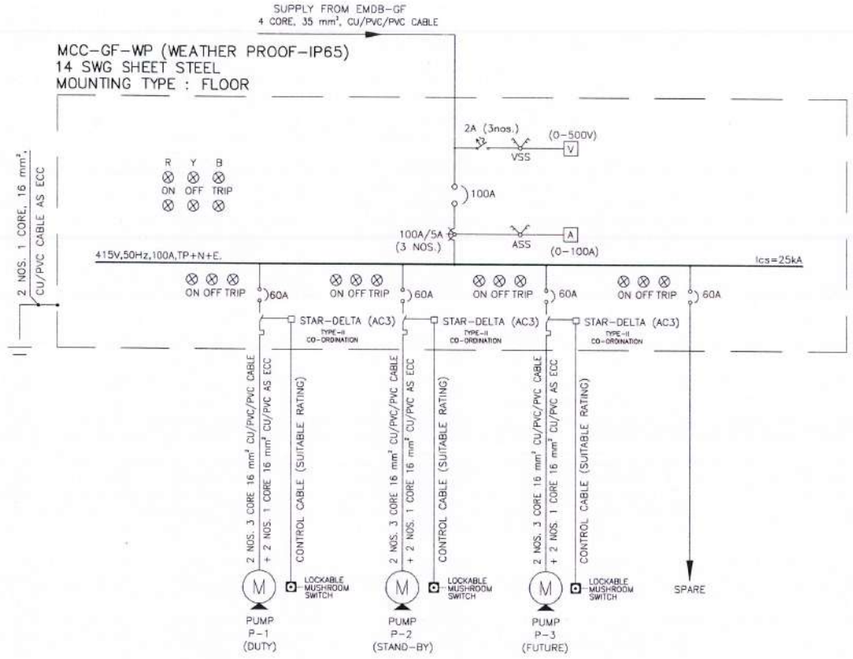
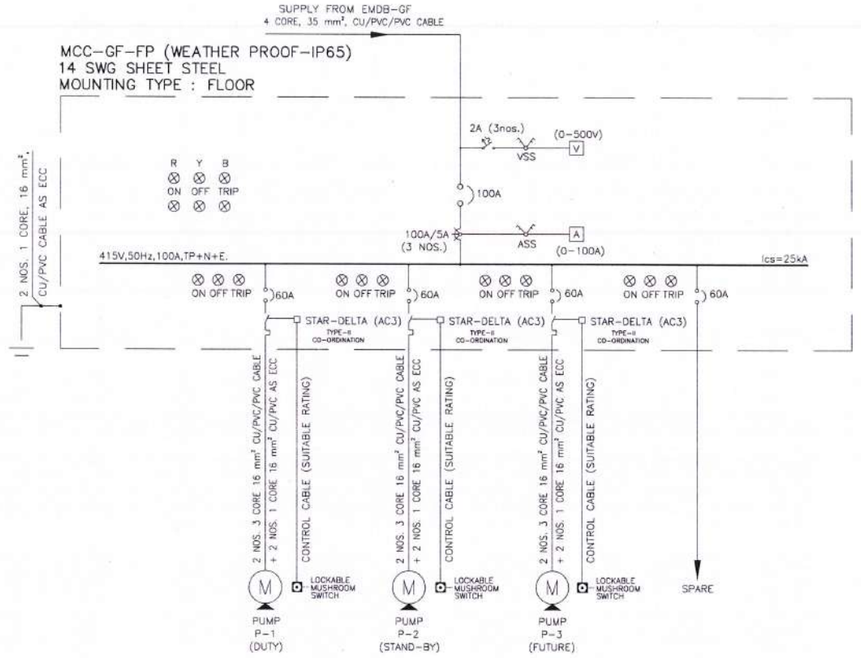
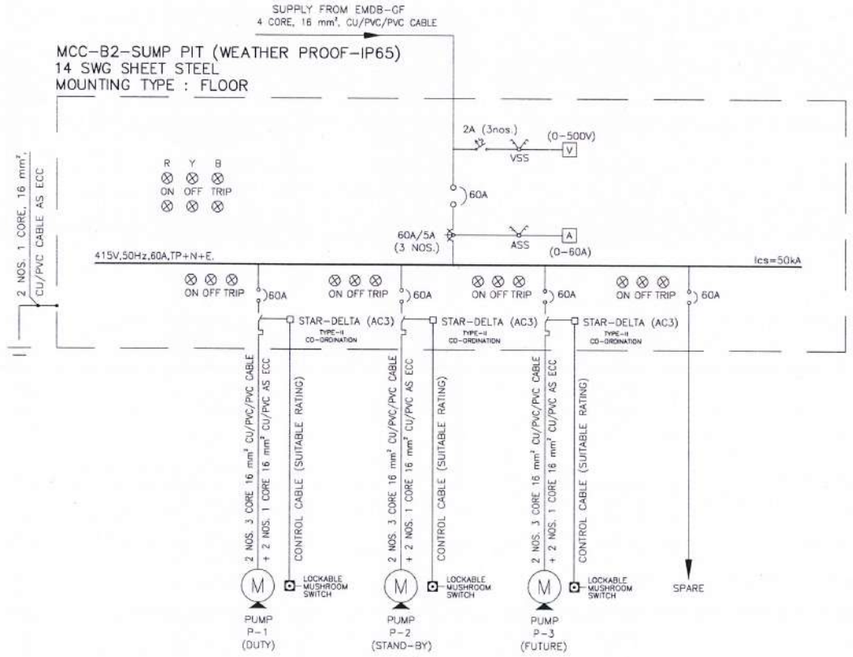
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.				
	ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbas Shaheed Road, Karachi. Tel: 99225430-34				
03				DRAWN	TM
02				SUBMITTED	SA
01				RECOMMENDED	SA
00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS		CHD./VER	AMS
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	AMS
PROJECT	JINNAH SINDH MEDICAL UNIVERSITY ADMIN & ACADEMIC BUILDING				
SINGLE LINE DIAGRAM & DB's DETAIL SHEET 10 OF 11					
DATE	MARCH , 2026				
DRAWING No.	4596/08/TD/0000				
SCALE	N.T.S				
REV.	0				







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National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI
9TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 99226470-74

REV.	DATE	DESCRIPTION	APPROVED
03			
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00	MARCH, 2026	ISSUED FOR BIDDING DRAWINGS	

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SUBMITTED	SA
RECOMMENDED	SA
CHD./VER.	AMS
APPROVED	AMS

PROJECT: JINNAH SINDH MEDICAL UNIVERSITY
ADMIN & ACADEMIC BUILDING

SINGLE LINE DIAGRAM & DB's DETAIL SHEET 11 OF 11

SCALE: N.T.S

DATE: MARCH, 2026

DRAWING No: 4596/08/TD/0000

REV: 0

NATURAL GAS PIPING WORKS		
S.NO.	DRAWING NO.	TITLE
1	4596/50J/TD/M201	LIST OF DRAWINGS
2	4596/50J/TD/M202	NOTES, LEGEND & MISCELLANEOUS DETAILS
3	4596/50J/TD/M203	RISER DIAGRAM
4	4596/50J/TD/M204	GROUND FLOOR PLAN - NATURAL GAS PIPING
5	4596/50J/TD/M205	1ST FLOOR PLAN - NATURAL GAS PIPING
6	4596/50J/TD/M206	2ND FLOOR PLAN - NATURAL GAS PIPING
7	4596/50J/TD/M207	3RD FLOOR PLAN - NATURAL GAS PIPING
8	4596/50J/TD/M208	4TH FLOOR PLAN - NATURAL GAS PIPING
9	4596/50J/TD/M209	5TH FLOOR PLAN - NATURAL GAS PIPING
10	4596/50J/TD/M210	6TH FLOOR PLAN - NATURAL GAS PIPING
11	4596/50J/TD/M211	7TH FLOOR PLAN - NATURAL GAS PIPING
12	4596/50J/TD/M212	8TH & 9TH TYPICAL FLOOR PLAN - NATURAL GAS PIPING
13	4596/50J/TD/M213	ROOF PLAN - NATURAL GAS PIPING

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

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ARCHITECTURE & PLANNING DIVISION KARACHI
4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	MEHBOOB
SUBMITTED	
RECOMMENDED	HASSAN
CHD./VER.	SOHAIB
APPROVED	SOHAIB

PROJECT: JSMU

LIST OF DRAWINGS

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M201

SCALE: N.T.S

REV.: 0

NOTES:

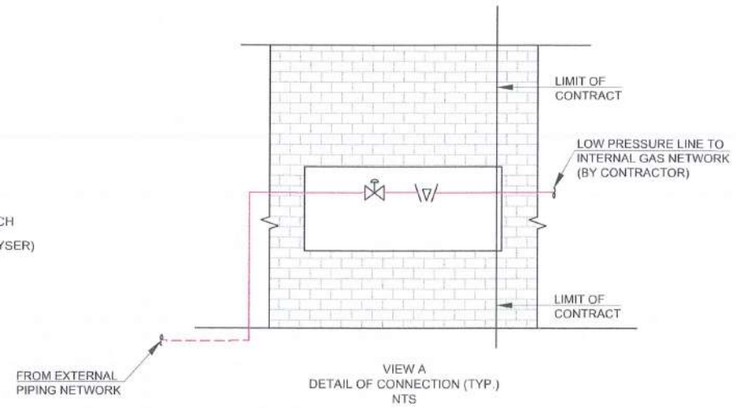
1. ALL EXTERNAL GAS PIPING NETWORK FROM GAS MAIN UP TO BUILDING INCLUDING GAS REGULATORS, PLUG VALVES, FITTINGS, INSTRUMENTS AND METER SHALL BE SUPPLIED AND EXECUTED BY SSGC.
2. ALL INTERNAL GAS PIPING WORKS (LOW PRESSURE) UP TO DESIGNATED SUPPLY POINTS WITHIN THE BUILDING, SHALL BE CONTRACTOR'S SCOPE OF WORK AND SHALL BE EXECUTED BY SSGC APPROVED CONTRACTOR ONLY.
2. THE LAYOUT OF GAS SUPPLY NETWORK SHOWN IS TENTATIVE. THE CONTRACTOR SHALL PREPARE DETAILED SHOP DRAWINGS AS PER SITE CONDITIONS AND SUBMIT THE SAME FOR APPROVAL OF THE ENGINEER PRIOR TO START OF WORK.
5. ALL PIPE SIZES MENTIONED ON THE DRAWING ARE NOMINAL DIAMETERS IN INCHES UNLESS OTHERWISE STATED.
4. LOCATION OF GAS CONNECTION / VALVES SHALL BE COORDINATED WITH THE EQUIPMENT LAYOUT IN EACH AREA. ALL GAS VALVES SHALL BE INSTALLED WITHIN 4 FT OF THE APPLIANCES THEY SERVE.
5. ALL GAS FIRED EQUIPMENT SHALL OPERATE AT A PRESSURE OF 8 INCHES WATER COLUMN.
6. ALL UNDER FLOOR INTERNAL GAS PIPES SHALL BE AT LEAST 1 FEET AWAY FROM OTHER SERVICES AND MINIMUM EARTH COVER OF 1½ FEET SHALL BE PROVIDED FOR UNDERGROUND PIPING.
7. CONCEALED PIPE WORK SHALL NOT BE SEALED UNTIL ALL INSPECTION / TESTING HAVE BEEN DONE.
8. ALL ABOVE GROUND OUTDOOR PIPING SHALL BE ELEVATED NOT LESS THAN 3 ½ INCHES (89 MM) ABOVE GROUND AND WHERE INSTALLED ACROSS ROOF SURFACES, SHALL BE ELEVATED NOT LESS THAN 3 ½ INCHES (89 MM).
9. ALL GAS PIPING WORK RUNNING ACROSS ROOF SLAB SHALL BE LAID ON CEMENTED PADS HAVING SUITABLE SPACING TO ENSURE UNIFORMLY SUPPORTED PIPE WORK.
10. PROVIDE UNIONS WHERE NECESSARY AND AT EACH ISOLATING VALVE TO ENSURE EASE OF REMOVAL AND MAINTENANCE.
11. GAS PIPING SHALL BE SLOPED NOT LESS THAN ¼" IN 15 FEET (7 MM IN 4.6 M).
10. PIPING IN SOLID FLOORS SHALL BE LAID IN CHANNELS AND COVERED IN A MANNER THAT WILL ALLOW ACCESS TO THE PIPING WITH MINIMUM DAMAGE TO THE BUILDING.
11. GAS PIPING IN CONTACT WITH EARTH OR WHERE PASSING THROUGH EXTERIOR WALL, SHALL BE PROTECTED AGAINST CORROSION BY WRAPPING WITH MATERIAL AS PER SPECIFICATION.
12. ALL UNDERGROUND PIPING, WHERE MIN. EARTH COVER CAN NOT BE MAINTAINED OR WHERE PIPING IS SUBJECTED TO EXTERNAL LOADING (SUCH AS PIPING INSTALLED BENEATH BUILDINGS, VEHICLE RAMPS ETC.), SHALL BE ENCASED IN A CONDUIT OF APPROVED MATERIAL DESIGNED TO WITHSTAND SUPERIMPOSED LOADING.
13. ALL OPENINGS AND ANNULAR SPACES BETWEEN PIPING AND SLEEVES / CONDUITS SHALL BE FILLED WITH NON-SHRINK GROUT TO PREVENT ENTRY OF ANY FOREIGN MATERIAL / MATTER.

LEGENDS:

NG	NATURAL GAS PIPELINE (UNDERGROUND / UNDER FLOOR)
NG	NATURAL GAS PIPELINE (ABOVE GROUND)
	PIPE BREAK
	PRESSURE REGULATOR (SSGC SUPPLY)
\▽/	PLUG VALVE (SSGC SUPPLY)
	BALL VALVE
GM	GAS METER (SSGC SUPPLY)
	PIPE DOWN
	GWH (NIC)
•	BRANCH CONNECTION
◎	PIPE UP (RISER)

ABBREVIATIONS:

NG	NATURAL GAS
F/A	FROM ABOVE
F/B	FROM BELOW
T/A	TO ABOVE
T/B	TO BELOW
N.I.C	NOT IN CONTRACT
NTS	NOT TO SCALE
PSI	POUNDS PER SQUARE INCH
GWH	GAS WATER HEATER (GEYSER)
TYP.	TYPICAL
CFT/HR	CUBIC FEET PER HOUR
MIN.	MINIMUM
MAX.	MAXIMUM
M	METER
MM	MILLIMETER
FT	FEET



VIEW A
DETAIL OF CONNECTION (TYP.)
NTS

NET GAS DEMAND					
S.NO.	EQUIPMENT	LOCATION	Qty (Nos.)	Rate (cft/hr)	Total Demand (cft/hr)
1	Burner (Pantry)	1st Floor	1	15	15
2	Burner (Pantry)	2nd Floor	1	15	15
3	Burner (Pantry)	3rd Floor	1	15	15
4	Burner (Pantry)	4th Floor	1	15	15
5	Burner (Pantry)	5th Floor	1	15	15
6	Burner (Pantry)	6th Floor	1	15	15
7	Lab Burner	6th Floor	1	5	5
8	Lab Burner	6th Floor	1	5	5
9	Burner (Pantry)	7th Floor	1	15	15
10	Lab Burner	7th Floor	1	5	5
11	Lab Burner	7th Floor	2	5	10
12	Burner (Pantry)	8th Floor	1	15	15
13	Lab Burner	8th Floor	1	5	5
14	Lab Burner	8th Floor	2	5	10
15	Burner (Pantry)	9th Floor	1	15	15
16	Lab Burner	9th Floor	1	5	5
17	Lab Burner	9th Floor	2	5	10
	Total for all Floors		20		190

INTERVALS BETWEEN PIPE SUPPORTS (HORIZONTAL AND VERTICAL)		
S. NO.	NOMINAL DIAMETERS	MAX. INTERVAL BETWEEN SUPPORTS (FT)
1	1/2"	6
2	3/4" - 1"	8
3	1 ¼" OR LARGER	10
4	VERTICAL PIPE RUN (ALL DIAMETERS)	EVERY FLOOR LEVEL

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

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4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	MEHBOOB
SUBMITTED	
RECOMMENDED	HASSAN
CHD./VER.	SOHAIB
APPROVED	SOHAIB

PROJECT: JSMU

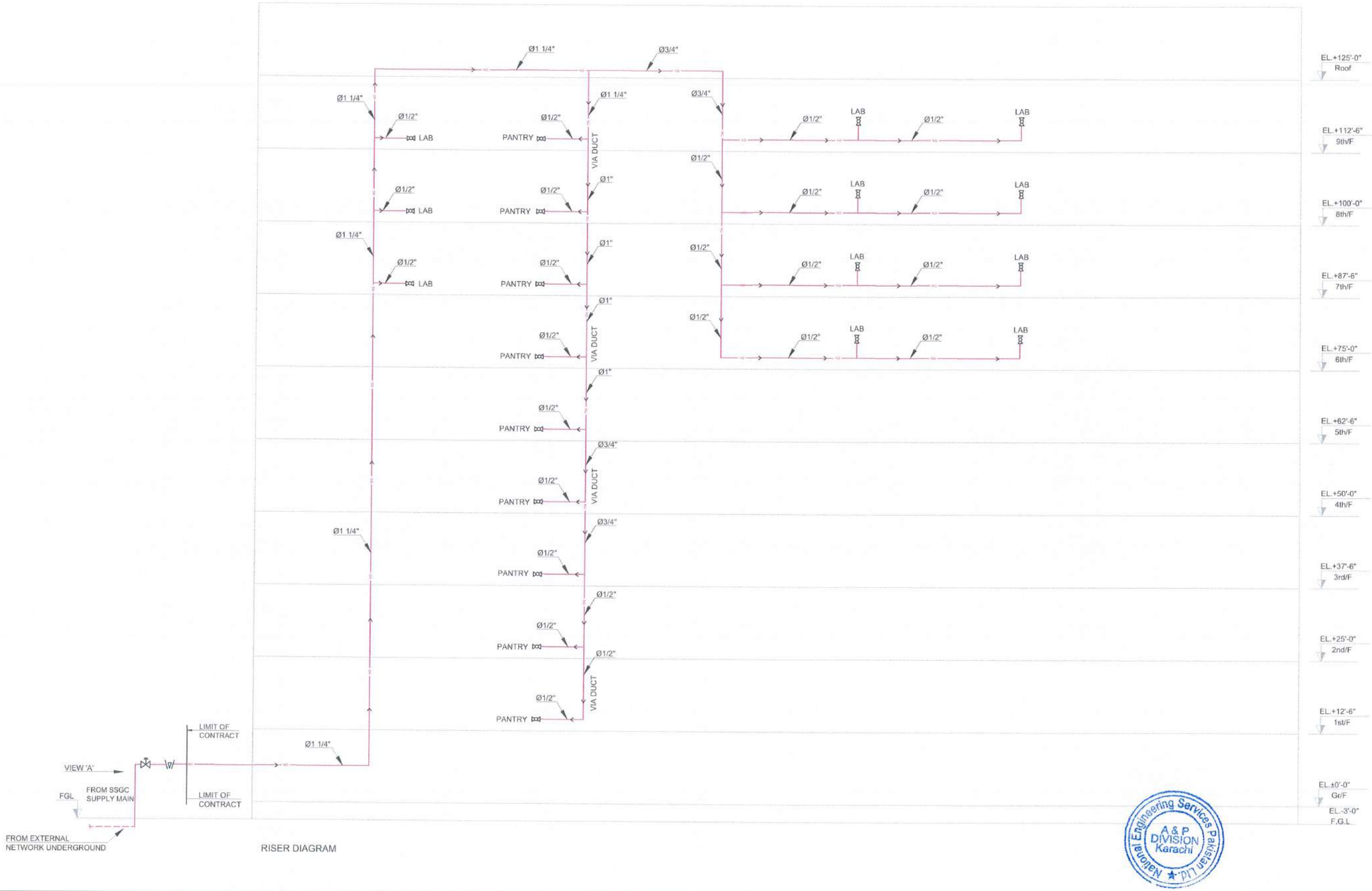
NOTES, LEGEND & MISCELLANEOUS DETAILS

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M202

SCALE: N.T.S

REV.: 0



RISER DIAGRAM

National Engineering Services Pakistan (Pvt.) Ltd. A&P DIVISION Karachi

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY

CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
ARCHITECTURE & PLANNING DIVISION KARACHI.
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REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	MEHBOOB
SUBMITTED	
RECOMMENDED	HASSAN
CHD./VER.	SOHAIB
APPROVED	SOHAIB

PROJECT: JSMU

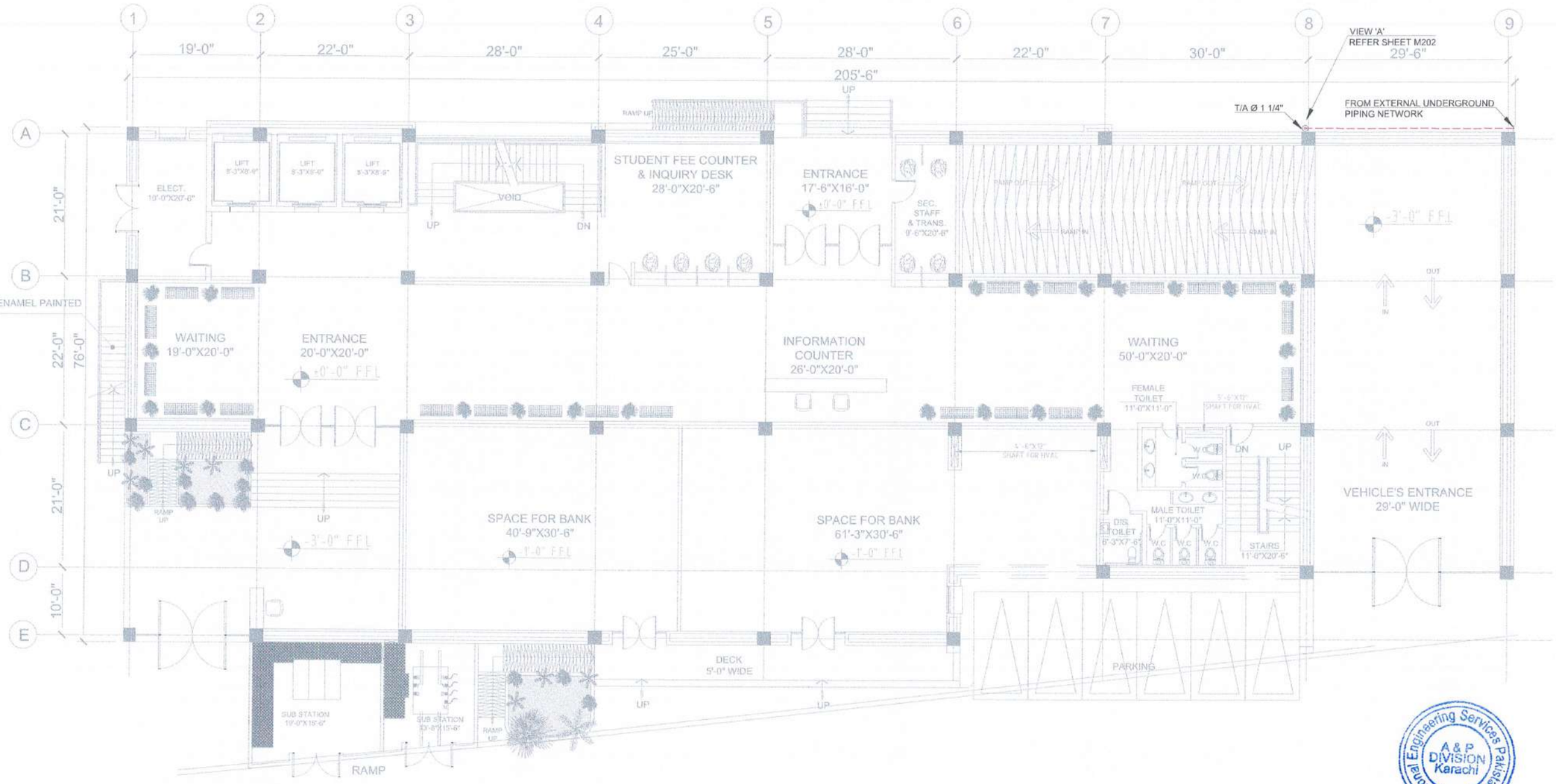
RISER DIAGRAM

DATE: MARCH, 2026

DRAWING No.: 4596/50J/TD/ M203

SCALE: N.T.S.

REV.: 0



GROUND FLOOR PLAN

MAIN ENTRANCE

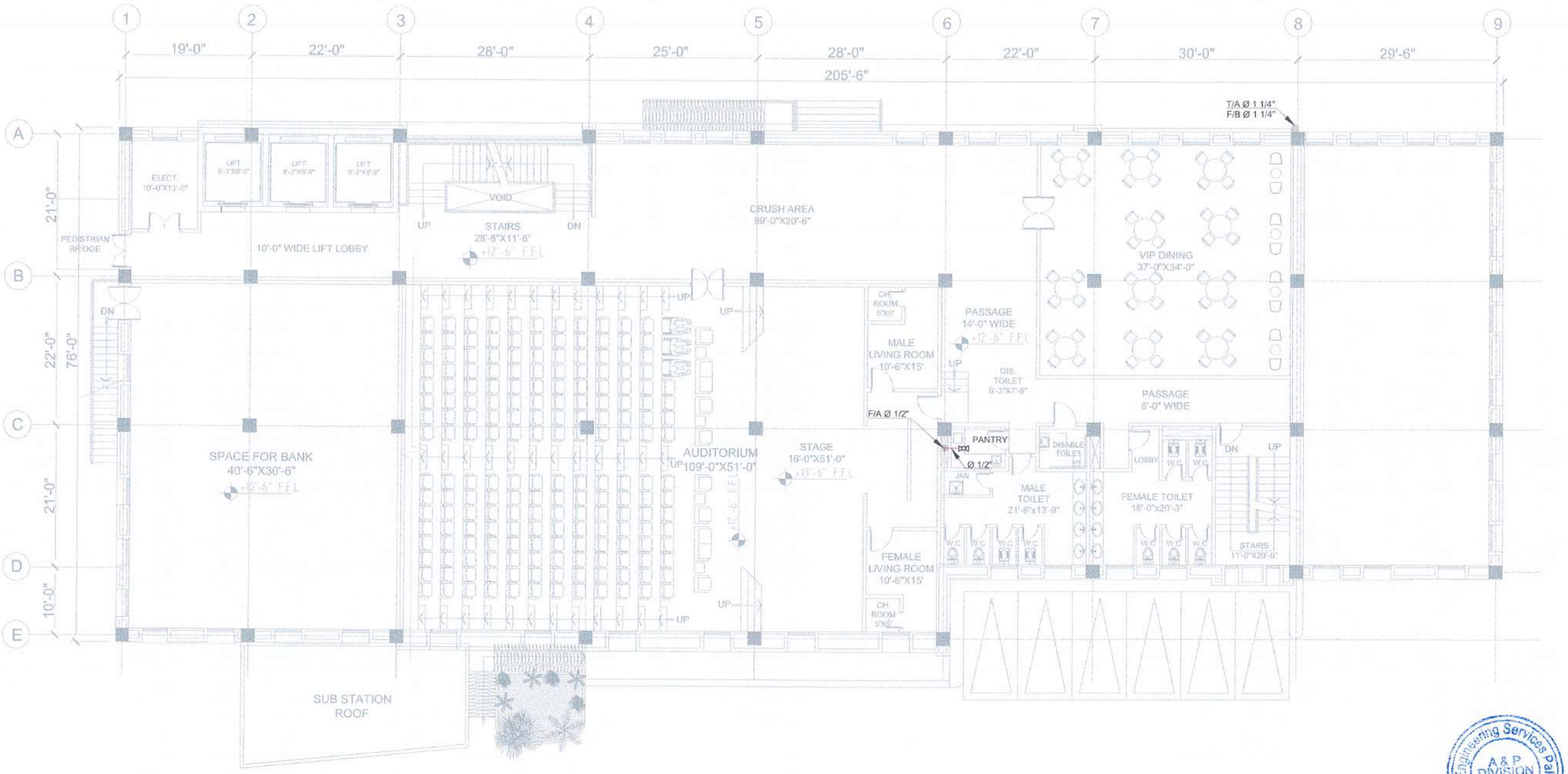
GROUND COVERAGE = 12832 SQ.FT

National Engineering Services Pakistan Ltd.
A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225438-34	PROJECT	JSMU
		04	DRAWN: MEHBOOB		
		03	SUBMITTED:		
		02	RECOMMENDED: HASSAN		
		01	CHD./VER.: SOHAIB		
		REV. / DATE / DESCRIPTION / APPROVED	APPROVED: SOHAIB		
				GROUND FLOOR	SCALE: N.T.S
				DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/M204
					REV.: 0



1ST FLOOR PLAN

VIP DINE AND AUDITORIUM

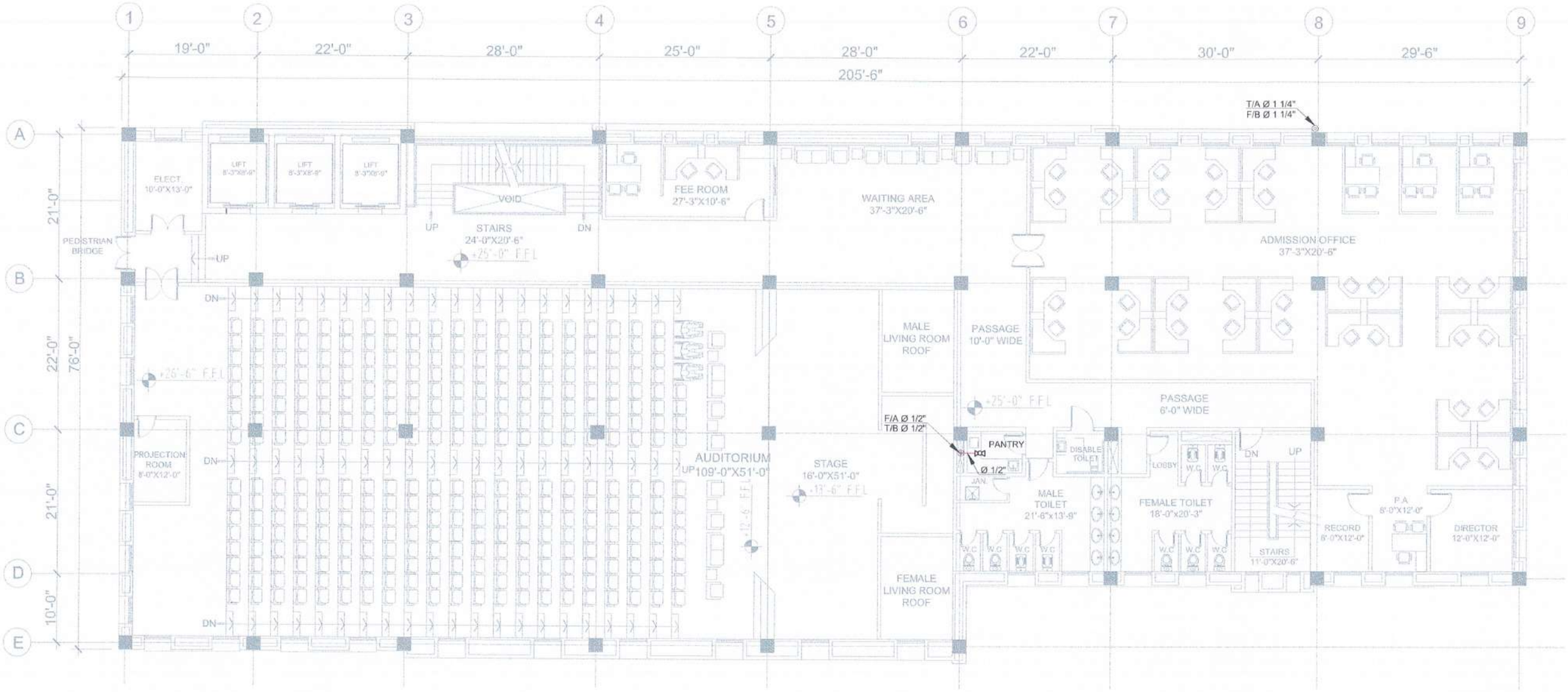
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	PROJECT	JSMU
04			DRAWN	MEHBOOB	
03			SUBMITTED		
02			RECOMMENDED	HASSAN	
01			CHD./VER.	SOHAIB	
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	SOHAIB
1ST FLOOR PLAN				SCALE	N.T.S
DATE	MARCH, 2026	DRAWING No.	4596/50J/TD/M205	REV.	0



2ND FLOOR PLAN

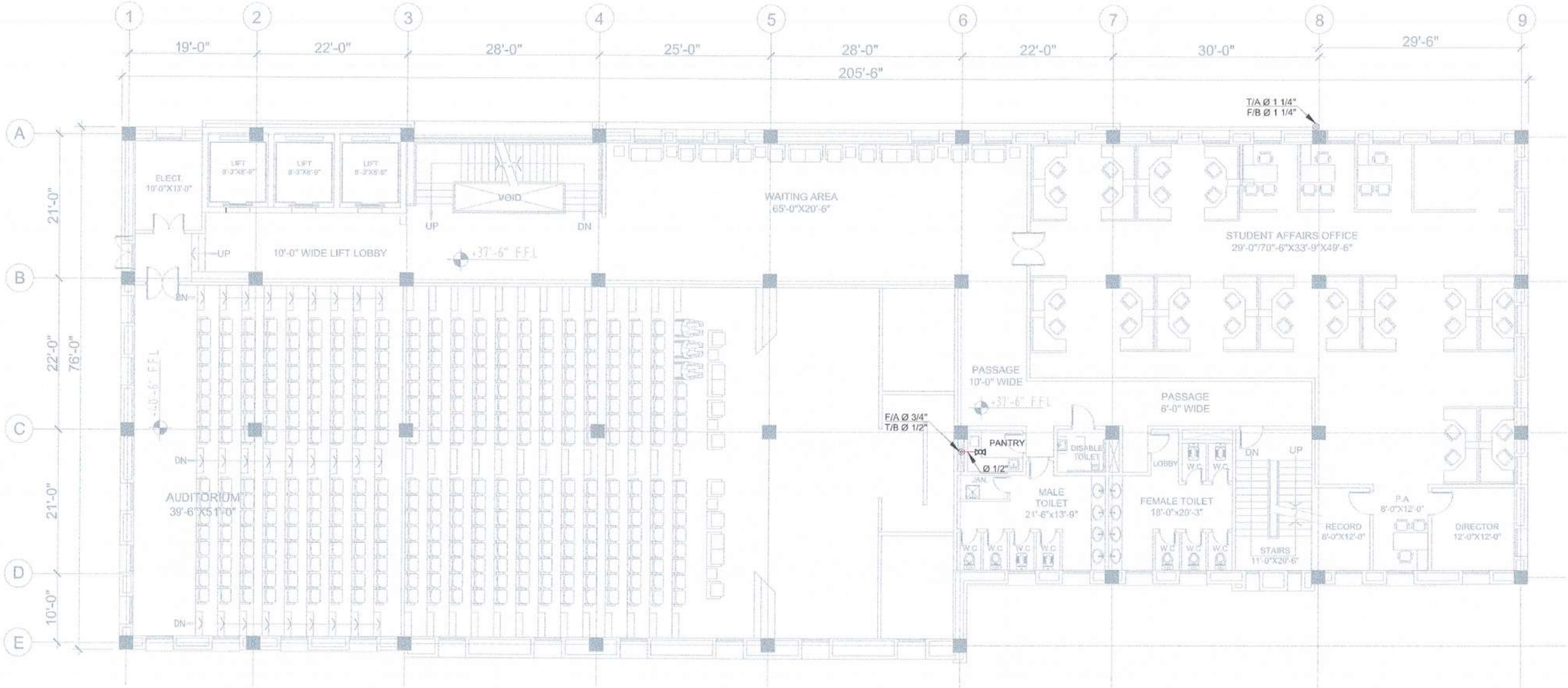
ADMIN AND AUDITORIUM
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.				
ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel. 99225430-34					
04			DRAWN	MEHBOOB	
03			SUBMITTED		
02			RECOMMENDED	HASSAN	
01			CHD./VER.	SOHAIB	
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	SOHAIB
PROJECT	JSMU				
2ND FLOOR PLAN					
DATE	MARCH, 2026				
DRAWING No.	4596/50J/TD/M206				
SCALE	N.T.S				
REV.	0				



3RD FLOOR PLAN

STUDENT AFFAIRS AND AUDITORIUM

COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

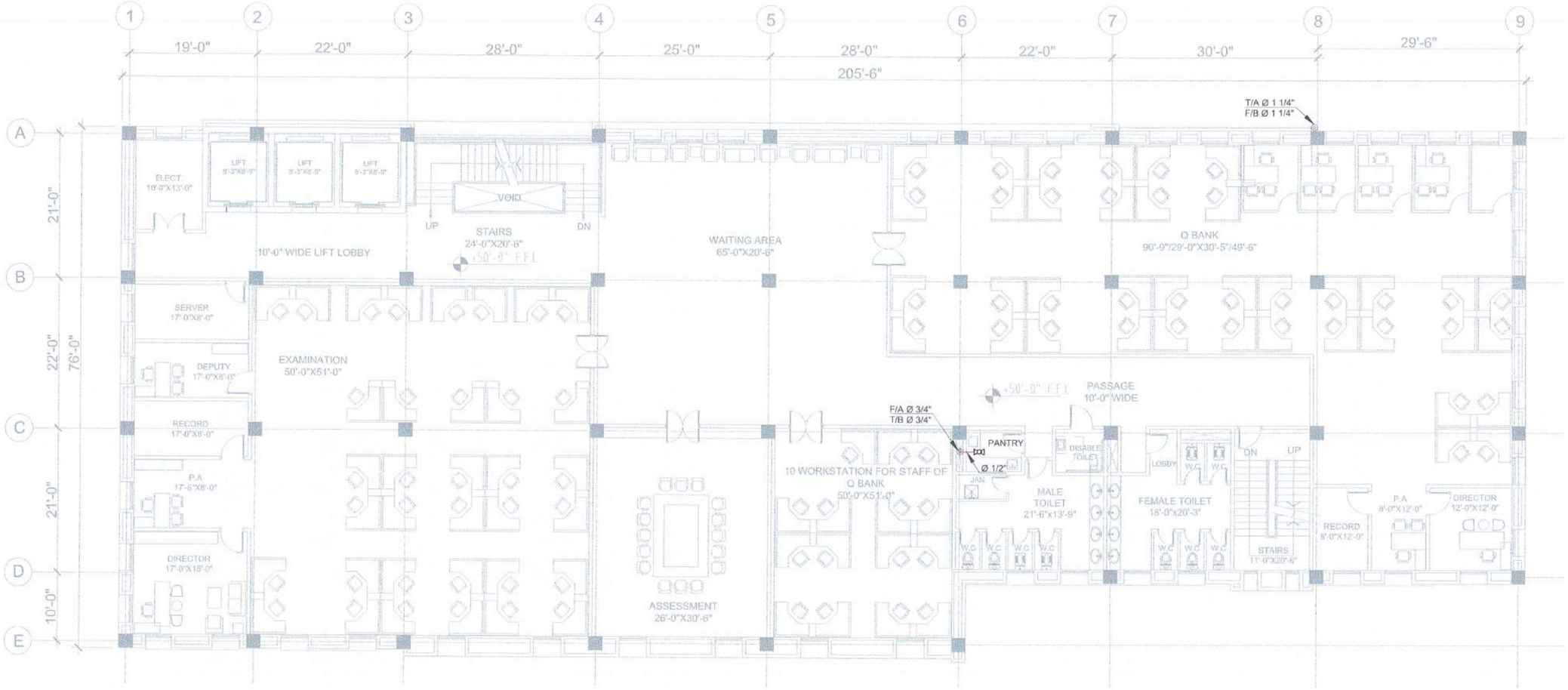
NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	PROJECT	JSMU
			ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34		

REV.	DATE	DESCRIPTION	APPROVED		
04				DRAWN	MEHBOOB
03				SUBMITTED	
02				RECOMMENDED	HASSAN
01				CHD./VER.	SOHAIB
				APPROVED	SOHAIB

3RD FLOOR PLAN		SCALE	N.T.S
DATE	MARCH, 2026	DRAWING No.	4596/50J/TD/ M207
REV.	0		



4TH FLOOR PLAN

Q. BANK/EXAMINATION

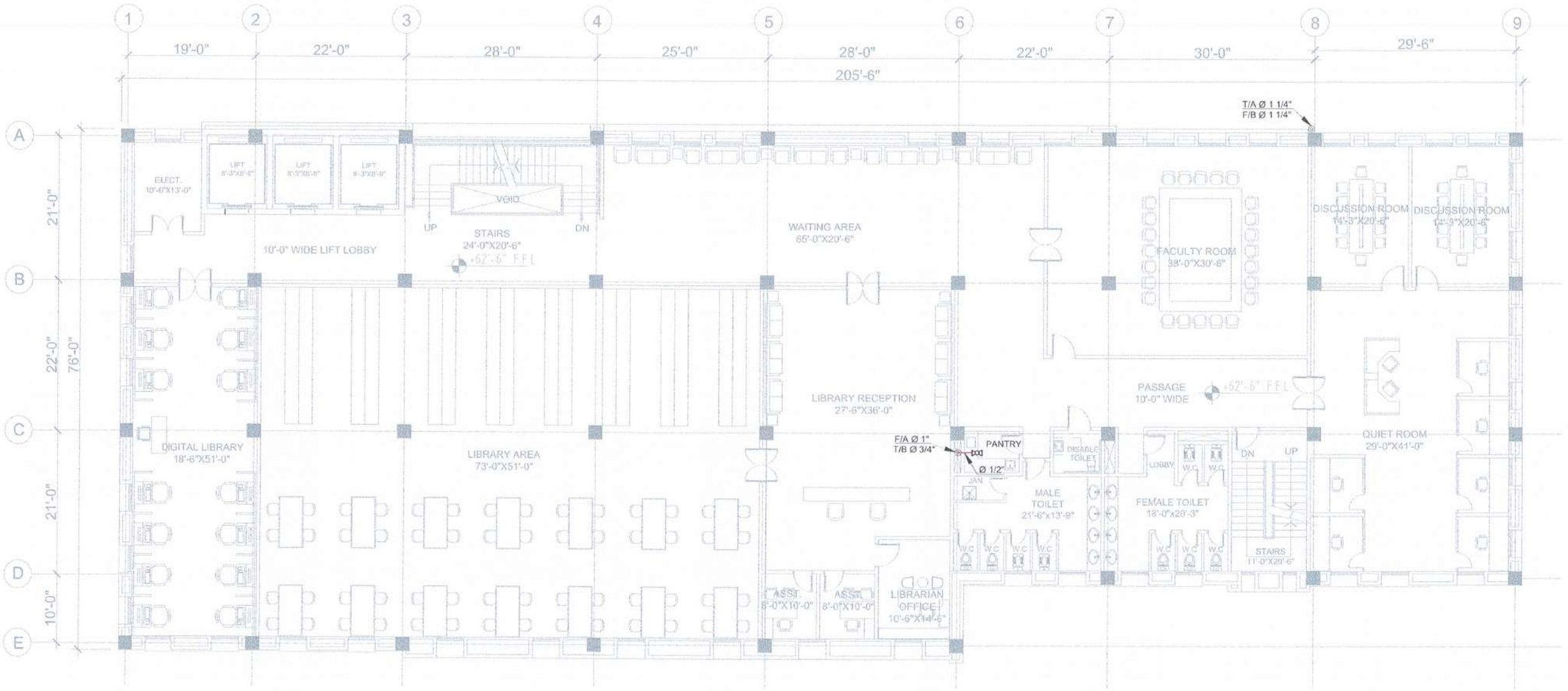
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	PROJECT	JSMU
04			DRAWN: MEHBOOB	4TH FLOOR PLAN	SCALE: N.T.S
03			SUBMITTED:		
02			RECOMMENDED: HASSAN		
01			CHD./VER.: SOHAIB	DATE: MARCH. 2026	DRAWING No.: 4596/50J/TD/M208
REV.	DATE	DESCRIPTION	APPROVED: APPROVED: SOHAIB		REV.: 0



5TH FLOOR PLAN

LIBRARY

COVERED AREA 10712 SQ.FT

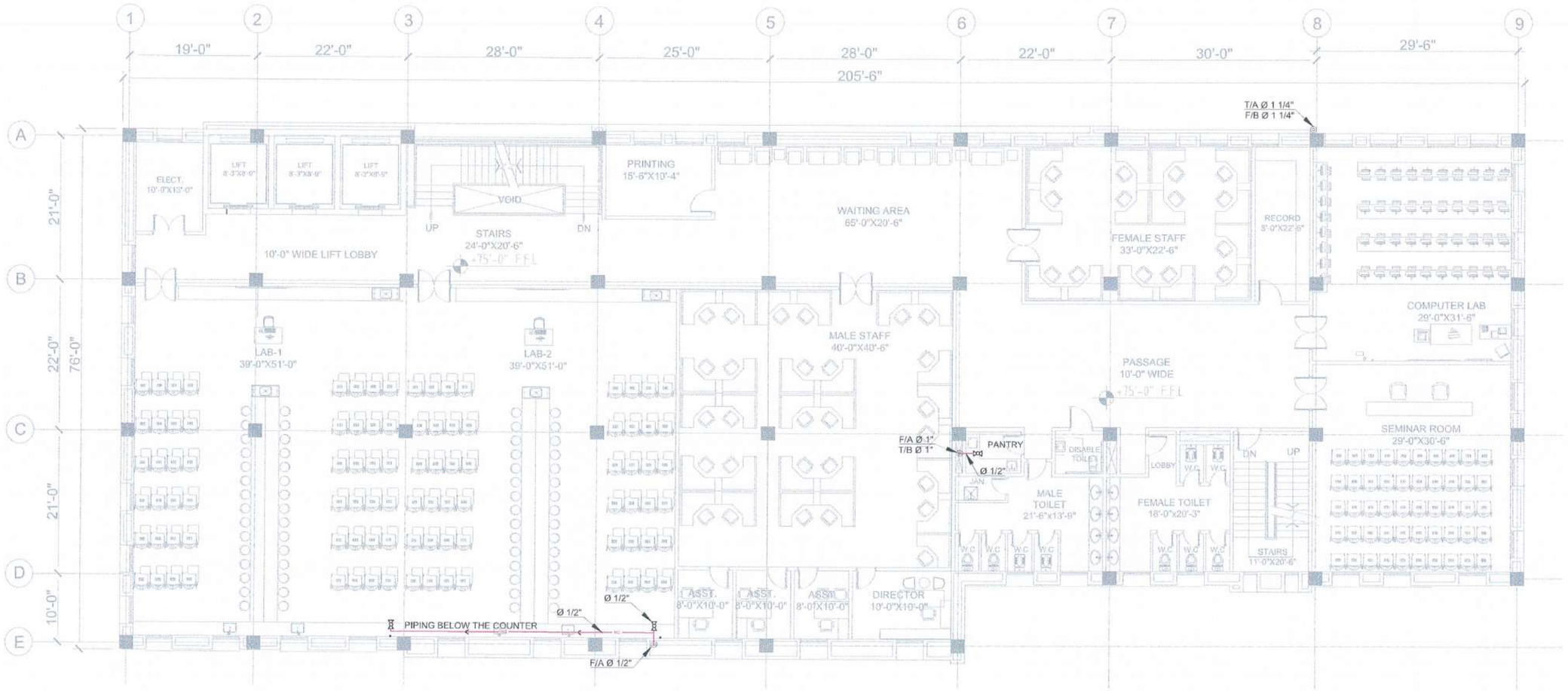
National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	
PROJECT	JSMU	5TH FLOOR PLAN		SCALE	N.T.S
DATE	MARCH, 2026	DRAWING No.	4596/50J/TD/ M209	REV.	0

REV.	DATE	DESCRIPTION	APPROVED	
04				DRAWN: MEHBOOB
03				SUBMITTED:
02				RECOMMENDED: HASSAN
01				CHD./VER.: SOHAIB
				APPROVED: SOHAIB



6TH FLOOR PLAN

DPT

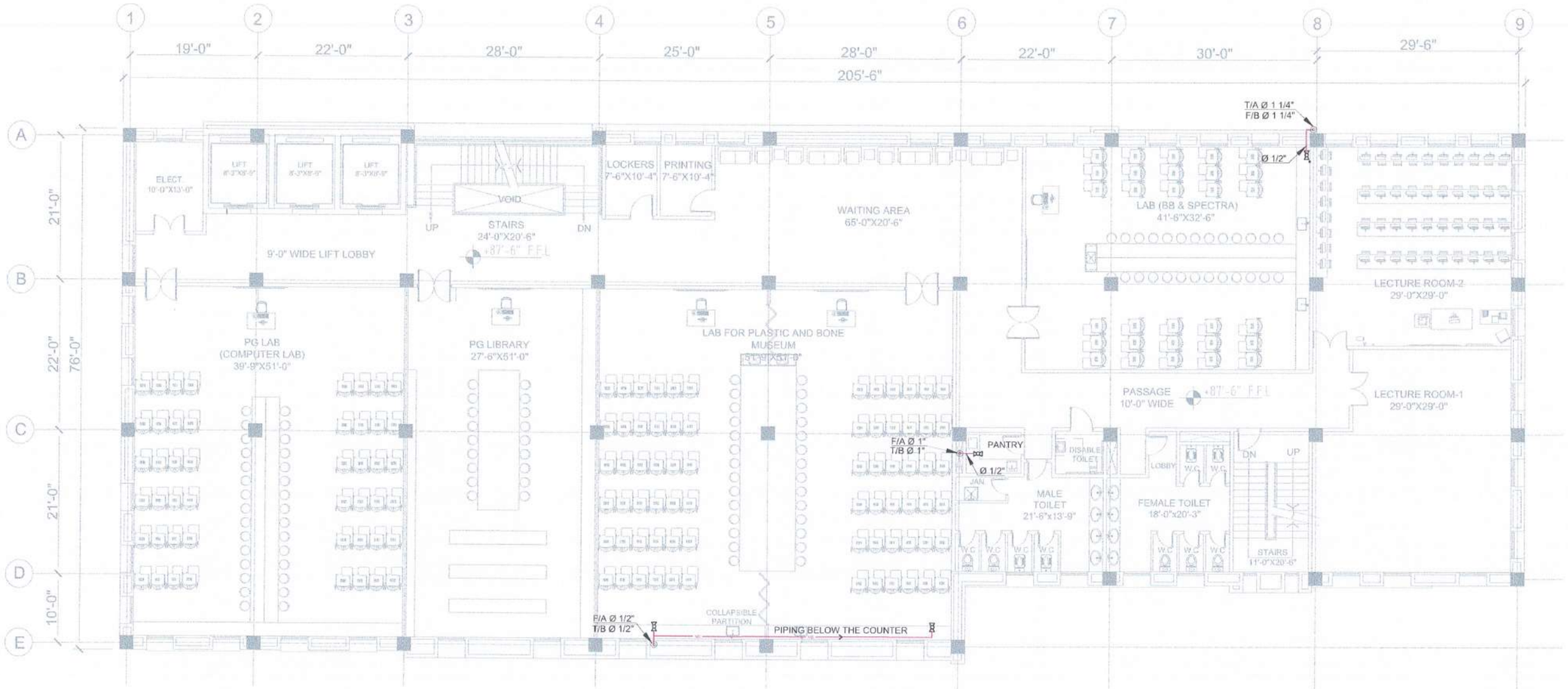
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.				
ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34					
04				DRAWN	MEHBOOB
03				SUBMITTED	
02				RECOMMENDED	HASSAN
01				CHD./VER.	SOHAIB
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	SOHAIB
PROJECT	JSMU				
6TH FLOOR PLAN					
DATE	MARCH, 2026				
DRAWING No.	4596/50J/TD/ M210				
SCALE	N.T.S				
REV.	0				



7TH FLOOR PLAN

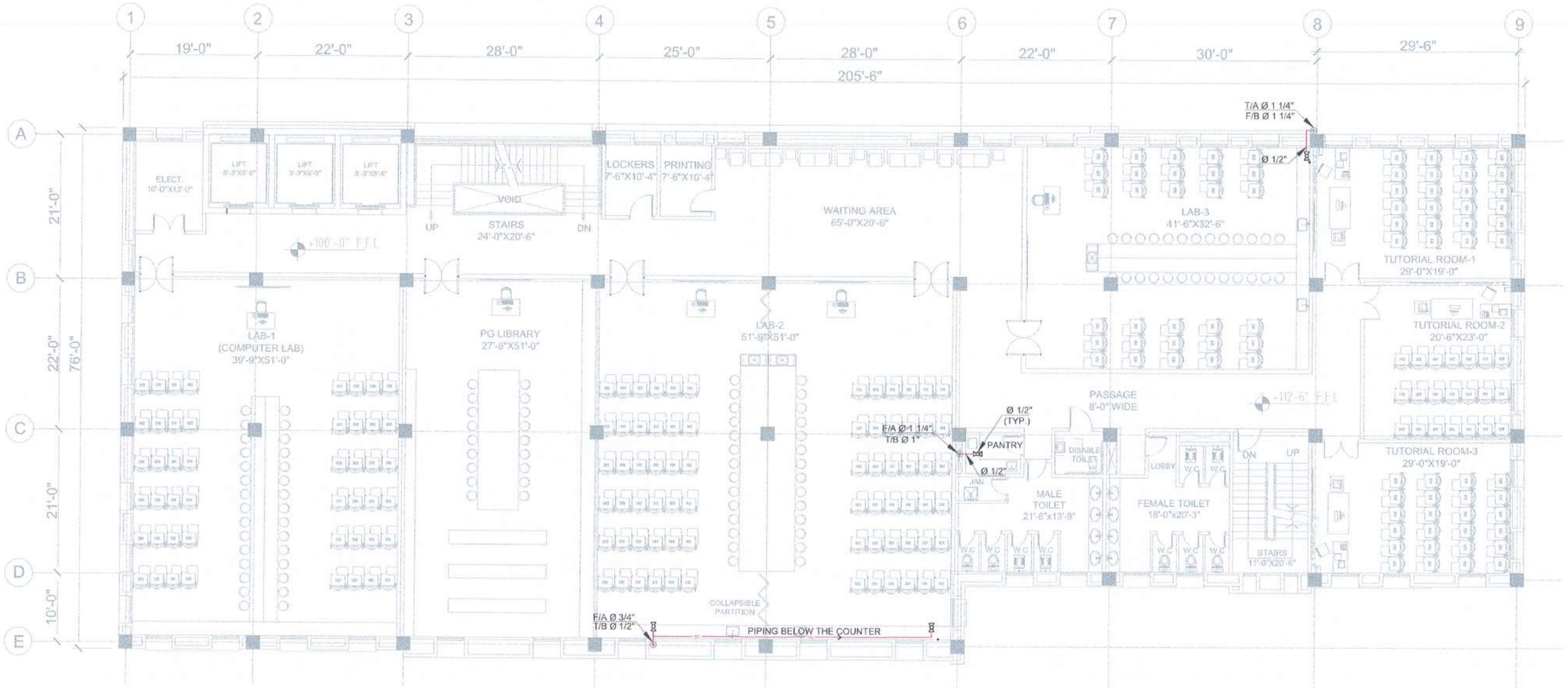
LABS AND TUTORIAL ROOMS
COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan LLC
A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY				
CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.				
	ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel. 99225430-34				
04			DRAWN	MEHBOOB	
03			SUBMITTED		
02			RECOMMENDED	HASSAN	
01			CHD./VER.	SOHAIB	
REV.	DATE	DESCRIPTION	APPROVED	APPROVED	SOHAIB
PROJECT	JSMU				
7TH FLOOR PLAN					
DATE	MARCH, 2026				
DRAWING No.	4596/50J/TD/ M211				
SCALE	N.T.S				
REV.	0				



8TH AND 9TH FLOOR PLANS ARE TYPICAL

LABS AND LECTURE ROOMS

COVERED AREA 10712 SQ.FT + COVERED AREA 10712 SQ.FT

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

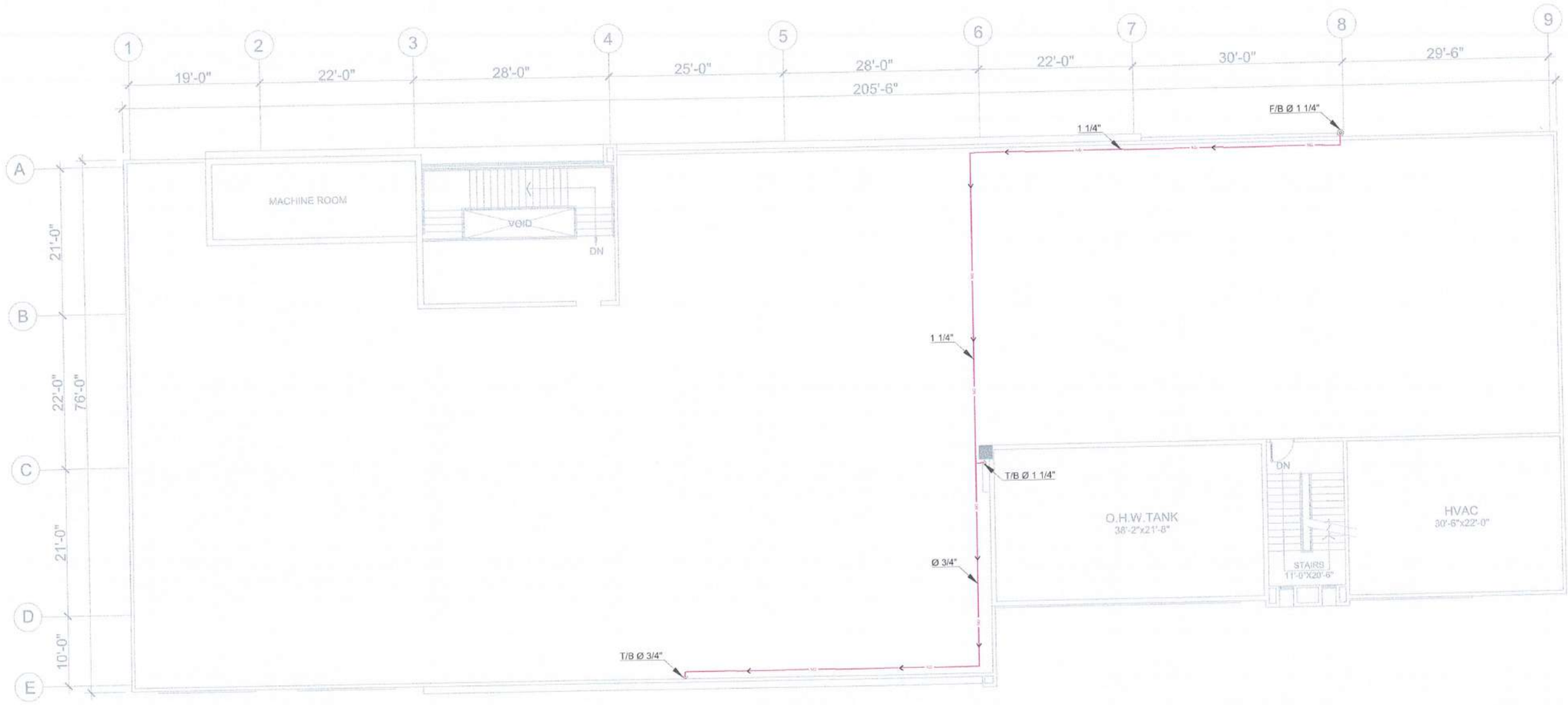
NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT	JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.	ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L Building, Abbasi Shaheed Road, Karachi. Tel: 99225430-34	
PROJECT	JSMU				
8TH & 9TH FLOOR PLAN					
SCALE	N.T.S				
DATE	MARCH, 2026				
DRAWING No.	4596/50J/TD/ M212				
REV.	0				

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	MEHBOOB
SUBMITTED	
RECOMMENDED	HASSAN
CHD./VER.	SOHAIB
APPROVED	SOHAIB



SERVICES MUMMTY

National Engineering Services Pakistan Ltd. A&P DIVISION Karachi

NOTES:

1. FOR LIST OF DRAWINGS, REFER DRAWING NO. 4596/50J/TD/M201.
2. FOR NOTES, LEGENDS & MISCELLANEOUS DETAILS, REFER DRAWING NO. 4596/50J/TD/M202.

CLIENT: JINNAH SINDH MEDICAL UNIVERSITY	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. ARCHITECTURE & PLANNING DIVISION KARACHI. 4TH FLOOR, N.I.C.L. Building, Abbasi Shaheed Road, Karachi, Tel: 99225430-34	04				DRAWN	MEHBOOB	PROJECT: JSMU	ROOF PLAN	SCALE: N.T.S
		03				SUBMITTED				
		02				RECOMMENDED	HASSAN		DATE: MARCH, 2026	DRAWING No.: 4596/50J/TD/M213
		01				CHD./VER.	SOHAIB			REV.: 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	SOHAIB			

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI

STRENGHTHENING / UPGRADATION OF JINNAH SINDH MEDICAL UNIVERSITY KARACHI (PACKAGE-01)

CONSTRUCTION OF ACADEMIC & ADMIN BUILDING

BIDDING & CONTRACT DOCUMENTS

VOLUME – II

SPECIFICATIONS
SPECIAL & TECHNICAL PROVISIONS

MARCH 2026

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
Architecture & Planning Division
4th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
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National Engineering Services Pakistan (Pvt.) Ltd. A & P DIVISION Karachi

JINNAH SINDH MEDICAL UNIVERSITY, KARACHI

CONSTRUCTION OF ACADEMIC AND ADMIN BUILDING AT JSMU, KARACHI

TECHNICAL SPECIFICATIONS

VOLUME-II

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SECTION - 0100

GENERAL REQUIREMENTS

01 GENERAL

The Conditions of Contract Part I & II shall form an integral part of these General Requirements.

The Contractor shall notify all sub-contractors of the provisions of the Conditions of Contract and the General Requirement of this Specification.

The arrangement and divisions of these Specifications is not to be construed as establishing the limits of responsibility of sub-trades.

The Contractor is responsible for delineating the scope of Sub-Contracts and for coordinating all the Works.

All works shall be carried out in accordance with the following specifications, supplemented by detailed specifications contained in the following sections. Any inconsistencies or ambiguities shall be brought to the notice of the Engineer for his clarification/decision. Decision and direction of the Engineer, in all such cases, shall be final and binding.

The Contractor shall make himself thoroughly familiar with the site conditions, foresee any and all problems likely to be encountered during execution of the works, and shall be able and ready to solve them effectively. Proposals for solutions to the problems shall be submitted to the Engineer for approval before proceeding with the work.

02 APPLICABLE CODES AND STANDARDS

In the absence of other Standards being required by the Contract Documents, all work and materials shall meet the requirement of the Uniform Building Code of the United States, and/or applicable American Society for Testing Materials (ASTM),American Association of State Highway and Transportation Officials (AASHTO) Specifications and the latest American Concrete Institute Manual of Concrete Practice and American Institute of Steel Construction (AISC) Manual relevant to the Works except in cases where the Pakistan Building Code requires a higher standard. In such cases the Pakistani Code shall govern. Where the abbreviations listed below are used, it refers to the latest code, standards, or publication of the following organizations:

AASHTO	American Association of State Highway and Transportation Officials.
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASA	American Standard Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Material
AWS	American Welding Society
BSI	British Standards Institute
ICAO	International Civil Aviation Organization
BSICP	British Standard Institute Code of Practice

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PCA	Portland Cement Association
PSI	Pakistan Standard Institute
PSQCA	Pakistan Standard & Quality Control Authority.
UBC	Uniform Building Code
UPS	Uniform Plumbing Code

If the Contractor, at any time and for any specific reasons, wish to deviate from the above standards or desires to use materials or equipment other than those provided for by the above standards, then he shall state the exact nature of the change giving the reasons for making the change and shall submit complete specifications of the materials and descriptions of the equipment for the Engineer's approval, whose decisions shall be conclusive and binding upon the Contractor.

03 CODES, STANDARDS, CERTIFICATES

The Contractor shall supply and have at his site office:

Copies of all latest editions of codes and standards referred to in these specifications by number, or equivalent codes and standards approved by the Engineer.

Catalogues and published recommendations from manufacturers supplying products and materials for the project.

The Contractor shall provide manufacturer's or supplier's certificates to the Engineer for all products and materials which must meet the requirements of a specific code or standard as stated in these Specifications.

04 UNITS OF MEASUREMENTS

The FPS System of Units shall be used throughout this Project.

05 MANUFACTURER'S RECOMMENDATIONS

Installation of manufactured items shall be in accordance with procedures recommended by the manufacturer or as approved by the Engineer.

06 EXISTING CONDITION AT SITE

Drawings and information pertaining to existing project conditions are available at Engineer's office for reference.

Neither the Employer nor the Engineer warrants the adequacy or correctness of these.

07 PROTECTION AND PRECAUTIONS

The Contractor and his sub-contractors shall afford all necessary protection to existing structures and will be required to make good at his own expense any damage done to such structures through his own or his representatives or subcontractors' fault and negligence.

The Contractor and his sub-contractors shall afford all necessary protection to existing roads in the area. He will clear and make good at his own expense any damage to or debris on these roads through his own fault and negligence. He must at all time ensure the free and normal flow of traffic and shall not cause obstruction

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to the traffic system. The Contractor and his sub-contractors shall provide and maintain necessary protection and precautionary measures such as warning signs, warning lamps and barricades etc. to prevent accidents.

The Contractor shall promptly correct all such damage to original condition at no additional expense to the Employer.

The Contractor shall cooperate with other Contractors performing work under other Contracts as necessary for completion.

08 SETTING OUT OF WORK

8.1 Verify accuracy of layout information shown on the Drawings, in relation to the property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.

(a) Do not change or relocate benchmarks or control points without prior written approval from the Engineer. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grade, location or conflicting construction.

(b) Promptly replace lost or damaged project control points with prior approval of the Engineer. Replacement of project control points shall be based on original survey control points.

(c) Establish and maintain the required number of permanent benchmarks on the job site as directed by the Engineer. Benchmarks shall be located from and referenced to data established from survey control points. Record benchmark location, with horizontal and vertical data, on Project Record Documents.

8.2 Existing utilities and equipment:

(a) The existence and location of underground and other utilities and construction indicated in the Construction Documents as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction and record this information on the relevant plan.

(b) Prior to construction, verify the location and invert elevation at points of connection to sanitary sewer, storm drainage and water service piping. Verify the location of electrical power and communication utilities for interface.

8.3 PERFORMANCE

(a) Working from lines and levels established by the property survey, establish benchmarks and reference markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Drawings shall not be scaled to determine dimensions.

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(b) Maintain a Surveyor's Log of control and other survey work. Surveyor's Log shall be made available for The Engineer reference.

Record deviations from required lines and levels, and advise the Engineer when deviations that exceed indicated or recognized tolerances are detected. Contractor shall record on Project Record Drawings deviations that are accepted and not corrected.

8.4 Site Works:

(a) Locate and lay out works, fill and topsoil placement, slopes and invert elevations by instrumentation and similar appropriate means.

(b) Prior to Substantial Completion, prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the Surveyor, to the effect that principal metes, bounds, lines and levels of Project are accurately positioned as shown on survey.

09 SEQUENCE OF CONSTRUCTION

The Contractor shall submit his proposal for approval of the Engineer the sequence of Construction, prior to starting the works. The works shall be executed as per approved sequence of construction.

10 PARTIAL POSSESSION

Whenever, as determined by the Employer any portion of work performed by the Contractor is in a condition suitable for use, the Employer may take possession of or use such portion.

Such use by the Employer shall in no instance be construed as constituting final acceptance, and shall neither relieve the Contractor of any of his responsibilities under the Contract, nor acts a waiver by the Employer of any of the conditions thereof, provided that the Contractor shall not be liable for the cost of repairs, re-work, or renewals which may be required due to ordinary wear and tear resulting from such use. However, if such use increases the cost or delays to the completion of remaining portions of work, the Contractor will be entitled to an equitable adjustment.

If, as a result of the Contractor's failure to comply with the provision of the Contract, such use proves to be unsatisfactory, the Employer will have the right to continue such use until such portion of the work can, without injury to the Employer, be taken out of service for correction of defects, errors, omissions, or replacement of unsatisfactory materials or equipment, as necessary for such work to comply with the Contract; provided that the period of such operation or use pending completion of appropriate remedial action shall not exceed twelve months unless otherwise mutually agreed upon in writing between the parties.

11 EXISTING SERVICES

The Contractor shall search for, find, locate and protect any wiring, cable, duct, pipe work, etc., within or immediately adjoining the site area.

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The Contractor shall take full responsibly for safety of existing service lines, utilities and utility structures uncovered or encountered during excavation and construction operations.

The Contractor shall take full responsibility for damaging any such service lines, utility/utility structure and any cost and/or expense that arises or issues from any such damage shall be borne directly by him. If damage to any such service occur the Contractor shall forthwith take remedial action, initiate safety precautions, install temporary services and carryout repair all at his own cost and expense and inform the Engineer and notify all relevant authorities.

Existing utilities which are to remain in service for or after the works are to be determined by the Contractor. If any existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during these operations, they shall be safeguarded, protected from damage, and supported.

12 PLANT AND EQUIPMENT

The Contractor shall submit a detailed list of plant and equipment which he shall undertake to bring to the site to carry out the work. The list shall satisfy the Engineer as to type, size and quantity. The list shall include for each piece of equipment the type, manufacturer, model, identification number and year of manufacture. The Contractor shall provide on the site of the work at his cost all of the equipment listed and all subsequent equipment required for approval of the detailed programme of work and such equipment which may be directed by the Engineer. The Contractor shall supply all plant and equipment necessary for the construction of each phase of the work and it must be on site, inspected and approved by the Engineer.

13 CONSTRUCTION AREA AND ACCESS

The Contractor shall confine his operations to the areas that are actually required for the Works and shall fence the area accordingly. Arrangements for access roads, storage areas and routes for haulage of materials are to be made by the Contractor at his own cost, subject to the approval of the Engineer.

14 STORAGE & HANDLING FACILITIES

The Employer will provide the Contractor possible space within or nearby the area of site of works for the storage of plant, equipment and materials and for Contractor's temporary office, during the currency of the Contract. In case the adjacent area as required by the Contractor is not available within the Project boundary for storage of plant, equipment and machines then the Contractor shall arrange at his own expense possible space for storage of plant, equipment and machines at his own cost and expense. On no account shall such temporary installations conflict/interfere with any of the permanent installations, services and any operational function of Employer. The handling and storage of all plants, equipment and materials at site shall be the sole responsibility of the Contractor and at no risk and cost to the Employer.

The Contractor shall protect all material against corrosion, mechanical damage or deterioration during storage and erection on site. The protection methods shall be to the approval of the Engineer.

15 TEST LABORATORY AND TESTING

15.1 Testing, except as otherwise specified herein, shall be performed by an approved testing agency as proposed by the Contractor and at no extra cost

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to the Employer. The Engineer may require all testing to be carried out under his supervision only.

15.2 If suitable and adequate material testing laboratory is not available in the vicinity, then the Contractor shall provide and maintain a materials testing laboratory in the vicinity of the Contractor's Camp and the laboratory shall have sufficient working area and shall be equipped with all necessary facilities including a suitable store room.

15.3 The Contractor shall supply and maintain to the satisfaction of the Engineer or his representative complete testing equipment, apparatus, tools, gauges, instruments, etc. in sufficient number and adequate for all tests to be carried out as specified in these specifications. Valid calibration certificates of gauges / instruments / equipment shall be provided by the Contractor.

15.4 The Contractor, after the approval by the Engineer for the source of cement and steel shall make available at the site sufficient stock of the materials in advance in order to allow sample testing for quality control prior to use.

15.5 The quality control testing shall be performed by the Contractor's competent personnel in accordance with a site testing and quality control programme to be established by the Contractor and approved by the Engineer or his Representative. The Contractor shall keep a complete record of all quality tests performed on site and submit the same to the Engineer. All quality control and related tests shall be carried out in accordance with applicable standards and codes.

16 CONSTRUCTION & CHECKING AT SITE

The Contractor shall submit to the Engineer in due time for approval and discussion, his proposals and plans as to the method and procedure to be adopted for the temporary and permanent works involved.

The submitting to these suggestions and arrangements, and the approval thereof by the Engineer shall not relieve the Contractor of his responsibilities and duties under the Contract.

The carrying out of all work included in the Contract is to be supervised by a sufficient number of qualified representatives of the Contractor and full facilities and assistance are to be afforded by the Contractor for the Engineer or his Representative to check & examine the execution of the work.

The Engineer reserves the right to inspect all parts of the works but may at his discretion waive inspection on certain items. This shall in no way absolve the Contractor from his responsibilities. This particularly applies to the checking of materials, the accurate setting out of foundations, and to the levelling, setting and aligning of the various parts, and to the proper fitting and adjustment of manufactured and finished materials and fixtures in position.

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If the Engineer or his Representative find that the work progress is slow in such a way that the works or parts thereof will not be completed in the time specified, then he shall order the Contractor to work overtime or in shifts and the Contractor shall comply. These arrangements will be free of all financial encumbrances and at no additional costs to the Employer.

In the event of night work, the Contractor shall provide sufficient and adequate lighting to the satisfaction of the Engineer or his Representative and shall supply the necessary manpower for satisfactory continuation of the work after normal hours.

17 BAR BENDING SCHEDULE

Bar bending (reinforcement bars) schedule of all drawings shall be prepared by the Contractor and submitted in triplicate to the Engineer for approval.

18 DRAWINGS

18.1 Bidding Drawings: The drawings listed in the General Conditions of Contract, Volume I and provided in Volume III are referred to as Bidding Drawings and these show the scope of work to be performed by the Contractor. Bidding Drawings shall not be used as a basis for fabrication or construction but may be used as a basis for placing preliminary order for materials, subject to corrections based on the future issue of Drawings as provided under sub-clause 18.2 Drawings Issued for Construction. Bidding Drawings are subject to be modified and supplemented by additional detail by the Engineer.

18.2 Drawings Issued for Construction: After Award of Contract, Bidding Drawings shall be replaced by Drawings Issued for Construction including supplementary Specifications as may be necessary. Such drawings and specifications shall be construed to be included in the expression Custody and Supply of Drawings under Sub-Clause 6.1 of Conditions of Contract Part I. Drawings Issued for Construction may include some of the Bidding Drawings with or without modification and additional drawings as required to express design intent in greater detail. Such drawings may also be modified from time to time. Drawings Issued for Construction will be the drawings from which shop, fabrication, erection, installation, concrete placing, formwork, or other construction detail drawings shall be prepared by the Contractor. The work shall be executed in conformity with Drawings Issued for Construction. The Contractor shall prepare a schedule of Drawings Issued for Construction of various parts of the Works based on Construction programme approved by the Engineer for issuance to the Contractor from time to time.

18.3 Study of Drawings: The Contractor shall study all Drawings Issued for Construction carefully as soon as practicable after receipt thereof, and any errors discovered shall promptly be brought to the knowledge of the Engineer for his instructions.

18.4 Copies of Drawing: Drawings will be issued to the Contractor free of charge as follows:

Drawings Issued for Construction - Two copies as specified in sub-clause 6.1 of Conditions of Contract Part - I i.e. Custody and Supply of Drawings.

18.5 Drawings to be furnished by the Contractor:

(a) Shop Drawings.

All shop drawings required for the work including all kinds of fabrication, field erection, installation, placement and layout drawings shall be furnished by the Contractor for approval of the Engineer. If additional detail drawings

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are necessary to complete any part of the work, such as additional reinforcing steel, drawings shall be prepared by the Contractor and submitted to the Engineer for approval. All drawings shall be complete and shall be submitted in due time and in logical order to facilitate proper coordination.

(b) Lift and placement Drawings.

At least thirty calendar days prior to starting construction of any concrete lift or other placement, the Contractor shall submit lift or other placement drawings to the Engineer for approval. Lift or other placement drawings shall be submitted for each lift or other placement of concrete to be placed. These drawings shall be to such scale as to clearly show all recesses, openings, and embedded parts, including embedded structural steel, mechanical and electrical items, reinforcement placement in each lift in sufficient detail for proper execution of the work.

(c) Construction Plant Layout Drawings.

Three prints of drawings, showing the layout of construction plant and equipment the Contractor proposes to use on the work, shall be submitted by the Contractor for review to the Engineer. The drawings shall show the locations of the principal components of the construction plant, offices; storage areas and yards which the Contractor proposes to construct or use at the site of the work and elsewhere. The drawings shall also show the unloading facilities for materials and equipment at the work site.

18.6 Submissions and Approvals:

(a) Except as otherwise specified, three copies of each drawing for approval or review shall be furnished to the Engineer. Within thirty calendar days after receipt, the Engineer will send one copy to the Contractor marked Approved, Approved/Except as Noted, or Returned for Correction. The notations Approved and Approved/Except as Noted will authorize the Contractor to proceed with the fabrication of the materials and equipment covered by such drawings subject to the corrections, if any, indicated thereon. Drawings returned for correction will be resubmitted for approval in the same manner as for new drawings. Every revision made during the life of the Contract shall be shown by number, date and subject in a revision block.

(b) Upon receipt of prints which have been Approved or Approved Except as Noted, the Contractor shall furnish three prints plus one reproducible of each drawing to the Engineer. If revisions are made after a drawing has been approved, the Contractor shall furnish 3 additional prints and one reproducible subsequent to each approved revision.

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(c) Shop drawings to be prepared by a Sub-contractor shall be submitted in the same manner as (a) & (b) above but they will be submitted through the Contractor.

(d) All of the applicable requirements of this Clause with reference to drawings to be prepared by the Contractor, including Sub-contractors,

shall apply equally to catalogue cuts, illustrations, printed specifications, or other data submitted for approval.

(e) Any work done on Contractor's drawings shall be at the Contractor's risk. The Engineer will have the right to request any additional details and to require the Contractor to make any changes in the drawings which are necessary to conform to the provisions and intent of design and specifications without additional cost to the Employer. The approval of the drawings by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. Approval by the Engineer of the Contractor's drawings shall not be held to relieve the Contractor of his obligation to meet all the requirements of the Specifications or of his responsibility for the correctness of the Contractor's drawings or of his responsibility for correct fit of assembled parts in final position or of his responsibility for the adequacy of method of construction.

19 AS-BUILT DRAWINGS

The Contractor shall, at all times, keep on the site one copy of all drawings and approved samples together with copies of all building, mechanical, electrical and public safety codes and relevant standards applicable to the works. All such material shall be made available to the Engineer.

In addition, the Contractor shall, at all times, keep on site a separate set of prints on which shall be noted neatly, accurately and promptly as the work progresses all significant changes between the work shown on the drawings and that which is actually constructed. The sub-Contractors shall each keep on site, at all times, a separate set of prints of the drawings showing their parts of the work on which shall be noted, neatly accurately and promptly as work progresses the exact physical location and configuration of the works as actually installed, including any revisions or deviation from the Contract Documents.

At the completion of the works, the Contractor shall at his expense, supply to the Engineer six copies and one reproducible copy of all drawings alongwith CD containing all as built drawings amended to comply with the work "As Built". The Contractor shall provide in the same format as the original drawings, any additional drawing required to record the work.

20 RESTORATION AND CLEANING

The Contractor shall do regular cleaning and clean away all rubbish and excess materials that may accumulate from time to time on completion and before handing over. Upon completion of the works he shall obliterate all signs of temporary construction facilities such as work areas, structures, foundations of temporary structures, stock piles of excess or waste materials, or any other vestiges of construction, unless otherwise directed by the Engineer. The works and site shall be left in a clean and satisfactory state for immediate use and occupation. Care shall be taken not to use any cleaning materials which may cause damage to the surface to be cleaned.

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21 PROTECTION OF THE WORKS

The Contractor shall whenever necessary cover up and protect the works from weather and damage by his own or other workmen performing subsequent operation. He shall provide all necessary dust sheets, barriers and guard rails and clear away the same at completion.

The Contractor shall take all proper steps for protection at all places on or about the works which may be dangerous to his workmen or any other person or to traffic. The Contractor shall provide and maintain warning signs, warning lamps and barricades as necessary.

22 PRODUCT DATA

Manufacture's standard schematic drawings shall be modified or deleted to indicate only information which is applicable to the project. Such standard information shall be supplemented to provide all additional applicable information.

Manufacturer's catalogue sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive literature shall be clearly marked to identify pertinent materials products or models. Dimensions and required clearances shall be indicated. Shop performance characteristics and capacities shall be noted.

23 SAMPLES

23.1 The Contractor shall furnish for approval of the Engineer with reasonable promptness all samples as directed by the Engineer or specifically called for in these Specifications. The Engineer shall check and approve such samples with reasonable promptness for compliance with the requirements of Contract Documents. All work shall be in accordance with approved samples.

23.2 Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Engineer, one for office use and the other for the Site.

23.3 Samples shall be furnished so as not to delay fabrication, allowing the Engineer reasonable time for consideration of the sample submitted.

23.4 Each sample shall be properly labeled with the name and quality of the material, manufacturer's name, name of the project, the Contractor's name and the date of submission, and the Specifications Article number to which the sample refers.

23.5 The manufacturer's installation directions shall be provided with each sample. The Contractor shall pay all transportation costs and deliver samples to the Engineer's office, Site or testing laboratory as directed by the Engineer.

Samples will not be returned unless return is requested at the time of submission; all packing and transportation costs for the return of samples shall be paid by the Contractor.

23.6 Samples shall be of adequate size and number to permit proper evaluation of the material by the Engineer. Where variations in colour, texture, dimensions or other characteristics are to be expected, the Contractor shall submit samples showing the maximum range of variation. Materials exceeding the range of variation of the approved samples shall not be used on the Work.

23.7 If both Shop Drawings and samples are required for the same item, the Engineer may require both to be submitted before approving either.

23.8 No acceptance or approval of any Shop Drawings or sample, or any indication or directions by the Engineer on any Shop Drawings shall constitute an authorization for any increase in the Contract Sum.

24 PRODUCT QUALITY AND HANDLING

Suppliers of local and foreign products and installations specified shall have been regularly engaged in the business of manufacturing, fabricating, installing and / or servicing work required for a period not less than 5 years. In addition, the Engineer may request as appropriate a:

- list of similar installations that describes project, scope and date of completion.
- complete literature, performance data, and technical data.
- list of services record within Pakistan.
- location of service office from which this installation could be maintained.

For the actual fabrication, installation, and testing of the specified work, use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturers recommended methods of installation. In acceptance or rejection, no allowance will be made for the lack of skill on the part of workmen.

Use all means necessary to protect materials before, during and after installation and to protect the installed work and materials of all other trades. In the event of damage, immediately make all repairs and replacement necessary for approval and at no additional cost to the Employer.

25 INSPECTION & TESTS REPORTS

All equipment and materials furnished under these specifications and all work performed in connection therewith will be subject to rigid inspection by the Engineer or the Engineer's Representative. Acceptance of equipment and material or the waiving off inspection thereof shall in no way relieve the Contractor of his responsibility for meeting the requirements of the Contract.

The Contractor shall furnish the Engineer with certified true copies of test reports of all materials used in the manufacture and fabrication of equipment and material. The result of these tests shall be in such form as to show compliance with the applicable Specifications, standards and codes for the material used.

26 ACCIDENT PREVENTION, PROTECTIVE EQUIPMENT

The Contractor shall comply and enforce compliance by all his sub-Contractors with the highest standards of safety and accident prevention in accordance with international standards and in compliance with all applicable laws, ordinances and statutory provisions in Pakistan.

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All requisite barriers, fences, warning signs, lights and other safety precautions as required for the protection of persons and property on or adjacent to the site shall be provided at the Contractor's cost.

All warning signs shall be in two languages, English and Urdu, and shall at all times be maintained in a clean and legible condition, to the satisfaction of the Engineer.

Trash shall be removed at frequent intervals to the satisfaction of the Engineer.

27 TEMPORARY FACILITIES

The Contractor shall provide, erect or install, maintain, alter as necessary and remove on completion except as otherwise directed by the Engineer all temporary facilities and services including access roads as described hereinafter and/or in the Contract Document.

The Contractor's temporary site office shall be available for use not later than one month after the date of the site handing over.

Installation of temporary services at the site shall be given priority over all other construction at the site.

27.1 Temporary Road

The Contractor shall prepare and maintain such temporary roads as may be necessary, from the site to the nearest road and also within the site. Such roads shall be positioned strictly in accordance with the Engineer's instructions and the Contractor shall reduce or control any dust nuisance by spraying with water as directed. The Contractor shall satisfy himself as to the locations and nature of the proposed access routes to the site and shall be responsible for preventing any damage whatsoever to adjacent property and vegetation and keeping the access road free from debris at all times.

27.2 Temporary Services

(a) Temporary Water Supply

The Contractor shall supply in sufficient quantity all necessary potable and other water for construction purposes for all trades at point within a reasonable distance of the work. He shall make arrangements and pay charges for water service installation, maintenance and removal thereof, and pay the costs of water for all trades.

When the permanent water supply and distribution system has been installed, it may be used as the source of water for construction purposes provided that the Contractor obtains the written approval of the Engineer and the Employer and assumes full responsibility for the entire water distribution system and pays all charges/costs for operation and maintenance of the system mutually agreed between the Employer and the Contractor.

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Temporary pipe lines and connections from the permanent service line, whether outside or within the area of site of works but necessary for the use of Contractor and his sub-contractor shall be installed, protected and maintained at the expense of the Contractor.

At completion of the work or at such time as the Contractor makes use of the permanent water supply installation, the temporary water services equipment and piping shall be removed by the Contractor at his own expense.

(b) Temporary Electricity

The Contractor shall make all the necessary arrangements for a temporary electricity service, pay all expense in connection with the installation, operation and removal thereof and pay the costs of electricity consumed by all trades.

In the event that the site can not be connected to a local electricity network or where the available power is insufficient the Contractor has to make his own provision and maintain such installation.

A temporary lighting system shall be furnished, installed and maintained by the Contractor as required to satisfy the minimum requirements for safety and security. The temporary lighting system shall afford adequate general illumination to all building areas. Adequate outdoor lighting shall be provided to illuminate staging trenches and the like to the satisfaction of the Engineer and general illumination throughout adequate for watchmen and emergency personnel.

Temporary equipment and wiring for power and lighting shall be in accordance with the applicable provisions of governing codes. Temporary wiring shall be maintained in a safe manner and utilised so as not to constitute a hazard to persons or property.

When the permanent electrical power and lighting systems are in an operating condition, they may be used for temporary power and lighting for construction purposes provided that the Contractor obtains the written approval of the Engineer and the Employer and assumes full responsibility for the entire power and lighting system and pays all charges/costs for operation and maintenance of the system mutually agreed between the Employer and the Contractor.

Approval, license etc. if required under local laws will be obtained by the Contractor on his own responsibility and cost.

At completion of construction work, or at such time as the Contractor makes use of permanent electrical equipment and devices, temporary electricity services shall be removed by the Contractor as his own expense.

(b) Waste Disposal

The Contractor shall make such temporary provisions as may be required in order to dispose of any chemicals, fuels, grease, bituminous materials, waste and soil waste and the like without causing pollution to either the site or the environment. Disposal of any materials, wastes, effluents, garbage, oil, grease, chemicals and the like shall be in areas specified by the concerned local authority proposed by the Contractor and subject to the approval of the Engineer. If any waste material is dumped in unauthorized areas the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed off as directed by the Engineer and replaced with

suitable fill material compacted and finished with topsoil all at the expense of the Contractor.

(c) Fire Protection

The Contractor shall provide and maintain adequate fire protection in the form of barrels of water with buckets, fire bucket tanks, fire extinguishers, or other effective means ready for instant use, distributed around the project and in and about temporary inflammable structures during construction of the works.

Gasoline and other flammable liquids shall be stored in and dispensed from safety containers approved by the Engineer and storage shall not be within building.

Torch-cutting and welding operations performed by the Contractor shall have the approval of the Engineer before such work is started and a chemical extinguisher is to be available at the location where such work is in progress.

The Contractor shall follow the instructions and specifications of the Civil Defence Department and or other local authority.

28 CONSTRUCTION SCHEDULE

A Construction schedule shall be maintained in accordance with the provisions of the General Conditions of Contract.

The schedule shall be accompanied with sufficient data and information including all necessary particulars of constructional plant, equipment, machinery, temporary Works, arrival of plant, equipment at site and their installation, method of operation, work forces employed, etc., for activities of the Works.

Should the Engineer consider any alteration or addition in the programme and time schedule, the Contractor shall conform thereto without any cost to the Employer.

Whenever necessary and wherever the progress of the actual work shows departure, the programme and time schedule shall be undated and submitted to the Engineer for his approval.

29 NOTIFICATION TO THE ENGINEER

The Engineer's Representative shall be notified daily in writing of the nature and location of the Works the Contractor intends to perform the next day so as to enable necessary inspection and measurement to be carried out. The Engineer may, if necessary, direct that longer notice be given of certain operations.

30 NIGHT WORK

When work is done at night the Contractor shall maintain from sunset to sunrise such lights on or about his work and plant as the Engineer may deem necessary for the proper observations of the work and the efficient prosecution hereof.

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31 WEATHER

No work is to be undertaken when, in the opinion of the Engineer, the weather is so unsuitable that proper protection of the work cannot be ensured.

32 CO-ORDINATION WITH OTHER CONTRACTORS

The Contractor shall make all necessary coordination with other Contractor and shall make sure that all embedding components such as pipes, steel bases etc. (as required for completion of electrical and other works) are properly, accurately and timely installed.

The Contractor shall inform other contractors if any, the schedule of any construction activity well in advance giving him sufficient time to finish his part of job, before any compaction/concreting etc. The Contractor shall get the signature of the authorized representative of the other contractor, before carrying out any construction activity.

If any part of existing work is damaged or has to be dismantled or redone due to negligence/omissions/incorrect position of the embedding etc. on part of the Contractor, all such losses/expenses shall be borne by the Contractor.

All expenses incurred for the above works including coordination are deemed to be covered in his Bid cost and no separate/extra payment shall be paid against such item.

33 SUBMISSION REQUIREMENTS

33.1 Schedule submission at least sixty days before the dates when reviewed submittals will be needed.

33.2 Submit Shop Drawings as per provision given in Sub-Clause 18.5 (a) of this General Requirements and number of copies of Product Data which the Contractor requires for distribution plus four copies which will be retained by the Engineer.

33.3 Submit three samples unless otherwise specified.

33.4 Accompany submittals with transmittal letter, in duplicate, containing:

- Date
- Project title and number
- Contractor's name and address
- The number of each Shop Drawing, Product Data and the Sample submitted.
- Notification of deviations from Contract Documents.
- Other pertinent data.

34 RESUBMISSION REQUIREMENTS

Shop Drawings:

- Revise initial drawings as required and resubmit as specified for initial submittal.

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- Indicate on drawings any changes which have been made by the Engineer.

- Product Data and Samples: Submit new data and samples as required for initial submittal.

35 SURVEY INSTRUMENTS

All the instruments, equipment, stakes and other material necessary to perform all work shall be provided by the Contractor. The survey work shall be carried out by competent staff consistent with the current practices. The Contractor shall maintain on site surveying instruments in perfect working conditions to enable the Engineer to check lines and level at all times.

Survey instruments and equipment shall include but not limit to the following:

- Electronic Total Station
- Electronic Data Recorder
- Disto Laser Meter
- Precision Level Invert Staff
- Automatic Levels
- Power level
- Compass, steel tape, ranging poles

36 MONTHLY PROGRESS REPORT AND PHOTOGRAPHS

36.1 During the continuance of the Contract, the Contractor shall submit monthly progress reports on forms as approved by the Engineer. Such monthly reports shall show the actual progress completed as of date of the report plotted against the schedule as given by the Contractor at the start of work and shall be broken down so as to indicate status of all activities associated with mobilization, design, material procurement, manufacture, surveys works, tests with regard to the agreed Contract programme.

36.2 The Employer and the Engineer reserve the right to coordinate the schedules of this Contractor and other contractors working at the Site, and to adjust and/or change any and all such schedules as required during the course of construction in order to achieve a coordinated project in harmony with the completion date.

36.3 Commencing after the first month of construction, and continuing every month until completion, the Contractor shall take and submit photographs to the Engineer's Representative, to show progress of his work and completion of each structure or major feature.

37 CONTRACTOR TO NOTIFY DELAYS ETC.

Any delay which will affect the completion of Works shall be detailed by the Contractor who shall state the action he is taking for effective completion of the Contract programme.

The Contractor shall submit a report in respect of the various sections of the Works, the equipment in use or held in readiness, a return of labour and supervisory staff, and details of any matters arising which may generally affect the progress of the work.

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The Contractor shall give a summary of the detailed progress report giving the position with regard to the agreed Contract programme.

The progress reports shall be set out in a format to the approval of the Engineer, and forwarded promptly so that on receipt the information contained therein is not more than 21 days out of date.

If during execution of the Contract, the Employer considers the progress position of any section of the work to be unsatisfactory, or for any other reason relating to the Contract, he will be at liberty to convene a meeting and the Contractor's Representatives are to attend such meeting.

The Contractor's Site Office shall prepare and submit 6 copies of a monthly progress report along with the photographs to the Employer and Engineer's Site Office. This report shall summarize site activities and record and details where difficulties in maintaining the agreed programme are being experienced or are likely to cause subsequent delay.

The Contractor's Site Office shall also prepare and submit to the Engineer's Site Office 2 copies of Daily Activity Report summarizing the main activities to be undertaken each day, noting special activities such a tests, alignment checks, etc. The Contractor shall be responsible for submitting daily, manpower & equipment details deployed at site. The contractor shall also be responsible for expediting the delivery of all material and equipment to be provided by himself and his subcontractors if any.

38 PHOTOGRAPHS

As soon as work commences on Site, the Contractor shall provide photographs of the works from positions to be selected by the Engineer. Each photographic / digital print shall not be less than 100mm x 100mm and shall bear a printed description, a serial number and the date when taken.

The negatives/soft copies of all photographs shall be held at the Contractor's Site Office, numbered and handed over to the Employer at the completion of the Contract.

39. SAFETY AND HEALTH

39.10 General

In executing the work of this Contract, the Contractor shall provide working conditions on each operation that shall be as safe and not injurious to the health and environment, as the nature of that operation permits.

In all rock excavation operations, the Contractor shall install, maintain and effectively operate appliances and use methods approved by the Engineer which will effectively reduce the amount of harmful dust and he shall exercise good practice in the control of silica dust in rock drilling. The crushing of rock, the dumping of stone, the mixing of concrete and the handling of cement, steel and other materials shall be so conducted that these operations will not be injurious to life, limb or health. All work shall be performed in accordance with applicable local and National laws, codes, requirements and regulations including safety, health, welfare of persons and others. The Contractor shall in general be fully conversant and comply with the relevant sections of all construction regulations relating to health and safety in construction and its recommendations.

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As regards protection of the environmental damage, Pakistan Environmental Protection Act (PEPA), 1997 and the Rules made thereunder shall be complied with. The Contractor shall employ a full-time health, safety and environment (HSE) Engineer to help accomplish the purposes of this Clause. The Contractor shall submit his detailed HSE Manual for approval of the Engineer, which shall upon approval be strictly followed for all work at the Project site. The Contractor shall comply with all statutory and other regulations concerning the safety of his site staff, operatives, staff of the Employer and Engineer and members of the public and protection of Environment, as a result of his operations. He shall obtain copies of all the relevant regulations, and shall make them available for inspection by the Engineer.

39.20 Accident and Fire Prevention

The Contractor shall enforce all necessary rules and regulations for the safe prosecution of the work in order to avoid preventable accidents and to minimize injuries to his employees and those of other concerned entities. Work areas shall be adequately posted with safety signs and posters.

The Contractor shall maintain a satisfactory system of inspection and scaling in all open cut excavations. All reasonable precautions shall be taken against fire, and provisions shall be made for the expeditious extinguishing thereof.

39.20.1 In addition to the reports which the Contractor may be required to submit under the law to the Engineer on or before the tenth day of each month a report giving the total force employed on this Contract in man-days during the previous calendar month, the number and character of all near accidents, and accidents resulting in injury and loss of time, and any other information on classification of employees, injuries received on the work and disabilities arising therefrom that may be required by the Engineer.

39.20.2 The Contractor shall, during the entire period of his operation at the construction site, provide emergency facilities with adequate medical and surgical equipment for first aid treatment and approved qualified personnel to administer such treatment to all injured persons, including the Employer's and Engineer's personnel. The Contractor shall designate competent personnel having similar experience who shall at all times be in readiness to answer calls to supply medical and surgical services. Ambulance services to the hospital at the Contractor's camp shall be available at all times.

39.20.3 No payment will be made for the services required in sub clause of 39.

39.30 Safety Devices

Safety devices shall be used, as required, and shall include but not be limited to those described hereinafter. Efficient safety helmets, safety gloves, safety boots, safety goggles, safety masks, safety screens, artificial breathing apparatus, fire proof clothing, safety harnesses etc., and shall be provided, as necessary, for all the personnel including all authorized visitors to the Site. Excavated areas shall be properly guarded from the beginning of excavation until the status of the work removes all possible element of danger. The efficiency of all safety devices shall be established by satisfactory tests acceptable to the Engineer at least once every three months thereafter. No payment will be made for the services required in sub clause of 39.30.

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40 FACILITIES FOR THE ENGINEER

40.1 Site Office

Not applicable

40.2 Transport Facility

The Contractor shall provide, operate and maintain brand new One (01) Suzuki Cultus Car VXR-i Euro II CNG & AC Fitted for the exclusive use of the Engineer's site supervision team to meet his transportation needs for the entire duration of actual construction period as well as for the duration of subsequent Defects Liability Period. The use of such transport facility shall be under the control of the Engineer. The Contractor shall be wholly responsible for providing at all times satisfactory operating services for the Engineer. The Contractor shall furnish, supply and provide, as may be necessary without specific direction of the Engineer, all fuels (350 liters of petrol or equivalent amount of CNG per month), lubricants, tires and other supplies, all maintenance, repairs and running costs and suitably qualified drivers at all times.

Prior to Ordering the Vehicle, the Contractor shall furnish to the Engineer for approval, detailed specification, name of manufacturer and model no. of the vehicle to be supplied. These data shall be presented within one week from the date of Engineer's Order to proceed with the works and the vehicle shall be furnished to the Engineer upon approval within two weeks from the date of Engineer's Order to supply the Vehicle.

The vehicle shall be right hand drive, and shall be brand new, properly serviced and ready for use. The Contractor shall provide vehicle to replace any such motor vehicle that is temporarily or permanently rendered unserviceable for any reason or declared to be beyond repair by the Engineer, at no additional cost to the Employer. The vehicle shall become the property of the Contractor on completion of the Contract.

41 MEASUREMENT & PAYMENT OF WORK

No payment shall be made for the works involved within the scope of this section of specification unless specified in the BOQ items mentioned under the facilities for the Engineer & facilities for the Employer.

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

*** End of Section 0100 ***

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SECTION - 0120

CONTRACTOR'S CAMP

1. SCOPE

The work to be done under this item consists of construction, erection, installation and maintenance of the Contractor's Project Site Offices or main camp and the Contractor's sub-camps or temporary camps, if any, and shall include all offices, shops, warehouses, and other operational buildings; all housing and related facilities including accommodations for the Contractor's personnel.

2. GENERAL

The location of the Contractor's camps, including all buildings, utilities and facilities therefor, and of the camps or establishments of all persons/parties in the vicinity operating or associated with the Contractor shall be subject to approval of the Engineer.

The work to be done under this item will terminate upon the actual Completion Date. However, if directed by the Engineer or the Employer, the Contractor shall continue such work to the extent required by the Contractor's personnel during the Defects Liability Period. No compensation shall be paid for the continued operation and maintenance of the Contractor's Camps during the Defects Liability Period.

Upon completion of the Works, or at such time within the Defects Liability Period as directed by the Engineer, the Contractor shall remove all buildings, utilities and other facilities from the Site and restore all camp areas to a neat and clean condition. The Employer may opt to retain any or all of the above mentioned facilities for his use after the completion of the works, in which case the Contractor shall have no claim on these facilities.

Contractor shall protect the environmental interests and HSE (Health, safety & Environmental) regulations at camp and works sites during execution of the contractual work.

3. CODES AND STANDARD

The construction, operation and maintenance of all camps of the Contractor shall comply with all applicable provisions of current Pakistan Labour Camp Rules.

4. MAINTENANCE

The Contractor shall furnish, make arrangements for, and carry out proper and adequate maintenance of the Contractor's Camp areas at such camp to provide a neat, well-kept camp in all respects with pleasant and healthy surroundings and conditions for all occupants of their camp. The Contactor's camp shall be kept clean, well-graded, free from under growth and bush and adequately drained. Roads and streets shall be kept in good condition. All utilities shall be adequately and properly operated and maintain to provide services and conditions meeting the requirements of these specifications in all respects.

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Adequately equipped and properly staffed portable first aid stations or dispensaries shall be provided by the Contractor at camps and other strategic locations to administer first aid treatment at any time required and free of charge to all persons on the Site, including employees of the Engineer and the Employer.

5. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

*** End of Section 0120 ***

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SECTION - 0130

STAKE-OUT SURVEY

1. SCOPE

The work to be done under this item the Contractor shall make the stakeout survey for construction purposes with competently qualified men, consistent with the current practices. The work shall proceed immediately upon the award of the Contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stakeout survey. The scope of this section of specifications is covered by detailed specifications as laid down herein.

2. MATERIAL AND EQUIPMENT

All instruments, equipment, stakes and other material necessary to perform all work shall be provided by the Contractor. These instruments and equipment shall be available to Engineer at all times for the purpose of checking the work of the Contract.

All stakes used shall be of a type approved by the Engineer, clearly and permanently marked so as to be legible at all times. It shall be the Contractor's responsibility to maintain these stakes in their proper position and location at all times. Any existing stakes or markers defining property lines and survey monuments which may be disturbed during construction shall be properly tied into fixed reference point before being disturbed and accurately reset in their proper position upon completion of the work.

3. CONSTRUCTION

The Contractor shall trim trees, bushes and other interfering objects, not consistent with the plan, from survey lines in advance of all survey work to permit accurate and unimpeded work by his stake-out survey crews and the Engineer's survey crews. The exact position of all work shall be established from control points, which are shown on the plans or modified by the Engineer. Any error, apparent discrepancy in or absence of data shown or required for accurately accomplishing the stakeout survey shall be referred to the Engineer for interpretation or furnishing when such is observed or required.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc. throughout the life of the Contract. Damaged, destroyed or inaccessible reference points, bench marks or stakes shall be replaced by the Contractor. Existing or new control points that will be or are destroyed during construction shall be re-established and all reference ties recorded thereon shall be furnished to the Engineer. All stakeout survey work shall be referenced to the centerlines shown on the Plans. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be kept neatly and made available to the Engineer upon request and furnished to the Employer upon Contract completion.

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The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be immediately made. Such checking by the Engineer shall not relieve the Contractor of any of his responsibilities for the accuracy or completeness of his work.

Reference points, base lines, stakes and benchmarks for borrow pits shall be established by the Contractor.

All required right-of-way and easement limits shall be established, staked and referenced by the Contractor concurrent with the construction stakeout survey.

The Contractor shall place at least two offset stakes or references at each centre lines station and at such intermediate stations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly marked with the correct centre line, station number, offset and cut or fill so as to permit the establishment of the true centre line location during construction. He shall locate and place all cut, fill, slope, line grade or other stakes and points as the Engineer may direct to be necessary for the proper progress of the work.

4. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

*** End of Section 0130 ***

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SECTION - 1200

DEWATERING

1. SCOPE

The work to be performed under this section of the specifications shall consist of supplying all labour, materials and plant and the performance of all work necessary for lowering and continuously controlling the piezometric levels of the ground water in the subsurface material as well as the control and handling of surface water, in such a manner as to maintain the bottom and slopes of the excavations for the structure's in a stable condition, and to permit the structures excavation and construction to be performed in the dry.

The Contractor shall build, maintain and operate all berms, channels, flumes, sumps and other temporary diversion and protective works needed to divert the surface water through or around the required excavations.

All excavations shall be dewatered and kept free of standing water, water seeping from the sides and bottom of the excavations above the free level or excessively mudy conditons as needed for proper execution of the excavation operations. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps and other equipment needed to dewater the excavation areas. Dewatering methods that cause a loss of fines from the bottom and slopes of the excavation will not be permitted.

The work shall include designing, supplying, installing, operating and maintaining a system of wells complete with pumps and associated equipment, standby power arrangements, piezometers and all other equipment necessary to achieve the required control of the ground water and surface water in the areas as shown on the drawings, as specified herein and as required by the Engineer. The work shall also include the construction and maintenance of ditches and sumps as required to achieve the specified results.

2. DEWATERING PLANS

Prior to commencement of the work, the Contractor shall furnish the Engineer, for review and comments, with complete plans and sketches for diverting surface water if any & dewatering of the required excavations. The Contractor shall submit detailed design calculations where required. To provide safe and stable excavations is the sole responsibility of the Contractor. Submission for review and comments of the required plans and sketches and any approval from Engineer shall not relieve the Contractor of any of his duties and obligations under the Contract.

The Dewatering System shall consist of the Basic Dewatering System, the Standby Dewatering System, and Standby Power System, monitoring devices, ditches, sumps pumps and all associated equipment as specified herein.

The basic Dewatering System shall be the minimum dewatering system required to achieve the specified results.

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The Standby Dewatering System shall be that system which may be required to achieve the specified results in case a part or all of the Basic Dewatering System becomes ineffective for maintenance or any reason other than a failure of the power supply.

The Standby Power System shall be that independent generating system which may be required to keep the Dewatering System fully operational in the event of a power failure.

3. DESIGN OF DEWATERING SYSTEM

The Contractor shall arrange to have the entire Dewatering System designed in detail, installed, maintained and operated by qualified and experienced personnel throughout the course of the work.

Should the Contractor with due consideration to be given to some properly qualified dewatering sub-contractor, his name, qualifications, record of previous jobs of a similar nature, personnel to be employed on the work, and other pertinent information shall be submitted to the Engineer for approval with the bid.

Two weeks prior to commencement of installation of the Dewatering System, the Contractor shall submit to the Engineer for his technical approval, complete final plans, details and description of the Dewatering System.

The Contractor shall be responsible for the arrangement and location of the various Dewatering System components necessary to accomplish the specified work.

The Engineer's approval of the installed Dewatering System will be based on the demonstrated performance of the system and the effectiveness with which it satisfies the requirements for dewatering the areas during the entire period of the Contract.

Approval of the Dewatering System by the Engineer shall in no way relieve the Contractor from the responsibility for satisfying the entire dewatering requirements as specified herein and to the satisfaction of the Engineer.

4. DEWATERING THE EXCAVATION

The Contractor shall install, maintain and operate a system of wells, trenches and pumps as required to perform the excavations for the areas and subsequent construction of the structures and placement of backfill in the dry.

The dewatering of the excavations shall be accomplished in a manner that will prevent seepage, boils, loss of fines, erosion, softening of the strata, and that will maintain the stability of the bottom and slopes of excavation. Should any damage to the work, in the opinion of the Engineer, be due to the inadequacy or failure of the Dewatering System, in part or in whole, then the supply of all labour, materials and plant, and the performance of all work necessary to carry out additional or remedial work resulting from such damage shall be undertaken by the Contractor at no additional compensation. The cost of any damage caused to the structures or the permanent works like structures and machinery and other equipment due to the failure of the dewatering system shall be borne by the Contractor and shall be

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covered by proper insurance to be provided by the Contractor and in accordance with insurance clauses of the "Conditions of Contract".

The Dewatering System shall be designed to operate on a continuous basis in such a manner that during excavation, the water level as observed in all piezometers installed near the prevailing excavation level, is at least one meter below the prevailing excavation level. If the water level observed in any or all of the piezometers is higher than the specified, the excavation shall be halted until remedial measures to the Dewatering System have been effected and the specified water levels in the piezometers attained or until the Contractor demonstrates to the satisfaction of the Engineer that it is safe to proceed with the excavation. Piezometer tips shall be installed near the bottom of the hole drilled for that purpose.

During construction of structures and subsequent backfill placement and associated work operations, the dewatering System shall operate on a continuous basis in such a manner that the water level, as observed in the piezometers located below the level of construction and backfill placement remains at least one meter below the lowest point of construction and backfill placement and the water level in the piezometers is maintained at such level till the concrete, if any, has sufficiently hardened and until in the opinion of the Engineer, it is safe to allow the water level to rise up to a pre-determined level.

The Dewatering System shall be maintained in operating condition so as to achieve the specified results until the construction of the structures and the backfill placement at all points, installation of machinery and other associated equipment and embedded parts has reached a stage when, in the opinion of the Engineer Dewatering system shall shut off in stages as directed by the Engineer.

The Contractor shall not permit the accumulation of surface water within the confines of the excavation areas. The Contractor shall control, remove and divert surface water runoff, and water discharging from the Dewatering System away from the excavations, to a point outside the working area as required by the Engineer. Further, no discharge will be allowed in existing Municipal Network. The Contractor shall use alternate measures such as boozers / tankers to collect water from Site and dispose off outside city premises. No extra payment shall be made on this account.

The Contractor shall perform all work including, but not limited to, the construction and maintenance of ditches and sumps and provide, install, maintain and operate pumps and pipelines of adequate capacity as are necessary for the effective control of surface runoff and groundwater not required to be intercepted by the Dewatering System.

The Contractor shall supply, install, maintain and operate as required, the generators for power supply which shall be of sufficient capacity to maintain all pumps and equipment for both the Basic and Standby Systems, operating on a continuous basis.

The Contractor shall supply, install and maintain an alarm system, which will alert responsible personnel at the time of power failure and at the same time will automatically activate the standby power units.

The Dewatering System shall be designed in such a manner that all or parts of the Standby System may be directly connected to the Basic System. If, during

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construction, it becomes necessary to make this connection, the Contractor shall expeditiously perform all work necessary to resolve the Standby Dewatering System to the requirements as heretofore specified.

The Standby Dewatering System shall be operated for a period of at least 3 hours' duration each week to demonstrate its complete effectiveness. For such demonstration no payment or compensation shall be paid to the Contractor.

5. OPERATIONS

Contractor's Dewatering System shall include the supply, installation, data recording and maintenance of piezometers as may be required to demonstrate the satisfactory performance of the Dewatering System.

In order to ascertain the continuous effectiveness of the Dewatering System, the Contractor shall supply all equipment and perform all work necessary to obtain and correlate records of the water elevation in each of the piezometeric observation wells as well as records of the discharges from the Dewatering System. These data shall be obtained on a continuous basis and shall be properly compiled and copies of the compiled data shall be submitted to the Engineer daily, or as required. The Contractor shall also keep the Engineer advised, on a daily or as required basis, on the equipment being utilized to affect the required results during the entire period when the Dewatering System is in operation.

6. MEASUREMENTS AND PAYMENT

Payment for dewatering item shall be made on lump sum bid price basis. This payment will include, but be not limited to, all costs incurred in connection with provision, installation, operation and maintenance, etc. of the complete Dewatering System consisting of basic Dewatering System, Standby dewatering system together with Standby Power arrangements. The item also includes transportation of all plant, equipment, supplies and personnel to the site, disposal of collected water and making all the necessary arrangements for satisfactory performance of the Dewatering System as specified and directed by the Engineer. The provision of safety measures required for excavation work and any insurance, premium paid to cover the life and property shall also be considered as part of this item for the purpose of payment. All the cost incurred on designing of the Dewatering System will be deemed to be included under this item for payment.

Interim payments for dewatering shall be made in following manner:

i) The first payment of 25% of BOQ rate of dewatering item will be made after the Contractor has brought and installed dewatering equipment on the Site in accordance with approved scheme of dewatering system.

ii) The second payment of 30% of BOQ rate dewatering item will be made after the Contractor has completed raft foundation.

iii) The third payment of 30% of BOQ rate dewatering item will be made after the Contractor has completed retaining wall.

iv) Remaining 15% of BOQ rate will be paid after completion of backfilling

*** End of Section 1200 ***

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SECTION - 1330

STONE SOLING

1. SCOPE

The work under this section of specifications consists of furnishing all plant, labour, equipment, appliances, materials and performance of all operations required in connection with the construction of stone soling in strict accordance with the specifications and Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. MATERIAL

Material shall be of approved quality it shall be comprise strong hard durable stone of the approved size free from impurities, quarry sap, dust, dirt and solubility characteristics. The stone shall be obtained from approved quarries and shall be sound, free from laminations and weak cleavages.

3. QUALITY CONTROL

The quality of material used in stone soling shall conform to the following.

- Maximum Los Angles Abrasion value 35% determined as per ASTM C-535-81.
- Soundness 5 cycles with sodium sulphate 10% determined as per ASTM C-88-8.
- Specific Gravity shall be not less then 2.65 determined as per ASTM C-127-84.
- Water Absorption shall not be more then 1.5%

4. CONSTRUCTION

4.1 Preparation of Sub-grade

Sub-grade shall be formed of suitable materials free of clods, sod, roots, stumps, brush or other objectionable material.

Sub-grade material shall be placed in successive layers not exceeding 6 inch in thickness and each layer shall be thoroughly compacted at optimum moisture content.

The sub-grade shall be compacted at optimum moisture content and loose pockets, if any, cut-out and refilled with selected materials in layers not more than 150mm thick and formed to levels and grades shown on the drawings.

Compaction shall be done by approved methods consistent with the soil/material to be compacted.

The maximum dry weight density of the sub-grade shall not be less than 95% of Modified AASHTO requirements.

4.2 Stone Ballast Soling

The Stone Ballast shall be well graded and broken hard of 2" mesh obtained from an approved quarry. The soling stone shall be 150mm in size from an approved quarry.

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The stone shall be laid and packed to even grades and well rolled using vibratory roller/plate compactor to a consolidated thickness of not less than 6 inch or as shown on the Drawings.

The whole of the surface of the compacted stone ballast soling will be blinded with murum or any other approved gritty material/ stone dust (Khaka). After the interstices have been filled with smaller size crushed stone, so as to effectively fill in the voids and crevices, soling area may be watered, if necessary and again thoroughly rolled with the same roller to produce a smooth and even surface free from irregularities, true to line and level.

Care is to be taken to avoid any damage to existing structures, mains or pipes while rolling operation is in progress. In places inaccessible for a roller, compaction shall be done by hand tampers weighing not less than 20 lb. or power reamers as directed by the Engineer.

5.0 MEASUREMENT AND PAYMENT

5.1 General

Except otherwise specified herein or elsewhere in the Contract Documents no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

5.1.1 Any losses of material, which may result from shrinkage, compaction, waste, overflow erosion, etc.

5.1.2 Sub-grade preparation.

5.1.3 Murrum or any other approved gritty material/ stone dust (Khaka).

5.1.4 Ballast material of approved quality.

5.1.5 Compaction of sub-grade and stone.

5.2 Stone Soling

5.2.1 Measurement:

Measurement of acceptably completed works of stone soling will be made on the basis of number of cubic meter / foot of compacted soling in position as shown on the Drawings or as directed by the Engineer.

5.2.2 Payment:

Payment will be made for acceptable measured quantity of compacted stone soling on the basis of unit rate per cubic meter / foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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*** End of Section 1330 ***

SECTION - 2300

PLAIN AND REINFORCED CONCRETE

1 SCOPE

The work under this section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the supply, manufacture, transporting, placing, consolidating, finishing and curing of plain and reinforced concrete for pavements and other structures as shown in the drawings, as specified herein and as required by the site conditions or as directed by the Engineer, for a complete job. Reinforcement does not form part of this section.

2 GENERAL

APPLICABLE CODES AND STANDARDS

The latest edition of following ACI, ASTM, Pakistan & British Standard are relevant to these specifications wherever applicable:

2.1 ACI (American Concrete Institute)

- 117 Standard Specification for tolerances for concrete construction and materials.
- 201.2 Guide to durable concrete
- 211.1 Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete.
- 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.
- 301 Specifications for Structural Concrete for Buildings
- 303.1 Standard Specification for Cast Iron Plate, Architectural Concrete
- 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
- 305 Hot Weather Concreting
- 308 Recommended Practice for Curing Concrete
- 309 Recommended Practice for Consolidation of Concrete
- 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- 351.1R Grouting for Support of Equipment & Machinery.
- 318 Building Code Requirements for Reinforced Concrete

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- 347 Recommended Practice for Concrete Formwork
- 350R Concrete Sanitary Engineering Structures
- 544.1R State-of-the-Art Report on Fiber Reinforced Concrete
- 544.2R Measurement of Properties of Fiber Reinforced Concrete
- SP-2 Manual of Concrete Inspection
- SP-142 Fiber Reinforced Concrete Developments and Innovation
- SP-155 Testing of Fiber Reinforced Concrete
- SP-182 Structural Applications of Fiber Reinforced Concrete

2.2 ASTM (American Society for Testing and Materials)

- C 31 Making and Curing Concrete Test Specimens in the Field
- C 33 Concrete Aggregates
- C 39 Compressive Strength of Cylindrical Concrete Specimens
- C 40 Organic impurities in sand for concrete.
- C 42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- C 78 Flexural Strength of Concrete (Using Simple Beam with Third Point Loading)
- C 87 Effect of organic impurities in fine aggregates on strength of mortar.
- C 88 Soundness of Aggregates
- C 94 Ready-Mixed Concrete
- C 109 Compressive Strength of Hydraulic Cement Mortars
- C 117 Materials Finer than No.200 Sieve in Mineral Aggregates by washing.
- C 123 Light weight pieces in aggregates
- C 125 Concrete and Concrete Aggregates
- C 127 Test method for Specific Gravity and Absorption of Coarse Aggregate
- C 128 Test method for Specific Gravity and Absorption of Fine Aggregate
- C 131 Resistance to Degradation of small size Aggregate by Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
- C 136 Sieve or Screen Analysis of Fine and Coarse Aggregates

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- C 138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- C 142 Clay Lumps and Friable Particles in Aggregates
- C 143 Slump of Portland Cement Concrete
- C 144 Aggregate for Masonry Mortar
- C 150 Portland Cement
- C 156 Test Method for Water Retention of Concrete Curing Materials
- C 157 Length Change of Hardened Hydraulic Cement Mortar or Concrete
- C 171 Sheet Materials for Curing Concrete
- C 172 Method of Sampling Fresh Mixed Concrete
- C 173 Air Content of Freshly Mixed Concrete by the Volumetric Method
- C 185 Air Content of Hydraulic Cement Mortar
- C 186 Heat of Hydration of Hydraulic Cement
- C 188 Density of Hydraulic Cement
- C 191 Time of Setting of Hydraulic Cement by Vicat Needle
- C 217 Weather resistance of Natural State
- C 227 Potential Alkali Reactivity of cement - Aggregate Combination.
- C 231 Air Content of Freshly Mixed Concrete by the Pressure Method
- C 260 Air-Entraining Admixtures for Concrete
- C 289 Potential reactivity of Aggregate
- C 293 Standard test method for Flexural Strength of Concrete (using simple beam with center Point Loading)
- C 309 Liquid Membrane-Forming Compounds for Curing Concrete
- C 321 Standard Test method for Bond Strength of Chemical Resistant material
- C 330 Light Aggregates for Structural Concrete
- C 332 Light weight aggregates for insulating concrete.
- C 348 Standard Test method for Flexural strength of Hydraulic Cement Mortars

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- C 400 Requirements for water use in mixing and curing concrete
- C 494 Chemical Admixtures for Concrete
- C 535 Resistance to Abrasion of Large Size Coarse Aggregates
- C 595 Specification for Blended Hydraulic Cements
- C 596 Standard Test method for Drying, shrinkage of Mortar Containing Hydraulic Cement
- C 685 Concrete Made by Volumetric Batching and Continuous Mixing
- C 881 Epoxy-Resin-Base Bonding Systems for Concrete
- C 989 Ground Granulated Blast – Furnace Slag for use in Concrete
- C 995 Standard Test Method for Time of Flow of Fiber Reinforced Concrete Through Inverted Slump Cone
- C 1018 Standard Test Method for Flexural Toughness and First- Crack Strength of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)
- C 1116 Standard specification for Fiber-Reinforced Concrete and Shotcrete)
- C 1399 Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
- D 75 Sampling Aggregates
- D 512 Chloride Ion in Water and Waste Water
- D 516 Sulphate Ion in Water and Waste Water
- D 596 Reporting Results of Analysis of Water
- D 1190 Concrete Joint Sealer, Hot-Poured Elastic Type
- D1411Water-Soluble Chlorides Present as Admixes in Graded Aggregate Road Mixes
- D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- D 1752 Preformed sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Concrete
- D 1850 Concrete joint sealer (cold application type)
- E 11 Wire-Cloth Sieves for Testing Purposes

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- E 96 Water Vapour Transmission of Materials in Sheet Form
- E 154 Materials for Use as Vapour Barriers under Concrete Slab
- E 337 Relative Humidity by Wet and Dry Bulk Psychrometer
- CALIF 217 Method of Test for Sand Equivalent
- CALIF 227 Method of Test for Evaluating Cleanness of Coarse Aggregate

2.3 CRD US Army Corps of Engineers

- CE CRD C 119 Method of Test for Flat and Elongated Particles in Coarse Aggregate
- CE CRD C400 Requirements for Water for Use in Mixing and Curing Concrete
- CE CRD C 513 Rubber Waterstops
- CE CRD C 572 Polyvinyl Chloride Waterstops
- CE CRD C 589 Standard Specification for latex agent for bending fresh to Hardened concrete.
- FF MM G 650 Epoxy-Resin Grout

2.4 B.S (British Standard)

BS EN 197-1 Cement composition, Specification and Conformity criteria replaced by BSN EN 197-1 2000

- 12 Portland cement (Ordinary & Rapid Hardening)
- 146 Portland Blast Furnace Slag Cement
- 410 Test Sieves
- 812 Methods for the sampling and testing of mineral aggregates, san fillers.
- 882 Specification for aggregates from natural sources for concrete (replaced by EN but remains current).
- 1305 Specification for Batch Mixer.
- 1881 Methods of Testing Concrete
- 3148 Methods of Test for water for making concrete remain current but replaced by BS EN 1008: 2002
- 4027 Specification for Sulphate Resistant Portland Cement
- 8110 Structural use of concrete.

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In addition, the latest editions of other Pakistan Standard, ACI, ASTM & British Standard and other Standards as may be specified by the Engineer for Special Materials and construction are also relevant.

3 SUBMITTALS

All submittals shall be in accordance with the schedule of submittals prepared by the Contractor and approved by the Engineer.

3.1 Proposed Mix Designs

Submit proposed designs for trial design batches for each grade of concrete along with samples of proposed material.

Submit proposed final mix designs for each grade of concrete at least 7 calendar days before the date planned for the start of concrete placement, along with samples of proposed materials which differ from those submitted previously, and reports of successful 3, 7 and 28 calendar day strength tests, for Engineer's approval.

3.2 Construction Procedure

Submit to the Engineer procedures for the following:

a) Both hot and cold weather concreting procedures shall be submitted to the Engineer by Contractor regardless of the need for the immediate implementation of such not less than two weeks before beginning the work. Procedures shall include requirements for insulation, enclosures and the like. Finishing procedures and timing and duration of curing shall be described.

b) Contractor's construction procedures shall be computer word processed procedure and shall include charts and diagrams as applicable and necessary, to fully explain the subject procedures, methods and equipment operation in order to allow effective review by the Engineer, assist the Testing Agency's evaluation of the work, and to allow Contractor's personnel to perform work in full conformance to the Tender & Contract Document.

c) Protection of concrete against injury due to mechanical contact and construction operation.

d) Protection of work by other trades.

3.3 Placement Schedule

Submit a placement schedule for approval prior to start of concrete placement operations. Daily concrete pour schedules shall be submitted 24 hours in advance of planned pours.

3.4 Formwork

Submit for approval copies of manufacturer's data and installation instructions for proprietary materials including form coatings, manufactured form systems, ties and accessories.

3.5 Certificates of Compliance

Submit certificates of compliance covering cement types, reinforcement, grout materials, additives, epoxy-resin materials etc. The certificates of compliance shall include the material or product manufacturer's statements that supplied items conform to Specifications.

3.6 Testing Programme

Submit test programme for all specified requirements along with the testing schedule for approval of the Engineer.

3.7 Test Reports

Submit test reports showing the result of required tests and compliance with specified standards and codes, for approval. Test reports shall be certified by the Contractor and the Testing Agency.

3.8 Samples

Submit to the Engineer for acceptance prior to purchase, fabrication or delivery, samples of materials for his approval.

Substitute products or materials proposed by the Contractor shall be submitted as samples for approval. The samples shall be accompanied by detailed information about materials.

3.9 Shop Drawings

Shop drawings shall be submitted to the Engineer for approval in accordance with the requirements of the Contract Documents and as specified herein under:

a) Shop drawings furnished for this section shall conform to the best standards of the construction industry. Shop drawings shall be prepared under the supervision of competent engineering personnel. Prior to submittal, the Contractor shall check each shop drawing for compliance with the requirements of the Contract Documents. As evidence of conformance with this requirement, each shop drawing shall bear the seal and the self-written signature of Contractor's registered Professional Engineer.

b) Shop drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale for all works to be provided. Drawings shall be accurately dimensioned, where applicable, and shall be noted clearly.

c) Work of Other Trades: Show in the shop drawings, and dimension thereon, holes required for passage of work of other sections through Cast-In-Place Concrete Work. Prepare and submit to the Engineer field work drawings for holes not shown in shop drawings.

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d) Submit shop drawings for curved and radial concrete formwork and identify the formwork materials proposed for use.

e) Construction Joint, Expansion Joint and contraction Joint Drawings: Show all joints given in the drawings, specified herein, and required by Contractor to provide for the sequence of pourings. Submit in sufficient time to allow the orderly detailing of reinforcing steel. Reinforcement shop drawings shall be prepared in conformance with the accepted Construction Joint, Expansion Joint and contraction Joint Drawings. Measures to control cracks e.g. shrinkage strips, admixture as per relevant ACI codes shall be shown on the drawings.

f) Reinforcing Steel, including welded wire fabric (WWF), shall be detailed in strict accordance with the methods and procedures provided in "ACI Detailing Manual". Reinforcing steel drawings shall be submitted simultaneously with related shop drawings.

Prepare shop drawings which provide for reinforcement, including dowels, properly positioned in all concrete work, so that material can be properly cut, bent and placed. Form not be removed for at least twelve (12) hours after the concrete has been placed. Forms shall be carefully given in shop drawings. Reinforcing steel drawings shall show, to scale, all concrete work including pits, kerbs, trenches, pads, equipment bases, steps, slopes, curves, openings, holes, blockouts and the like. Provide schedules and details showing placing sequences, bending, lengths and locations of all reinforcement.

h) Detailing: All reinforcing steel shall be detailed in strict compliance with ACI 318 and ACI 315.

3.10 Coordination Drawings

Submit coordinated drawings of the following:

All sleeve locations, whether round or of other shape, penetrating exterior and interior walls, pits, slabs, beams, other structural systems and pavements.

The position of all embedded items required to receive the work of other trade, including details needed to assure correct placement of both the embedded items and the reinforcing steel.

The Contractor shall coordinate and crosscheck for accuracy, completeness and correct relationship to the work of other sections, each shop drawing prepared for the work of this section, including each shop drawing prepared by nominated subcontractors. Contractor's check shall include a verification of strict compliance with the Contract Documents and shall be performed prior to submission of each shop drawing for review by the Engineer. The Contractor shall certify the co-ordination, accuracy, and Contract compliance of each shop drawing by a written statement placed in each drawing and attested by the responsible person in charge of the work for Contractor. The personally inscribed initials of the person(s) preparing each drawing as well

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as the detailing agency's supervisor and chief checker shall be included in the title block or similar prominent location.

3.11 Mill Test

Furnish the Engineer with certified mill test report for cement and for steel reinforcement, including bars, welded wire fabric, dowels, anchors and splices for approval.

3.12 Name of Manufacturers/Suppliers

Submit for acceptance by the Engineer:

- Aggregates
- Ready mix concrete
- Reinforcing bars
- Welded steel wire fabric
- Concrete accessories
- Cement
- Admixture
- Joint filler
- Joint sealants
- Water stops
- Membrane curing, sealing, hardening compound
- Bonding compound
- Form oil
- Anchors

4 MATERIALS

4.1 Cement

4.1.1 The cement shall be fresh and of approved origin and manufacturer. It shall be one of the following as may be specified by the Engineer.

- Sulphate Resistant Portland Cement (low alkali) complying with the requirements of BS-4027 or ASTM C-150 Type V.

- Ordinary Portland Cement Type II (low alkali) complying with the requirements of BS-12 or ASTM C-150.

- Portland Blast–Furnace Slag Cement shall conform to BS-146 or to ASTM C-595. Slag shall consist of finely ground granulated iron blast–furnace slag and shall conform to ASTM C-989 Grade 80, 100, or 120.

- The proportioning of OPC and Portland Blast Furnace Slag material shall be in the ratio of 60 OPC to 40 Slag or as approved by the Engineer."

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4.1.2 Unless otherwise specified, ordinary Portland Cement complying with the requirements of ASTM C150 Type 1 shall be used.

4.1.3 The Contractor shall supply to the Engineer at fortnightly intervals, reports of tests for conformance with the relevant specified standard in respect of the samples of cement from the work-site. These tests shall be carried out in a laboratory approved by the Engineer.

4.1.4 Only one brand of each type of cement shall be used for concrete in any individual member of the structure. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed.

4.1.5 There shall be sufficient cement at site to ensure that each section of work is completed without interruption.

4.1.6 Cement reclaimed from cleaning of bags or from leaky containers shall not be used.

4.1.7 The Contractor shall provide and erect (at his cost) in a suitable plain, dry, well ventilated, weather-proof and water proof shed of sufficient capacity to store the cement.

4.1.8 The cement shall be used as soon as possible after delivery and cement which the Engineer consider has become stale or unsuitable through absorption of moisture from the atmosphere or otherwise shall be rejected and removed immediately from the site at the Contractor's expense. Any cement in containers damaged so as to allow the contents to spill or permitting access of the atmosphere prior to opening of the container at the time of concrete mixing shall be rejected and removed immediately from the site at the Contractor's expense.

4.1.9 Mixing together of different types of cement shall not be permitted.

4.2 **Aggregates**

4.2.1 The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer.

Aggregates shall conform to ASTM C33 (including applicable ASTM Documents referenced therein) and as specified. Coarse aggregates shall be well graded from fine to coarse within the prescribed limits of this specification. Fine aggregate shall consist of natural sand, manufactured sand or combination of the two and shall be composed of clean, hard, and durable spherical or cubical particles. Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or a combination thereof and shall be clean, hard, uncoated particles of maximum nominal size as specified for each grade of concrete.

All fine and coarse aggregates shall be clean and free from clay, loam, silt and other deleterious matter. If required, the Engineer reserves the right to have them washed by the Contractor at no additional expense. Coarse and fine aggregates shall be delivered and stored separately at site. Aggregates shall not be stored on muddy ground or

where they are likely to become dirty or contaminated. The materials shall be stock piled for a period before use for at least a day so as to drain nearly to constant moisture content. The grading of the coarse and fine aggregates shall be tested at least once for every 100tons supplied, to ensure that grading is uniform and same as that of the samples used in preliminary tests.

The sulphate content of aggregates shall not exceed 0.40 percent by weight for each individual source of coarse and fine aggregate. The chloride content of aggregates shall not exceed 0.05 percent by weight for each source of coarse and fine aggregate. The total sulphate content of concrete shall not exceed 4.0 percent by weight of the cement. The total chloride content of concrete shall not exceed 0.40 percent by weight of the cement.

Aggregates, when tested in accordance with CRD C119 shall contain not more than 8 percent by weight of thin, flat and elongated particles.

Petrographic analysis of aggregate shall be carried out initially for each source and periodically whenever directed by the Engineer.

The specific gravities and absorption of aggregates shall be identified in accordance with ASTM C 127 and ASTM C 128.

Prior to the initial use of each source of aggregates, certified tests shall be performed on aggregates to verify compliance with these specifications and submitted for Engineer's review and approval.

Gradation of coarse aggregates for concrete shall conform to the gradations given in Table-I.

The gradation of combined coarse and fine aggregates shall be within the grading limit specified in Table-II.

The Fineness Modulus of fine aggregate (sand) shall be not less than 2.6 nor more than 3.1. In at least four out of five successive test samples, the modulus shall vary by not more than 0.20 from the moving average for the last five tests. The gradation of the coarse aggregate will be suitable if the results of four out of the last five consecutive tests comply with the gradation requirements.

Furnish certified test reports for aggregate tests listed in Table-III, Quality Tests.

4.3 **Water**

Only clean water from the sources approved by the Engineer shall be used. The Contractor shall supply sufficient water for all purposes, including mixing the concrete, curing and cleaning plant and tools. Water analysis shall be performed in accordance with ASTMD596.

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In case of doubt, the Engineer may require that concrete mixed with water proposed to be used should be tested to have a compressive strength not less than 90% of the strength of concrete mixed with distilled water.

4.4 Concrete Patching Compound

Use an approved epoxy-resin compound applied according to manufacturer's instructions. Compound shall be paintable material which produces no evidence of bleeding and which, after final set, shall not be affected by high humidity and moisture. Epoxy-resin compound shall comply with FSMM-G-650, Type 1, Grade C.

4.5 Fiber Reinforced Concrete

Duracrete Polypropylene Fiber or approved equivalent concrete reinforcing: Concrete shall be treated with Duracrete polypropylene synthetic reinforcing fibers or approved equivalent when indicated on the drawings or as otherwise specified by the Engineer in accordance with the fiber manufacturer's recommendations.

a. Synthetic reinforcing fibers shall be manufactured from virgin polypropylene.

b. The dosage rate shall be1.8 kg/cu.m (3.0 Lb/ Cu yd) of concrete.

c. Fiber supplier shall provide technical assistance, if required.

d. All fibers must meet or exceed the standards and specifications set forth in ACI 544, Fiber Reinforced Concrete.

e. Listed below are the minimum properties of the polypropylene fibers for use. All fibers must meet or exceed the characteristics described in ACI-544, IR, Table 1.1, Fiber Reinforced Concrete.

1. Tensile Strength: 4.4 grams/denier
2. Elongation at break: 12%
3. Fiber: 100% Fibrillated / Monofilament Polypropylene (as per site requirement)
4. Lengths: 19 mm
5. Absorption: Nil
6. Specific gravity: 0.9
7. Ignition point: 593 °C
8. Melting point: 160-170 °C
9. Heat & UV stabilization: Long term
10. Thermal conductivity: Low
11. Electrical conductivity: Low
12. Salt resistance: High
13. Acid resistance: High
14. Alkali resistance: 100% (alkali proof)

4.6 Additives

All additives shall be from a manufacturer approved by the Engineer.

Air Entraining Admixtures shall conform to ASTM C 260. Other admixtures shall conform to ASTM C 494.

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Liquid Crystalline Water Proofing Bitocrete C-16 from Schomberg Germany or equivalent.

4.7 Vapour Barrier

Polyethylene sheeting conforming to ASTM E154 and 0.2mm thick as a minimum. Other similar material having a vapour permeance rating not exceeding 0.5per meter as determined by ASTME96, will be considered unless noted otherwise.

4.8 Grout

a) Damp Pack Bedding Grout: Mix of one part Portland cement and 2 parts of fine aggregate proportioned by weight and not more than 4 gal. (17 liters) of water per bag of cement.

b) Pre-mixed, Non-Shrink, Non-Metallic Grout: "Masterflow 713" manufactured by Master Builders, "Euco-N.S." manufactured by the Euclid Chemical Company or other approved equal.

c) Pre-mixed, Non-Shrink, Metallic Grout: "Embeco636" manufactured by Master Builders, "Firmix" manufactured by the Euclid Chemical Co., or other approved product.

d) Expansive Grout: CE CRD-C588, Type A or M, as required.

4.9 Cover Material for Curing

Curing material shall conform to the following:

a) Impervious Sheeting: ASTM C171, type optional, except that polyethylene sheeting shall be 0.1mm minimum thickness, white opaque. Where the work is exposed to high winds the impervious sheeting shall not be used.

b) Burlap: Cloth made of jute or kenaf shall conform with AASHTO M182 and shall weigh a minimum 0.3kg/m^2.

c) Liquid Membrane Forming Compound: ASTM C309, Type 2.

4.10 Joint Fillers

ASTM D 1751, preformed, resilient bituminous type or ASTM D1752, preformed sponge rubber.

4.11 Joint Sealants

ASTM D 1190, ASTM D 3569, ASTM D 3406, hot-pour type.

4.12 Swell bar

Provide swell bar- 2010 A of approved manufacturer.

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4.13 Waterstops

Provide flat, dumbbell type or center bulb type water stops at construction joints where shown. Web thickness not less than 5mm for units up to 125mm wide, and not less than 10mm for widths over 125mm. Provide polyvinyl chloride (PVC) waterstops of approved manufacturer.

4.14 Epoxy Resin

ASTM C 881, type, Grade 3, Class C.

4.15 Formwork

a) Formwork for Concrete Pavement

Forms shall be made of steel of an approved section, with a base width of at least two hundred (200) millimeters and the depth shall be equal to the thickness of the pavement at the edge as shown on the plans. The forms shall be staked with steel stakes, and stakes shall be of a length approved by the Engineer. Each section of forms shall have a stake pocket at each end and at intervals of not more than one and one-half (1.5) metres between ends. The stake pockets shall have approved devices for locking the form to the steel stakes. Each section of forms shall be straight and free from bends and warps at all times. No section shall show a variation greater than three (3) millimeter in three (3) metres from a true plane surface on the top of the form, and the inside face shall not vary more than six (6) millimeters from a plane surface.

Before placing forms, the underlying base shall be to the required grade, and shall be firm and compact. The forms shall have full bearing upon the foundation throughout their length and shall be placed with exactness to the required grade and alignment of the edge of the finished pavement. They shall be so supported during the entire operation of placing, tamping and finishing the pavement that they will not deviate vertically at any time more than three (3) millimeters from the proper elevation.

Forms shall not be removed for at least twelve (12) hours after the concrete has been placed. Forms shall be carefully removed in a manner to avoid damage to the pavement. Under no circumstances will the use of pry bars between the forms and the pavement be permitted. Pavement, which in the opinion of the Engineer, is damaged due to the careless removal of forms shall be repaired by the Contractor, as directed by the Engineer, at the Contractor's own expense.

Forms shall be thoroughly cleaned and oiled each time they are used.

When pavement is placed adjoining existing concrete pavement upon which the finishing machine will travel, any irregularities in the old pavement shall be ground down to a true, uniform surface, of sufficient width to accommodate the wheels of the finishing equipment, if necessary to obtain proper smoothness of the pavement.

b) Formwork for Structures

Material, workmanship etc. of formwork for structures, refer specification Section2100.

4.16 **Reinforcement**

Materials for reinforcing steel, welded wire fabric, dowels and tie bars, refer specification Section 2200.

5 MATERIAL TESTING

A. Samples and Testing

Samples from stock on the site or suppliers materials shall be taken by the Contractor in presence of the Engineer. Furnish tests and certificates as specified.

B. Cement

Sampled cement shall be tested by a testing laboratory. Certified copies of laboratory test reports shall be furnished for each lot of cement and shall include all test data, results and certification that the sampling and testing procedures are in conformance with the Specifications for approval. No cement shall be used until test results are satisfactory. Cement that has been stored for more than four months after being tested shall be re-tested before use. Cement found unsatisfactory under test shall be immediately removed from the construction site or supplier stock.

C. Aggregates

Aggregate sampling shall conform to ASTM D 75. Aggregates shall be sampled and tested by a testing laboratory. No aggregate shall be used until test results are satisfactory to the Engineer.

D. Water

Water analysis shall be performed in accordance with ASTM D 596, and the report shall be submitted for Engineer's approval.

E. Admixtures

Sampling and testing of all admixtures used in concrete mix shall be in accordance with the standard procedure recommended by an approved testing laboratory. No admixture shall be used until test results are satisfactory and approved.

F. Concrete

a) Compressive Strength: The Contractor shall provide and test three sets of specimens taken under the supervision of the Engineer from each 125 cubic metres or not less than once a day from each grade of concrete placed. Samples shall be secured in accordance with ASTM C 172. Test specimens shall be made and cured in accordance with ASTM C-31. Specimens shall be tested in accordance with ASTMC39 or ACI-214. Test specimens shall be evaluated for each grade of

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concrete specified in conformance with ACI318, chapter "Concrete Quality". The standard age of concrete for tests shall be 3, 7 and 28 calendar days.

b) Slump and Entrained Air: Slump test and entrained air tests shall be performed in the field under the supervision of the Engineer. Slump test shall conform to ASTM C 143 and entrained air content shall be determined in accordance with ASTM C 231 or C 173 as applicable.

c) Concrete removed for the Structure: When the results of the strength test of the specimen indicate deficiency in specified requirements or where there is other evidence that the quality of concrete is below specified requirements, core boring tests shall be made in conformance with ASTM C-42. If a deficiency is discovered, the Contractor may be allowed to make load test, at his expense, and results shall be evaluated in conformance with ACI 318, Chapter 20.

5.1 Frequency of Testing

a) The following tests shall be performed initially for approval and as per required frequency thereafter:

-	Aggregates	ASTM C 33	----------
-	Soundness	ASTM C 88	bi-weekly
-	Specific Gravity	ASTM C 127	weekly
-	Absorption	ASTM C 128	weekly
-	Abrasion	ASTM C 131	weekly
-	Gradation	ASTM C 136	daily
-	Sand Equivalent	ASTM C 217	weekly
-	Cleanliness	ASTM C 227	weekly
-	Elongation	CRD C 119	bi-weekly
-	Chloride Ion	ASTM D 512	bi-weekly
-	Water Analysis	ASTM D 596	bi-weekly

b) The following tests shall be performed initially for approval and thereafter as specified:

- *Concrete Compressive Strength*: ASTM C39. Three sets of specimens for each 75 cu.m of each grade of concrete placed or at least three sets for each grade per work shift.
- *Flexural Strength*: Three sets of specimens for each 100 cu.m of concrete placed or at least three sets per work shift. The concrete shall be sampled in accordance with ASTM C172. Flexural strength specimens shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 78.

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- *Sulphate (S03) Content, Chloride Content and pH value*: One test per month for each grade of concrete. Broken laboratory specimens from strength tests shall be used for hardened concrete Sulphate, Chloride content and pH Value tests.

6 EXECUTION

6.1 Nominal Concrete Mixes

6.1.1 The cement, fine aggregate and the coarse aggregate shall be weighed separately. The proportions of cement to fine aggregate and coarse aggregate shall be adjusted as per ACI 211 & ACI 318 so as to provide the concrete of the required crushing strength when tested as set out in Table1.

6.1.2 The Contractor shall regulate and arrange mixing of the ingredients for the designed mix of the concrete by weight-batching.

6.1.3 Water/Cement Ratio

The quantity of water used shall be just sufficient to produce a dense concrete of the specified strength. For all exterior exposed work and foundations the water/cement ratio shall not exceed 0.45, allowance being made for any water in the fine and coarse aggregates.

6.1.4 Workability

Admixtures may be used where necessary to achieve required workability, with the Engineer's approval. For concrete pavements, the mix determined shall be workable concrete having a slump between 13mm and 50mm, as determined by ASTMC143. For other structures the concrete shall be proportioned and produced to have a slump of 75mm or less if consolidation is to be by vibration, and 125mm or less if consolidation is to be by methods other than vibration.

6.2 Strength and Durability Requirements for Concrete

Strength and Durability Requirements for Concrete are given below :

Class of Concrete	Specified Cylinder Compressive Strength at 28 days (MPa)	Specified Cylinder Compressive Strength at 28 days (Psi)
A1	35.0	5000
A	28.0	4000
B	21.0	3000
C	17.0	2400
D	8.0	1100
E	5.0	700

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The flexural strength of concrete for pavement shall be 4.5 MPa at 28 days as per ASTM C 78 with minimum cement content of 340Kg of cement per cubic metre of concrete. The flexural strength requirement is the governing factor,

excess cement if any used to achieve the required flexural strength shall not be payable.

6.2.1 The Contractor shall adopt all necessary measures as per ACI201.2, like proper grading of aggregates, control of water cement ratio and cement content, proper compaction and curing, to achieve dense and durable concrete.

6.2.2 The Contractor shall submit mix design by weight for each grade of concrete at least 45 calendar days before any placement of concrete, along with samples of the proposed materials. Manufacture 12nos. test cylinders 12" (305mm) x 6" (152mm) in accordance with ASTMC-31, and in accordance with the mix design batching by weight and test 3 cylinders each at 3, and 28 days in the presence of Engineer's Representative, in accordance with ASTMC-39 and submit all relevant data and results of tests for approval of the Engineer. The Contractor shall obtain approval from the Engineer in writing for each mix design before producing the actual concrete for the works.

6.3 Batching

6.3.1 All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement may be taken as 50 kg.

6.3.2 Aggregates shall be batched by weight, due allowance being made for water content. Aggregates may be batched by volume only with the prior permission of the Engineer. The apparatus for weight batching may be as integral part of the mixer or a separate unit of a type approved by the Engineer. It shall be accurate within 2% and shall be checked for accuracy at least once a week.

6.3.3 The quantity of additives shall be as prescribed by the manufacturer or as directed by the Engineer.

6.4 Mixing

6.4.1 The concrete shall be mixed in an approved batch mixer. It shall be fitted with the manufacturer's plate stating the rates, capacity and the recommended number of revolutions per minute and shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water measuring device.

6.4.2 Mixing shall continue for the period recommended by the mixer manufacturer or until there is apparently a uniform distribution of the materials and the mass is uniform in colour, whichever period is longer. However, minimum mixing time shall not be less than 1-1/2 minutes.

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If it is desired to use a mixing period of less than 1-1/2 minutes, the Engineer's approval shall be obtained in writing.

6.4.3 Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.

6.4.4 The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10 percent of their original height.

6.4.5 Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be re-tempered, but shall be discarded.

6.5 Transporting

6.5.1 The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means which will prevent segregation or loss of or addition to ingredients. It shall be deposited as nearly as practicable in its final position so as to avoid re-handling or flowing. All skips vehicles, or containers used for transporting the concrete shall be thoroughly clean.

6.5.2 During hot or cold weather, concrete shall be transported in deep containers, on account of their ratios of surface area to mass, which reduces the rate of loss of water by evaporation during hot weather and loss of heat during cold weather.

a) Batching: The Contractor shall submit to the Engineer for review the plans and capacity of the concrete batching plant and delivery equipment, which shall comply with ASTM C-94.

The Contractor shall furnish test certificates for the scales and metering devices before producing concrete and at least every six weeks thereafter.

b) Accuracy of Plant Batching: Cement measured by weight in individual batchers shall be within $\pm$1.0 percent of the desired intermediate and final weights in cumulative batchers. The minimum batching accuracy shall be $\pm$0.3 percent of scale capacity for small loads below 30 percent of scale capacity.

Aggregate measured by weight in individual batchers shall be within $\pm$2.0 percent of the desired weight, or within $\pm$1.0 percent of the desired intermediate and final weights in cumulative batchers; but in either case, the minimum batching accuracy shall be $\pm$0.3 percent of scale capacity for small loads below 15 percent and 30 percent of scale capacity, respectively.

Water measured by volume or by weight shall be within $\pm$1.0 percent of the desired amount.

Liquid admixtures measured by volume or by weight shall be within $\pm$1.0 percent of the desired amount.

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Compensation for changes of moisture content in fine and coarse aggregate shall be made by devices which shall correct the batch water and the weight of the affected aggregate simultaneously without changing the batch setting.

c) Mixing and Delivery: Concrete shall be mixed completely in the batching plant. Records shall be kept of water added in normal batching.

Concrete shall be transported to the point of discharge in agitator-mixer trucks, or by other approved means.

Trip tickets shall be provided for each delivery. The tickets shall show the designation of the materials in each batch, measured weight or volume of materials, methods of cooling concrete, class of concrete, batch number, mixer number, batch volume, date and time water was added to the mix, time of discharge from the mixer, and delivery truck number.

When it is necessary to add water to the agitator-mixer, it shall be done in accordance with ASTM C 94 and recorded.

6.6 Concrete for Pavement

6.6.1 The base upon which the concrete pavement is laid shall have been constructed or prepared under other relevant section of the specifications and shall be smooth, compacted and true to the grade and cross-section shown on the drawing and shall be maintained throughout the period of placing concrete pavement.

To prevent flow of cement slurry from concrete, polyethylene sheet 0.2mm thick as vapour barrier, as per relevant section of specifications shall be placed on cement treated base course, prior to placing of concrete.

6.6.2 Formwork

Before placing forms, the underlying base shall be to the required grade, and shall be firm and compact. The forms shall have full bearing upon the foundation throughout their length and shall be placed with exactness to the required grade and alignment of the edge of the finished pavement. They shall be so supported during the entire operation of placing, tamping and finishing the pavement that they will not deviate vertically at any time more than three (3) millimeters from the proper elevation.

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Forms shall not be removed for at least twelve (12) hours after the concrete has been placed. Forms shall be carefully removed in a manner to avoid damage to the pavement. Under no circumstances will the use of pry bars between the forms and the pavement be permitted. Pavement, which in the opinion of the Engineer, is damaged due to the careless removal of forms shall be repaired by

the Contractor, as directed by the Engineer, at the Contractor's own expense.

Forms shall be thoroughly cleaned and oiled each time they are used.

When pavement is placed adjoining existing concrete pavement upon which the finishing machine will travel, any irregularities in the old pavement shall be ground down to a true, uniform surface, of sufficient width to accommodate the wheels of the finishing equipment, if necessary to obtain proper smoothness of the pavement.

6.6.3 Placing Reinforcement

All pavement reinforcement shall be placed as shown on the plans. All reinforcement required by the works shall be held in proper position by sufficient number of metal bar supports or chairs as approved by the Engineer. The dowels may be installed mechanically by means of equipment and methods approved by the Engineer. The satisfactory placement of the dowels shall depend upon the ability of the mechanical device to place the dowels in their true position. The Engineer may require, when satisfactory placement is not obtained by mechanical means, that the dowels be installed ahead of placing the concrete and that they be securely staked and tied if necessary to hold them in their exact position. The use of removable devices, supporting the bars from the forms, will not be permitted.

6.6.4 Placing Concrete

a) General

The concrete shall be deposited on the base course in successive batches for the full width between forms and in a manner which will require as little re-handling as possible. Spreading shall be done by an approved mechanical spreader in a manner that will prevent segregation and separation of the materials. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances. The amount of material deposited shall be sufficiently in excess of that required to form the pavement to the required cross section after consolidation in order to provide a roll of concrete ahead of the front screed of the finishing machine for the full length of the screed.

When concrete is placed adjoining a previously constructed lane of pavement and when mechanical equipment will be operated upon the existing lane of pavement, the concrete shall be at least 7 days old and at a flexural strength approved by the Engineer. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 3 days, if approved by the Engineer.

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Concrete shall be thoroughly consolidated against and along the full length and on both sides of all expansion joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly. Damage to joint assemblies caused by dumped concrete shall be repaired immediately, as directed by the Engineer, at the Contractor's expense.

Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by methods approved by the Engineer.

Placement of concrete ahead of the initial spreader strike- off shall not be more than fifteen (15) minutes ahead of final spreader strike-off. If concrete is placed in one (1) layer only, the placement of concrete shall not be more than twenty (20) minutes ahead of the spreader strike-off.

b) Works in extreme weather

Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 4°C and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 2°C. When concreting is authorized during cold weather, the Engineer may require the aggregates to be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials. Unless otherwise authorized, the temperature of the mixed concrete shall not be less than 10°C at the time of placement in the forms.

If the air temperature is 2°C or less at the time of placing concrete, the Engineer may require the water and/or the aggregate to be heated to not less than 21°C nor more than 66°C. Concrete shall not be placed on frozen sub-grade nor shall frozen aggregates be used in the concrete.

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During periods of warm weather when the maximum daily air temperature exceeds 30°C, the following precautions should be

taken. The forms and/or the underlying material shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 32°C. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

6.6.5 Joints

a) General

Joints shall be constructed exactly in accordance with the details shown on the plans and the Specifications and with the best of workmanship.

b) Expansion Joints

Expansion joints shall be of the type and dimensions and of the spacing shown on the plans. Joint filler shall be of premolded compressible material according to ASTM D1751 or ASTM D1752, and joint sealant material shall be according to ASTM D1190.

The entire joint assembly shall be of a type designated on the plans and shall be installed in such a position that the centerline of the joint assembly is perpendicular to the centerline of the pavement slab and the dowels lie parallel to the centerline of the slab. Finished joints shall not deviate more than six (6) millimeters in the horizontal alignment from a straight line. No plugs of concrete shall be permitted anywhere within the expansion space.

One-half of the length of each dowel bar shall be painted, and then thoroughly coated with hard grease, or lubricant as approved by the Engineer, to prevent the concrete from bonding to that portion of the dowel.

An expansion cap of the dimensions shown on the plans shall be placed on the greased end of each dowel. The greased ends shall be free to slide in the dowel holder and shall extend in the direction as indicated on the plans. Any excess grease on the dowel holder shall be removed.

The joint shall be securely staked or fastened in place prior to placing the concrete and in a manner to ensure that the joint and the dowel bars will remain in their proper position after the concreting and finishing operations are completed.

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The finishing machine shall be operated in a manner that will prevent displacement of the joint. If for any reason it is

necessary to straighten a joint, any depressions caused by this operation shall immediately be filled with fresh concrete, re-spaded and brought to the original crown in advance of the longitudinal finishers. Any fluid laitance or mortar caused by this operation shall be removed and replaced with fresh concrete.

As the finishing machine approaches the joint on the first trip, the excess concrete shall be shoveled ahead and the tamper and each screed, in turn, shall be lifted over the joint. On the second trip of the finishing machine, the screed may be operated over the joint.

c) Contraction Joints

Contraction joints shall be of the type and dimensions and at the spacing shown on the plans.

Sawed contraction joints shall be cut by means of an approved concrete saw. The joints shall not be sawed until the concrete has hardened to the extent that tearing and raveling is precluded.

All joints shall be sawed during the initial curing period and the sawing shall begin before the pavement starts shrinking and before uncontrolled cracking takes place.

Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or the removal of the curing media and the cutting of the joints. In no case shall the pavement be left overnight without having the joints sawed.

The joints shall be sawed at the depth, spacing, and lines shown on the plans. Guidelines or devices approved by the Engineer shall be provided to ensure cutting the joint in a straight line and perpendicular to the centerline of the pavement.

The dust resulting from sawing shall be completely removed from the joint and adjacent areas by means of an air jet or a combination of air and water applied under pressure immediately after the joint has been cut, and before filling with joint sealant.

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When the plans specify that dowels be installed through contraction joints, the base course at the contraction joints shall be accurately trimmed to the required cross section and to the proper depth of the pavement.

A string line shall be stretched between the pavement forms along the centerline of the joint.

Each dowel shall be painted and thoroughly coated with hard grease, or lubricant, in accordance with the directions shown on the plans or as approved by the Engineer, to prevent the concrete from bonding to that portion of the dowel.

The entire joint assembly shall be an approved type and shall be installed in such a position that the centerline of the joint assembly is perpendicular to the centerline of the pavement and the dowels lie parallel to the pavement surface parallel to the centerline of the pavement.

The greased ends of the dowels shall be placed in the direction as indicated on the plans and shall be free to slide in the dowel holder. Any excess hard grease on the dowel holder shall be removed.

d) Construction Joints

A butt construction joint shall be made perpendicular to the centerline of the pavement at the close of each day's work and also when the process of depositing concrete is stopped for a length of time such that, in the opinion of the Engineer, the concrete will have taken its initial set. This joint shall be formed by using a clean plank header having a nominal thickness of fifty (50) millimeters, a width of not less than the thickness of the pavement and a length of not less than the width of the pavement. The header shall be cut true to the cross-section of the finished pavement and shall be accurately set and held in place in a plane at right angles to centerline and perpendicular to the surface of the pavement.

The top surface of the header shall be protected with steel as approved by the Engineer. On the face along the center of the header there shall be fastened a trapezoidal piece of metal or wood the full length of the header. Seventy millimeters wide and at least forty millimeters in depth as per drawing to form a grooved joint. The header shall have drilled holes to accommodate the dowel or tie bars hereinafter specified. Upon resumption of work any surplus concrete remaining upon the base course shall be removed. The header shall then be carefully removed and fresh concrete deposited against the old in such a manner as to avoid injury to the edge of the old concrete. The fresh concrete shall be vibrated into the groove in a manner to ensure an interlocking joint.

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Dowel bars or load transfer devices shall be used in all construction joints in accordance with the details shown on the plans. The edges of the joint shall be grooved, edged, and

sealed with the material used for sealing expansion and contraction joints.

No construction joint shall be placed within three (3) metres of an expansion, contraction, or other construction joint.

6.6.6 Consolidating and Finishing for Concrete Pavement

a) Sequence: The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight edging, and final surface finish. The addition of superficial water to the surface of the concrete to assist in finishing operations generally will not be permitted. If the application of water to the surface is permitted by the Engineer, it shall be applied as a fog spray by means of approved spray equipment.

b) Finishing at Joints: The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material; it shall be firmly placed without voids or segregation under and around all load-transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in sub-section 6.4.4. After the concrete has been placed and vibrated adjacent to the joints, the finishing machine shall be operated in a manner to avoid damage or misalignment of joints. If uninterrupted operations of the finishing machine, to over and beyond the joints, cause segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the screed is approximately 20cm from the joint. Segregated concrete shall be removed from the front of and off the joint; the screed shall be lifted and set directly on top of the joint, and the forward motion of the finishing machine shall be resumed. Thereafter, the finishing machine may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

c) Machine Finishing: The concrete shall be spread as soon as it is placed, and it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area as many times and at such intervals as necessary to give the proper consolidation and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. When side forms are used, the tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish. During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. When in operation, the screed shall be moved forward with a combined

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longitudinal and transverse shearing motion, always moving in the direction in which the work is progressing, and so manipulated that neither end is raised from the side forms during the striking-off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

d) Hand Finishing: Hand finishing methods will not be permitted, except under the following conditions. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade; in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete when reinforcement is used.

The screed for the surface shall be at least 0.6m longer than the maximum width of the pavement to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal or of other suitable material covered with metal. Consolidation shall be attained by the use of a suitable vibrator.

e) Floating: After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, using one of the following methods:

1. Hand Method: The hand-operated longitudinal float shall not be less than 3.6 m in length and 15 cm in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete shall be worked with a sawing motion, while held in a floating position parallel to the pavement centerline and passing gradually from one side of the pavement to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the pavement edge on each pass.

2. Mechanical Method: The Contractor may use a machine composed of a cutting and smoothing float(s), suspended from an guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with, the side forms or pavement subgrade. If necessary, long-handled floats having blades not less than 1.5 m in length and 1.5 cm in width may be used to smooth and fill in open textured areas in the pavement.

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Long-handled floats shall not be used to float the entire surface of the pavement in lieu of mechanical methods. When strike-off and consolidation are done by hand and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of a long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating any excess water and laitance shall be removed from the surface of the pavement by a straightedge 3m or more in length. Success drags shall be lapped one-half the length of the blade.

f) Straight-edge Testing and Surface Correction: After the pavement has been struck off and consolidated and while the concrete is still plastic, it shall be tested for trueness with a 5m straightedge. For this purpose the Contractor shall furnish and use an accurate 5m straightedge swung from handles 0.9 m longer than one-half the width of the pavement. The straight edge shall be held in contact with the surface in successive positions parallel to the centerline of the pavement and the whole area gone over from one side of the pavement to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straight edge. Any excess water and laitance shall be removed from the surface of the pavement. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straight edge and until the slab conforms to the required grade and cross section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

6.6.7 Surface Texture

The surface of the pavement shall be finished with broom finish for all newly constructed concrete pavements.

Brush or Broom Finish: If the pavement surface texture is to be a type of brush or broom finish, it shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface, providing corrugations that are uniform in appearance and approximately 2mm in depth. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. Any imperfections resulting from the texturing operation shall be corrected.

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6.6.8 Skid Resistant Surfaces

In addition to broom and brush finish in the plastic concrete pavement skid resistant surfaces comprising saw-cut grooves, plastic grooves or

wire combing shall be provided as specified below and as directed by the Engineer.

a) Sawcut Grooves: For new concrete pavements that have hardened, transverse grooves shall be saw-cut in the pavement forming a 6mm by 6mm by 31mm configuration. The grooves shall be continuous for the entire runway length. They shall be saw-cut transversely in the runway pavement to within 3m of the runway pavement edge to allow adequate space for equipment operation. The maximum transverse saw-cut grooves shall not exceed 40 m. The tolerances for the saw-cut grooves shall meet the following:

Alignment tolerance.
Plus or minus 38 mm in alignment for 23 m.

Groove tolerance.
Minimum depth 5 mm.
Maximum depth 8 mm.
Minimum width 5 mm.
Maximum width 8 mm.

Center-to-center spacing.
Minimum spacing 31 mm.
Maximum spacing 50 mm.

Saw-cut grooves shall not be closer than 76mm to transverse paving joints. Grooves may be continued through longitudinal construction joints. Cleanup of waste material shall be continuous during the grooving operation. Waste material may be disposed of by either flushing with water, sweeping, or vacuuming. Waste material must not be allowed to enter the storm or sanitary sewer system.

b) Plastic grooves: The grooves formed in the plastic concrete shall be 6mm by 6 mm by 31 mm. The grooves shall be continuous for the entire runway length and width. The tolerances for the grooves formed in plastic concrete shall meet the following:

Alignment tolerance.
Plus or minus 76 mm in alignment for 23 m.

Groove tolerance.
Minimum depth 3 mm.
Maximum depth 10 mm.
Minimum width 3 mm.
Maximum width 10 mm.
Center-to-center spacing.
Minimum spacing 31 mm.
Maximum spacing 50 mm.

c) Wire Combing: The wire combing technique shall use steel combs or tines of various dimensions to form groove-like texture in the plastic concrete pavement and shall provide grooves that are approximately 3mm by 3mm spaced 13mm center-to-center.

6.6.9 Surface Test

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 5 m straight edge or other specified device. Areas in a slab showing high spots of more than 6 mm but not exceeding 13 mm in 5 m shall be marked and immediately ground down with an approved grinding machine to an elevation that will fall within the tolerance of 6 mm or less. Where the departure from correct cross section exceeds 13 mm, the pavement shall be removed and replaced at the expense of the Contractor when so directed by the Engineer.

Any area or section so removed shall not be less than 3 m in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 3 m in length shall also be removed and replaced.

6.6.10 Removing Forms

Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least twelve (12) hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as specified for the surface. Major honeycombed areas will be considered as defective work and shall be removed and replaced at the Contractor's expense, as directed by the Engineer. Any area or section so removed shall not be less than three (3) metres in length nor less than the full width of the paving lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than three (3) metres in length, shall also be removed and replaced.

6.6.11 Protecting and Curing of Concrete Pavement

a) Initial Curing

As the surface of the freshly laid pavement is progressively finished, the initial curing and protection operations shall commence.

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Upon completion of the finishing operation and while the surface of concrete is still moist, but no free water remains, a liquid curing membrane, as specified in ASTM C309 (Type 2) shall be applied to the exposed surfaces of the pavement at

the rate of not less than one (1) liter per three and two-thirds (3-2/3) square meters of surface area when mechanical pressure distributors are used. The curing membrane, except on irregular areas, shall be applied by means of approved self-propelled mechanical pressure distributors or approved hand sprays. Satisfactory means shall be provided for thoroughly mixing the curing membrane compound before and during its use.

The mechanical spraying equipment shall include a full width spray bar equipped with multiple nozzles or a traversing spray which travels from one edge of the pavement to the other. In either case the path of adjacent nozzles or passes of the traversing spray shall overlap minimum of one-half (1/2) the width of the spray pattern so that all portions of the surface shall receive double applications from adjacent nozzles or passes. The pumping, pressure, and distribution arrangement shall be correlated with the forward speed to provide adequate and uniform coverage of the pavement at not less than the minimum rate required. Irregular areas to which the mechanical distributor cannot be adapted may be covered with hand sprays.

When hand sprays are used, the curing membrane shall be applied in two(2) applications, each at a rate of not less than one (1) liter per five(5) square metres of surface area so as to provide a total rate of application of one (1) liter per two and one-half (2-1/2) square meters of surface area. The path of the spray on the second application shall be at right angles to the path of the spray on the first application. When hand operated sprays are permitted, the equipment supplying the pressure to the spray nozzle shall be capable of supplying constant and uniform pressure to provide uniform and adequate distribution of the curing membrane compound at the rates required. If from any cause, such as rainfall soon after its application, the curing membrane is damaged, the Contractor shall immediately apply another application of curing membrane to the surface of the pavement. The rate of application for the replacement membrane shall be the same as for the original membrane.

Unless otherwise directed by the Engineer, immediately following the application of the curing membrane, an approved shade structure with canvas shall be placed approximately 300 mm above the pavement surface. The shade structure with canvas shall be constructed of materials and in a manner approved by the Engineer. In no case shall any portion of the shade canvas come in contact with the pavement. The concrete pavement shall not be exposed to the direct rays of the sun for more than one (1) hour, within the first twenty-four hours. The initial curing shall be continued for a period of

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twenty four (24) hours from the time the curing membrane is applied.

When forms are removed, the edges of the pavement shall receive curing membrane at the rate of coverage specified for the pavement surface.

The curing membrane may be applied to the vertical edges of the pavement by means of hand sprays or by nozzles attached to the mechanical distributor, but the edges of the pavement shall be covered with curing membrane at the rate specified within thirty (30) minutes after removal of the forms.

When hot-poured joint compound is used, all joints shall be sawed during the initial curing period. The shade-canvas may be moved at joint locations for short periods of time to permit the sawing. Before being sealed, the joints shall be thoroughly cleaned of all loose saw dust, laitance, dirt, other foreign matter, and free of water. As the method of final curing is different from that of the initial curing, the cleaning, and sealing of joints shall be performed immediately following the removal of the shade-canvas at the end of the initial curing period and prior to the application of the polyethylene sheeting.

In no case shall any portion of the concrete pavement be exposed to the direct rays of the sun for more than one (1) hour.

b) Final Curing:

Following jointing operations, curing membrane shall be applied to the joint area at the rate specified for the pavement surface.

Upon completion of the initial curing period and after the shade canvas has been removed and jointing operation has been completed including application of curing membrane, the pavement shall be completely covered with white opaque polyethylene film as specified in AASHTO M-171. Adjoining sheets shall be lapped a minimum of four hundred and fifty (450) millimetres. The sheeting shall be held in place in a manner approved by the Engineer.

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Final curing shall be continued until the concrete reaches an age of fourteen (14) days. During this period, the curing membrane and polyethylene film shall be protected from damage from any cause. Any damage from any cause shall be immediately repaired by the Contractor at his expense. No traffic, including workmen shall be allowed on the surface of the pavement until the expiration of the fourteen (14) day curing period, or as directed by the Engineer.

6.6.12 Sealing Joints

a) Materials

Joint sealant shall be hot-poured elastic type compound, fuel-resistant complying with ASTM D3569 for airfield pavements and ASTM D3406 for other pavements.

b) Execution

After the fourteen (14) day curing period for the pavement has elapsed, the jute or other protective covering shall be removed from the joint and the joint thoroughly cleaned of all loose scale, saw dust, dirt, laitance or other matter.

Cleaning may be accomplished with a compressed air jet, air and water under pressure, wire brushes or in extreme cases the joint shall, when directed by the Engineer, be resawed to ensure a completely clean joint. The joint surfaces and adjacent areas of the slab shall be thoroughly clean.

The hot-poured joint material shall be heated in a approved heating unit to the temperature within the range required as shown by tests. The joint shall be filled from the bottom of the saw cut to the surface of the pavement. Any joint with a depth greater than twenty-five (25) millimeters shall be filled with a minimum of two (2) layers, each layer being approximately equal in depth. The material shall be poured within the required temperature in the workman like manner neatly so that it should not spread on the sides of the joint and is evenly placed.

6.6.13 Protection of Pavement

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc. The Contractor's plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense. In order that the concrete be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all time materials for the protection of the edges and surfaces of the unhardened concrete. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears

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imminent, all paving operations shall stop and all available personnel shall begin cover the surface of the unhardened concrete with the protective covering.

6.6.14 Opening to Traffic

The Engineer shall decide when the pavement shall be opened to traffic. The pavement will not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 550 pounds per square inch (3.792 MPa) when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening to traffic, the pavement shall be cleaned.

6.6.15 Surface Tolerances

Extreme care must be exercised in all phases of the operation to assure the pavement will pass the specified tolerances. The following tolerances are applicable:

a) Lateral deviation from established alignment of the pavement edge shall not exceed plus or minus 30 mm in any lane.

b) Vertical deviation from established grade shall not exceed plus or minus 12mm at any point.

c) Surface smoothness deviations shall not exceed 6 mm from a 5m straight edge placed in any direction, including placement along and spanning any pavement joint or edge.

6.6.16 Tolerance in Pavement Thickness

Areas found deficient in thickness by more than 1.0 inch (25 mm) shall be evaluated by the Engineer and, if the deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans.

6.7 Embedded Items

6.7.1 Suitable templates or instructions or both shall be provided for setting out items not placed in the forms. Embedded items and other materials for electrical, mechanical or other operations shall have been completed, inspected tested and approved before concrete is placed.

Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective water-tightness fully equal to that of the continuous waterstop material, shall permanently develop mechanical strength not less than that of the parent section, and shall permanently retain their flexibility.

6.7.2 Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than four percent of the area of the cross section of a column on which stress is calculated or which is required for fire protection. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall be of such size or in such location as not to impair unduly the strength of the construction; such sleeves, conduits, or pipes may be considered as replacing structurally in compression the displaced concrete, provided that they are not exposed to rusting or other deterioration, are of uncoated or galvanized iron or steel not thinner than standard steel pipe, have a nominal inside diameter not over 50mm and are spaced not less than three diameters on centres. Except when plans of conduits and pipes are approved by the Engineer, embedded pipes and conduits other than those merely passing through, shall not be larger in outside diameter than one third the thickness of the slab, wall, or beams in which they are embedded nor so located as to impair unduly the strength of the construction. Sleeve pipes, or conduits of any material not harmful to concrete and within the limitations of this section may be embedded in concrete with the approval of the Engineer provided they are not considered to replace the displaced concrete.

6.7.3 All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

6.7.4 Expansion joint material, waterstops and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with approved readily removable material to prevent the entry of concrete into the voids.

6.7.5 Non Shrink Grout

Grout of placement under base and bearing plates of steel, machinery and equipment, for grouting anchor bars and dowels and for similar uses shall be as specified. The grout shall be used in accordance with the following and as per manufacturer's recommendations, and as directed by the Engineer.

Concrete surfaces to receive non-shrink grout shall be roughened, cleaned and dampened. Form shall be provided to retain the grout until sufficiently hard to support itself. Grout shall be poured in place and thoroughly rodded or strapped to prevent air entrapment and formation of voids. After non-shrink grout has received its initial set, it shall be kept damp for at least 24 hours.

TABLE I: Gradation of Concrete Aggregates

Percentage by Weight Passing
Coarse Fine

Particle Size Square Openings (Equivalent U.S. Sieve Designation)	19 mm to 5 mm	25 mm to 5 mm	37.5 mm to 19 mm	50 m to (Sand) 25 mm
	¾"-No.4	1"-No.4	1½ "-3/4"	2"-1"
63.0 mm (2 1/2 in.)	-	-	-	100
50.0 mm (2 in.)	-	-	100	95-100
37.5 mm (1 1/2 in.)	-	100	90 - 100	35 – 70
25.0 mm (1 in.)	100	94 - 100	20 - 55	0 - 15
09.0 mm (3/4 in.)	090 –100	-	0 - 15	-
12.5 mm (1/2 in.)	-	25 - 60	-	0 - 5
09.5 mm (3/8 in.)	20 - 55	-	0 - 5	100
05.0 mm (No.4)	0 - 10	0 - 10	-	95 - 100
02.36 mm (No. 8)	0 - 5	0 - 5	-	-
1.18 mm (No. 16)	-	-	-	45 - 80
0.60 mm (No. 30)	-	-	-	25 – 55
0.30 mm (No. 50)	-	-	-	10 - 30
0.15 mm (No. 100)	-	-	-	02 - 10

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TABLE II: Gradation of Combined Course and Fine Aggregates for Concrete

Particle Size Square Openings (Equivalent U.S. Sieve Designation)	Percentage by Weight Passing Sieves Maximum Aggregate Size 50mm	37.5mm	25mm	19mm	9.5mm
63.00 mm (2 1/2 in.)	100	-	-	-	-
50.00 mm (2 in.)	90 - 100	100	-	-	-
37.05 mm (1 1/2 in.)	70 – 90	90-100	100	-	-
25.00 mm (1 in.)	50 - 75	50 - 86	90 - 100	100	-
19.00 mm (3/4 in.)	45 - 70	45 - 75	55 - 100	90 -100	-
12.05 mm (1/2 in.)	-	-	-	-	100
09.05 mm (3/8 in.)	38 - 55	38 - 55	45 - 75	60 - 80	90 - 100
05.00 mm (No. 4)	30 - 45	30 - 45	35 - 60	40 - 60	50 - 85
02.36 mm (No. 8)	22 - 35	23 - 38	27 - 45	30 - 45	37 - 52
01.18 mm (No. 16)	15 - 27	17 - 33	20 - 35	20 - 35	25 - 40
00.60 mm (No. 30)	10 - 18	10 - 22	12 - 25	13 - 23	15 - 25
00.30 mm (No. 50)	4 - 10	4 - 10	5 - 15	5 – 15	5 - 15
00.15 mm (No. 100)	1 - 3	1 - 3	1 - 5	1 - 5	1 - 5
0.075 mm (No. 200)	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2

TABLE III: Quality Tests for Aggregates

Material	Test	Requirement	Test Designation
Coarse	Abrasion	Loss 40% max.	ASTM C 131
Coarse	Absorption	2.0% max.	ASTM C 127
Coarse	Clay Lumps	1.0% max.	ASTM C 142
Coarse	Surface Coating	0.5% max.	ASTM C 117
Coarse and Fine	Soundness	Loss 10% max.	ASTM C 88
Coarse and Fine	Sieve	As specified	ASTM C 136
Fine	Absorption	4.0% max.	ASTM C 128
Coarse	Cleanness	75% min.	CALIF 227
Fine	Sand equivalent	70% min.	CALIF 217

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6.8 Concrete for Structures

6.8.1 Placing

6.8.1.1 Before placing of concrete, formwork shall have been completed; water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors and other embedded items shall have been kept in position; and the entire preparation shall have been approved.

No concrete shall be placed into the foundation pits and trenches until the ground to receive the same has been examined and approved by the Engineer for this purpose.

6.8.1.2 Concrete shall be deposited continuously, or in layer of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the Contract Documents or as approved by the Engineer. Placing shall be carried out at such a rate that the concrete, which is being integrated with fresh concrete, is still plastic. Concrete, which has partially hardened, shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

6.8.1.3 The actual sequence of construction proposed by the Contractor shall be subject to the Engineer's approval before construction starts on any part of the structure, and this sequence shall not be varied without the Engineer's approval.

6.8.1.4 The concrete shall be placed as soon after it has been mixed as is practicable. Once the concrete has left in the mixer, no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means available.

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The time between mixing and placing should be reduced if the mix is richer or the initial workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere.

The Contractor shall ensure that the delay between mixing and placing does not exceed 45 minutes under any circumstances. Any concrete, which does not satisfy this requirement shall be discarded.

6.8.1.5 Concrete shall be deposited as nearly as possible in its final position to avoid re-handling. In no circumstances may concrete be railed or

made to flow along the forms by the use of vibrators. Concreting shall be carried on as a continuous operation using methods, which shall prevent segregation or loss of ingredients.

6.8.1.6 The free fall of concrete shall not be allowed to exceed two metre and where it is necessary for the concrete to be placed more than this depth, it shall not be dropped into its final position, but shall be placed through pipes fed by a hopper. When a pipe is used for placing concrete the lower end shall be kept inside, or close to the freshly deposited concrete. The diameter of the pipe shall be not less than 225 mm.

6.8.1.7 Workmen carrying concrete to the site, and all other workmen, shall move only along runways or planks placed for the purpose and no person shall be allowed to walk on the reinforcement.

6.8.2 Consolidation

6.8.2.1 All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Only competent workmen shall operate vibrators. Use of vibrators to transport within forms shall not be allowed.

Vibrators shall be inserted and withdrawn at points approximately 450 mm apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not excessive so as to cause segregation, generally from 5 to 15 sec. A spare Vibrator shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented, if necessary, by spading to work the course aggregate back from the formed surface.

6.8.2.2 If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to effect an improvement in the quality of the concrete to the satisfaction of the Engineer and in conformity with the provisions of Clause 5.

6.8.2.3 Vibrator shall not be allowed to contact the formwork for exposed concrete surfaces.

6.8.2.4 Mechanical vibrators shall be of a type approved by the Engineer to suit particular conditions.

6.8.2.5 Over-vibration or vibration of very wet mixes shall be avoided.

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6.8.3 Curing and Protection

6.8.3.1 Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury, and shall be maintained with minimum moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of the Engineer.

6.8.3.2 For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing, as approved by the Engineer.

- Ponding or continuous sprinkling.
- Application of absorptive mats or fabric kept continuously wet.
- Application of waterproof sheet materials approved by the Engineer.
- Application of other moisture-retaining covering as approved.
- Application of a curing compound conforming to ASTM C309.

The compound shall be applied in accordance with the recommendations of the manufacturer. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.

6.8.3.3 Moisture loss from surface placed against wooden forms or metal forms, and exposed to heating by the sun, shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the time prescribed as follows by one of the methods specified above.

6.8.3.4 Curing in accordance with sub-clauses above shall be continued for at least 10 days in the case of all concrete except concrete with rapid-hardening Portland Cement, for which the period shall be at least 3 days. Alternatively, if tests are made of cubes kept adjacent to the structure and cured by the same methods and to the same intensity, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the minimum specified works cube strength. If one of the first four curing procedures specified above is used initially, it may be replaced by one of the other specified procedures any time after the concrete is one day old provided the concrete is not permitted to become surface dry during the transition.

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6.8.3.5When the mean daily outdoor temperature is less than 5°C (41°F), temperature of the concrete shall be maintained between 10°C to 20°C (50°F-68°F) for the required curing period specified above.

When necessary, arrangements for heating, covering insulation or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature with measures to avoid concentration of heat. Combustion heaters shall not be used during the first 24 hours, unless precautions are taken to prevent exposure of the concrete to exhaust gasses, which contain carbon dioxide.

6.8.3.6When necessary, provision for wind-breaks, shading, spraying, sprinkling, ponding or wet covering with a light coloured material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operation will allow.

6.8.3.7Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 3°C (37.4°F) in any one hour or 10°C (30°F) in any 24 hour period.

6.8.3.8Concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibrations, during the curing period. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

6.8.4 Works in Extreme Weather

6.8.4.1Unless adequate protection is provided, and approval is obtained, concrete shall not be placed during rain.

Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.

6.8.4.2When the temperature of the surrounding air is expected to be below 5°C (41°F) during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 13°C (55.4°F) for sections less than 300 mm in any dimensions nor 10°C (50°F) for any other sections.

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When necessary, concrete material should be heated before mixing and carefully protected after placing. In general, heating of mixing water alone to about 60°C (140°F) may be sufficient for this purpose. Calcium chloride up to a maximum of 1-1/2 percent of the weight of cement may be used to accelerate the rate of hardening only with prior written permission of the Engineer. Use of calcium chloride in excess of 1-1/2 percent is harmful. No frozen material or concrete

damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 25 litres per bag of cement.

If water or aggregate is heated above 38°C (100°F), the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38°C (100°F).

6.8.4.3 During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 32°C (90°F). For mass concreting, this temperature should not exceed 21°C (70°F). When the temperature of the concrete exceeds 32°C (90°F), precautionary measures approved by the Engineer shall be put into effect. When the temperature of the steel is greater than 50°C (122°F), steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or ice flakes, or well crushed ice may be substituted for all part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.

Other precautions recommended by ACI Standard 305 shall also be adopted.

6.8.5 Construction Joints

6.8.5.1 Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be approved by the Engineer.

6.8.5.2 Joints not shown on the drawings shall be so made and located as to least impair the strength of the structures and shall need prior approval of the Engineer. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floor slabs or beams, and at the top of footings or floor slabs. Beams, brackets, column capitals, haunches and drop panels shall be placed at the same time as slabs. Joints shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

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6.8.5.3 Reinforcing steel shall continue across the joints. Key and inclined dowels shall be provided as, and where directed by Engineer. Longitudinal keys at least 40mm (1-1/2") deep shall be provided in all joints in walls and between walls and slabs or footings.

6.8.5.4 When the work has to be resumed on a surface which has hardened, such surface shall be roughened in an approved manner which will

expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

6.8.5.5 The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in un-exposed walls and all others not mentioned herein shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

6.8.5.6 The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs; and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout similar in proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 12 mm thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained initial set.

6.8.5.7 When the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle, and brushed, care being taken to avoid dislodgement of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work, particular attention being paid to corners and closed spots.

6.8.5.8 Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement passing through them, so that each portion can be positioned and removed separately without disturbance or shock to the reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of the Engineer. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement. Wood strips inserted for architectural treatment shall be kerfed to permit swelling without pressure on the concrete.

6.8.7 Expansion Joints

Expansion joints shall be provided wherever indicated on the Drawings or as directed by the Engineer. In no case shall the reinforcement, or other embedded items be run continuous or through an expansion joint. All expansion joints shall be carefully placed so as not to be displaced during concreting. The method of placing the expansion joints shall be strictly in accordance with the Drawings and/or as directed by the Engineer. All materials for use in the expansion joints shall have, prior approval of the Engineer before placing order for supply.

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6.8.8 Embedded Items

6.8.8.1 Sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

6.8.8.2 All embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with approved readily removable material to prevent the entry of concrete into the voids.

7 FINISHING OF FORMED SURFACES

7.1 General

7.1.1 After removal of forms, the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Contract Documents.

7.1.2 When finishing is required to match a small sample furnished to the Contractor, the sample finish shall be reproduced on an area at least 10 square metres (100 Sq.ft.) in an inconspicuous location Designated by the Engineer before proceeding with the finish in the specified location.

7.1.3 Allowable deviations from plumb or level and from the alignment, profile grades, and dimensions are specified in Clause 9. Tolerances for concrete construction defined as 'tolerances', are to be distinguished from irregularities in finish as described herein. The finish requirements for concrete surfaces shall be as generally specified in this clause and as indicated on the Drawings. Finishing of concrete surfaces shall be performed only by workmen who are skilled in concrete finishes. The Contractor shall keep the Engineer informed as to when finishing of concrete will be performed. Unless inspection is waived in each specific case, finishing of concrete shall be performed only in the presence of the Engineer. Concrete surfaces will be tested by the Engineer where necessary to determine whether surface irregularities are within the limits herein after specified.

Surface irregularities are classified as abrupt or gradual. Offsets caused by displaced or misplaced form sheathing or lining or sections, or otherwise defective form lumber will be considered as abrupt irregularities, and will be tested by direct measurements. All other irregularities will be considered as gradual irregularities, and will be tested by use of a template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template will be 2 meters (6 ft.) for testing of formed surfaces and 3 meters (10 feet) for testing of unformed surfaces.

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7.2 As-cast Finishes

Unless otherwise specified or indicated on the Drawings the classes of finish shall apply as follows:

7.2.1 Rough form finish:

No selected form facing materials shall be specified for rough form finish surfaces. The holes and defects shall be patched. Fins exceeding 5 mm (1/4") in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

7.2.2 Fair face finish:

Fair face finish applies to concrete formed surfaces, the appearance of which is considered by the Engineer to be of special importance, such as surfaces of structures prominently exposed to public view. Location of surfaces of concrete structures requiring fair face finish are shown in the Drawings. Surface irregularities, measured as described in sub-clause 7.2.1, 'Rough form finish', shall not exceed 5 mm (1/4") for gradual irregularities and 2.5 mm (1/8") for abrupt irregularities, except that abrupt irregularities will not be permitted at construction joints. Abrupt irregularities at construction joints and elsewhere in excess of 2.5 mm (1/8") and gradual irregularities in excess of 5 mm (1/4") shall be reduced by grinding so as to conform to the specified limits. Abrupt irregularities at construction joints shall be ground on 1 to 20 ratio of height to length.

Unless otherwise approved, repair of imperfections in formed concrete shall be completed within 24 hours after removal of forms. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, hardboard, metal, plastic paper, or other approved material capable of producing the desired fair face finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edge, patches, dents, or other defects, which will impair the texture of the concrete surface shall not be used. The holes and defects shall be patched. All fins shall be completely removed.

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8 REPAIR OF DEFECTS

8.1 General

8.1.1 Any concrete failing to meet the specified strength or not formed as shown on drawings, concrete out of alignment, concrete with surfaces beyond required tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of the Engineer shall be removed at Contractor's cost.

The Engineer may reject any defective concrete and order it to be cut out in part or in whole and replace at the Contractor's expense.

8.1.2 All ties, bolt holes, and all repairable defective areas shall be patched immediately after form removal.

8.2 Repair of Defective Areas

8.2.1 Defective and honeycombed concrete shall be removed down to sound concrete. The area to be patched and an area at least 150 mm (6") wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1-part cement to 1-part fine sand passing No.25 BS Sieve and shall then be well brushed into the surface.

8.2.2 The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not less than 1 part cement to 2-1/2 parts sand by weight. White Portland cement shall be substituted for a part of the gray Portland cement on exposed concrete in order to produce a colour matching the color of the surrounding concrete, as determined by a trial patch.

8.2.3 The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

8.2.4 After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to loose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface to permit initial shrinkage; it shall be left undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for at least 7days. Metal tools shall not be used in finishing a patch in a formed wall, which will be exposed.

8.2.5 Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as-cast surfaces shall not exceed 0.2 square metre in each 100 square metres of as-cast surface. This is in addition to form tie patches, if the project design permits ties to fall within as-cast areas.

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8.2.6 Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determined by trail to obtain a good colour match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

8.2.7 Patches in architectural concrete surfaces shall be cured for at least 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

8.3 **Tie and Bolt Holes**

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar. If architectural appearance requires, these holes may be filled partially creating the desired round clear holes pattern on surfaces exposed to view.

8.4 **Proprietary Materials**

If permitted or required by the Engineer, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations with prior approval of the Engineer.

9 CONCRETE CONSTRUCTION TOLERANCES

All tolerances shall be as per ACI 317.

Where tolerances are not stated in the specifications or drawings for any individual structure or feature thereof, maximum permissible deviations from established lines, grades, and dimensions shall conform to the following. The Contractor is expected to set and maintain concrete forms so as to ensure complete work within tolerance limits. These allowable tolerances shall not relieve the Contractor of his responsibility for correct fitting of indicated materials and components. These tolerances are not cumulative.

9.1 Variation from the plumb (or the specified batter for inclined walls). (allowable variation)

9.1.1 In the lines and surfaces of columns and walls, and in arises

In any 3 metres (10') of length or height	6 mm (1/4")
Maximum for the entire length or height	25 mm (1")

9.1.2 For exposed corner columns, control joint grooves and other conspicuous lines

In any bay or 6 metres (20') maximum	6 mm (1/4")
Maximum for the entire length or height	13 mm (1/2")

9.2 Variation from the level or from the grades indicated on the drawings.

In beam soffits, and in arises measured before removal of supporting shores.

In any 3 metres (10') of length	6 mm (1/4")
In any bay or in any 6 metres (20') maximum	10 mm (3/8")
Maximum for the entire length	19 mm (3/4")

9.3 Variation of the linear structure lines from established position in plan and related position of columns and walls.

In any bay or 6 metres (10')	± 13 mm (± ½")
Maximum for the entire length	± 25 mm (± 1")

9.4 Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls.

Up to 12" (300mm)	- 6 mm (-1/4") +10 mm (+3/8")
More than 12" (300mm)	- 10 mm (-3/8") +13 mm (+1/2")

9.5 **Footings**

9.5.1 Variation in dimensions in plan - 13mm (-1/2")

Plus (plus variation applied to concrete only, not to the reinforcing bars or dowels). (formed) + 50mm (+2")

9.5.2 Misplacement or eccentricity

2 percent of the footing width in the direction of misplacement but not more than (applies to concrete only, not to reinforcing bars or dowels). + 50mm (+2")

9.5.3 Reduction in thickness

Minus 5 percent of specified thickness - 5%

10.0 ACCEPTANCE OF STRUCTURE

10.1 General

10.1.1 Completed concrete work, which meets all applicable requirements will be accepted subject to the other terms of the Contract Documents.

10.1.2 Completed concrete work, which fails to meet one or more of the requirements and which has been repaired to bring it into compliance will be accepted subject to the other terms of the Contract Documents.

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10.1.3 Completed concrete work, which fails to meet one or more of the requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that remaining work complies with the requirements.

10.2 Dimensional Tolerances

10.2.1 Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of clause 9 shall be considered potentially deficient in strength and subject to the provisions of sub clause 10.4.

10.2.2 Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of clause 9 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this clause.

10.2.3 Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected as decided by the Engineer or if misplaced items interfere with other construction.

10.2.4 Inaccurately formed concrete surfaces exceeding the limits of Clause 9 or of Clause 5.5 of Section 'Formwork' shall be removed and replaced, and those that are exposed to view, may be rejected, or shall be repaired, or removed and replaced, as directed by the Engineer.

10.3 Appearance

10.3.1 Architectural concrete with surface defects exceeding the limitations described in relevant Clauses of this section shall be removed and replaced.

10.3.2 Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.

10.3.3 Concrete not exposed to view is not subject to rejection for reason of defective appearance.

10.4 Strength of Structure

10.4.1 Strength of the structure in place will be considered potentially deficient if it fails to comply with any requirement which is relevant to the strength of the structure, including but not necessarily limited to the following conditions:

- Concrete strength requirements not considered to be satisfied in accordance with Clause 6 hereof.
- Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements as specified under section 'Reinforcement' in the Contract Documents.
- Concrete, which differs from the required dimensions or location in such a manner as to reduce the strength.
- Curing less than that specified.
- Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
- Mechanical injury, construction fires, premature removal of formwork, likely to result in deficient strength.
- Poor workmanship likely to result in deficient strength.

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10.4.2 Structural computations and/or additional testing may be required when the strength of the structure is considered potentially deficient.

10.4.3 Core tests may be required when the strength of the concrete in place is considered deficient.

10.4.4 If core tests are inconclusive or impractical to obtain or if structural computations do not confirm the safety of the structure, load tests may be required and their results evaluated, in accordance with ACI Standard 318.

10.4.5 Concrete work judged inadequate by structural computations or by results of a load test shall be reinforced with additional construction, if so directed by the Engineer or shall be replaced, at the Contractor's expense.

10.4.6 The Contractor shall bear all costs incurred in providing the additional testing and/or computations required by this section.

11.0 MEASUREMENT AND PAYMENT

11.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

11.1.1 All types of formwork.

11.1.2 All types of expansion, construction and contraction joints including joint fillers, sealant, caps & grease.

11.1.3 All sampling, mixing and testing as specified.

11.1.4 Concrete mix design.

11.1.5 Vapour barrier.

11.1.6 Impervious sheeting, burlap covering, liquid membranes compound, additives, non-shrink grout, epoxy resins and water stops.

11.1.7 Anchor bolts and other embedded parts.

11.1.8 All submittals including shop drawings, co-ordination drawings etc.

11.1.9 Repair and replacement of defective work.

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11.1.10 Surface texture, skid resistant surfaces & surface test.

11.1.11 Curing, cement sand mortar 1:4 for jointing of pre-cast Jali

11.1.12 Installation / fixing in position of all precast / prefabricated concrete elements, as shown on drawings.

11.1.13 Tie bars, dowel bars, dowel bar sleeves and welded wire mesh.

11.1.14 Providing and laying Duracrete fiber or equivalent as specified.

11.2 Plain and Reinforced Concrete

11.2.1 Measurement

Measurement of acceptably completed works of plain and reinforced concrete will be made on the basis of number of cubic meter/feet of concrete actually provided, placed, consolidated, finished, cured in position, complete as shown on drawings or as directed by the Engineer.

11.2.2 Payment

Payment will be made for acceptable measured quantity of plain and reinforced concrete on the basis of unit rate per cubic meter/feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

11.5 Pre-Cast Concrete Jali

11.5.1 Measurement

Measurement of acceptably completed works of Pre-Cast Concrete Jali will be made on the basis of actual area in square meter/foot of Jali provided and placed in position as shown on drawings or as directed by the Engineer.

11.5.2 Payment

Payment will be made for the acceptable measured quantity of Pre-Cast Concrete Jali on the basis of unit rate per square meter/foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

11.6 Swell bar/Water Stopper

11.6.1 Measurement

Measurement of acceptably completed works of Swell bar/Water Stopper will be made on the basis of actual length in running meter/foot of water stopper provided and placed in position as shown on drawings or as directed by the Engineer.

11.6.2 Payment

Payment will be made for the acceptable measured quantity of Water Swell bar/Stopper on the basis of unit rate per running meter/foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 2300***

SECTION - 3010

STAINLESS STEEL MATERIAL & FINISHES

1.0 SCOPE

The requirement of this section is to apply to all stainless steel work which forms a part of the basic design and finish of the project. Certain major items are specified under other sections of these Specifications, in which case applicable portions of this section are included by reference.

Applicable portions of other sections of these Specifications are hereby included by reference to establish minimum quality standards and shall become a part of this section as if written out in full herein.

The work covered by this section of Specifications, consists of supply of all material, labour, plant, equipment and appliances including welding, bolts, nuts, washers, anchor bolts, embedded parts etc, fabrication and erection in accordance with the specifications and as per drawings and as directed by the Engineer.

2.0 TECHNICAL REQUIREMENTS

A. General

a) Provide units composed of brake formed shapes with visible portions of profile matching detail indicated on the drawings, and free from additional slots, grooves, fins or other.

b) Fabricate and assemble all work in the shop wherever possible and otherwise pre-fit as required to reduce field fabrication to a minimum.

B. Design

Design anchors to allow for horizontal and vertical expansion. Screws, nuts, washers, bolts and reinforcement shall be aluminum, and of adequate strength for the proposed use.

C. Appearance

a) Fit member neatly and to hairline accuracy with profile extending into joints without additional trim. Match flush joints to form perfectly smooth plane; match offset joints to hairline butt fit to flat surface beyond point of tangency of corner radius. Units using extra trim to conceal misalignment will not be acceptable.

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b) Make all connections by means of concealed fasteners; exposed fasteners will be permitted where essential. Use countersunk flat head machine screws for exposed fasteners as approved by the Engineer.

c) Where additional strength of section is required to meet structural requirements, provide additional wall thickness or stiffeners inside the extrusion. Width of face (sight line) dimensions indicated on the drawings are maximum permissible exposed surfaces.

d) Manufacturer's standard sections will be acceptable only when such extrusions are substantially in accordance with the profiles indicated on the drawings as accepted by the Supervising Engineer.

D. Packaging for Shipment

Crates and wrapping as required. Material is accepted or rejected based on conditions as delivered to the job-site prior approvals notwithstanding.

3.0 SUBMITTALS

A. Samples

Submit the following samples of materials and assemblies specified herein:

a)	Preliminary Approval Samples:	All finishes.
b)	Product Samples:	Hardware.
c)	Range Samples:	All finishes.
d)	Test Samples:	Upon request.

B. Shop Drawings

a)	Project Shop Drawings:	All fabricated materials.

4.0 SAMPLES

A. Samples

Before any work is performed, the following samples shall be submitted:

a) Representative samples of appropriate size of all stainless steel included in this work, to show final finished appearance.

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b) Representative samples of welded connections, mitred joint, and butt weld and typical brake form and bend for bar sheet stock to show final finished appearance.

c) Representative samples of proposed mechanically fastened connections to show final assembled appearance.

B. All samples shall be labeled to show material finish, thickness and specific use and location on work.

C. For project reference, one set of record samples will be retained by the Supervising Engineer, and kept available at the job site and one returned to the Contractor.

5.0 SHOP DRAWINGS

Submit shop drawings in accordance with Conditions of Contract. Coordinate shop drawings with material description to show location and extent of various finishes.

6.0 MAINTENANCE INSTRUCTIONS

Prepare and deliver to the Supervising Engineer a complete maintenance manual.

Such documents are an integral part of the requirements of these Specifications and require close cooperation between the basic metal manufacturer, the fabricator and the finisher.

Maintenance information shall include specific instructions for:

- Routine cleaning instructions with recommendations for materials and schedule applicable to locality and exposure.

- Recommendations for major cleaning as required to maintain appearance.

Appropriate publications shall be included but these shall not be regarded as taking the place of required specific instructions.

7.0 MATERIALS

A. Stainless Steel

a) Materials not otherwise specified, in accordance with requirements of "Structural Steel Work".

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b) All Bar Stock including Shapes: Cold drawn AISI Type 1018 steel.

c) Stainless Steel: ASTM A167 Type 316.

B. **Support Devices**

a) Reinforcement: Meet requirements of "Reinforcement" section.

b) Fasteners used in assembling sections: Exactly matching adjacent surfaces where exposed or AISI 300 series stainless steel.

c) Steel Anchors: Hot dip galvanized, or AISI 300 series.

d) Inserts: For required anchorage into concrete or masonry work, furnish inserts of cast iron, malleable iron or 2.8 mm steel hot-dip galvanized after fabrication.

e) Expansion Anchor Devices: Fed. Spec. FF-S-325 Group III, Type 4, Class 1, Int. Amendment 3: Molly "Parbabolt" or equal.

C. **Paint for Ferrous Metal**

Primer as follows: equivalent product manufactured by one of the approved manufacturers listed under "Painting and Finishing"; Fed. Spec. TT-P-86e, Type II, or "Tnemec" cement-in-oil type.

D. **Setting Grout**

Rapid setting grout warranted by manufacturer to be compatible with aluminum; UPCO "Bostick 275"; similar by Steelcote. Grace or Acme Highway Products using less than full unit of powder so that mixture is pourable; or use L & M Crystex Grout. Metallic grout is not acceptable.

E. **Accessory Materials**

a) Joint Filler: Expanded cellular neoprene, closed cell, tape, coated with non-staining adhesive one surface; ASTM D 1056 "Testing Sponge and Expanded Cellular Rubber Products". Type SC-41: shape as required.

b) Protective Coverings: After finishing procedures have been completed, apply protective wrappings of paper or plastic film. Keep material dry until wrappings are removed. Coatings, if used, must be completely removed.

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F. **Glass**

For railing, 12mm thick tempered glass in panels shall be used with stainless steel balustrades. For further details of glass refer specification section 6250 i.e. Glazing.

8.0 STAINLESS STEEL FINISHES

Finish designations are indicated herein in accordance with the standards of the American Iron and Steel Institute.

9.0 FABRICATION

A. **General**

Comply with requirements of "Structural Steel Work", Section 3000.

B. **Welding and Grinding Stainless Steel**

a) All welding shall be in accordance with appropriate recommendations of the American Welding Society and shall be done with electrodes and by methods recommended by the manufacturer of the alloys being welded. Type, size, and spacing of welds shall be as shown on approved shop drawings. All welds behind finished surfaces shall be so done as to minimize distortion or discolouration on the finished side. All weld spatter and welding oxides on finished surfaces shell be removed by descalding or grinding.

b) Unless otherwise shown or specified, all weld beads on exposed polished surfaces shall be ground and polished to match and blend with finish on adjacent parent metal. Grinding and polishing shall be done only with clean wheels and other abrasives free from iron compounds.

c) Thoroughly clean material after grinding or polishing to remove all contaminants which might affect appearance.

10. PROTECTION AND CLEANING STAINLESS STEEL

All work shall be protected from damage of any kind during handling, transportation and at the project site. All material shall be stored under waterproof cover on wood blocking or on suitable floors.

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Finished surfaces shall be covered with protective paper, tape, or other approved strippable coating prior to shipment from the fabricator. Should construction schedules delay removal of protective strippable coating, periodic

inspection at increasingly frequent intervals shall be made to be certain coating may be easily removed.

Upon completion, all exposed surfaces shall be thoroughly cleaned in accordance with the recommendations of the stainless steel producer.

11.0 MEASUREMENT & PAYMENT

11.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

11.1.1 Providing nuts, bolts, screw, rivets, heads, fillets, welds and welding rods.

11.1.2 Galvanized and prime coating of paint.

11.1.3 Providing and installation of glazing in position.

11.1.4 All embedded parts unless otherwise specified in the Bill of Quantities, base plates, brackets.

11.1.5 Painting.

11.1.6 Master balustrades, grouting, pipes/bars etc

11.2 Stainless Steel Railing

11.2.1 Measurement

Measurement of acceptably completed works of stainless railing in will be made on the basis of running foot / meter as shown on the drawings or as directed by the Engineer.

11.2.2 Payment

Payment will be made for acceptable measured quantity of stainless railing in groves on the basis of unit rate per running foot / meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 3010 ***

SECTION - 4600

CARPENTRY AND JOINERY

1. SCOPE

The work covered under this section of Specifications consists of providing all material, labour, plant, equipment, appliances and performing all operations in any floor and at any height connected with the fabrication and erection of all woodwork, regarding doors including surface finish treatment, procuring and applying preservatives, installation of "Finish Hard Ware" in connection with finish woodwork as per details shown on the Drawings or as directed by the Engineer.

2. APPLICABLE CODE AND STANDARDS

Latest editions of following ASTM,ANSI,AWPA,AWPB,USDC, ISO and British Standards are relevant to these specifications wherever applicable.

2.1 ASTM - American Society for Testing and Materials:

ASTM A 36 Specification for Structural Steel.

ASTM D 4442 Test Method for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

2.2 ANSI - American National Standards Institute:

A199.1 Construction and Industrial Plywood.

2.3 AWPA - American Wood Preservers Association:

AWPA C1 Timber Products-Pressure Treatment (General Requirements).

AWPA C2 Lumber, Timbers, Bridge Ties and Mine Ties-Pressure-Treatment.

AWPA C9 Plywood-Pressure Treatment.

AWPA C20 Structural Lumber, Fire Retardant-Pressure Treatment.

AWPA M4 Care of Pressure-Treated Wood Products.

2.4 AWPB - American Wood Preservers Bureau:

AWPB LP-2 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservative for above Ground Use.

AWPB LP-3 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Light Petroleum Solvent-Penta Solution for above Ground Use.

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AWPB LP-4 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Volatile Petroleum Solvent (LPG) - Penta Solution for above Ground Use.

AWPB LP-22 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservative for Ground Contact Use.

AWPB LP-44 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Volatile Hydrocarbon Solvent-Penta Solution for Ground Contact Use.

AWPB LP-55 Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Creosote or Creosote Coal tar Solution for Ground Contact Use.

2.5 USDC - United States Department of Commerce:

USDC PS-1 Softwood Plywood, Construction and Industrial.

USDC PS-20 American Softwood Lumber Standard.

2.6 ISO (International Organisation for Standardisation)

1891 Bolts, screens, nuts and accessories-Terminology and nomenclature.

1097 Plywood - Measurement of dimensions of panels.

1098 Veneer Plywood for general use-General Requirement

2427 Veneer Plywood with rotary cut veneer for general use-Classifications by appearance of panels with outer veneer of beech.

2429 Ply wood - Veneer plywood with rotary cut veneer for general use-Classifications by appearance of panels with outer veneers of brand leaved species of tropical Africa.

3804 Plywood-Determination of dimension of test pieces.

3805 Plywood-Determination of density.

3806 Plywood-Determination of moisture content.

6442 Door leaves-Measurement of defects of general flatness.

6443 Door leaves-Measurement of dimensions and of defects of squareness.

6444 Door leaves-Test of behavior under humidity variations.

2.7 BSI (British Standards Institution)

459 Wooden doors.

1186 Quality of timber and workmanship in joinery.

1127 Hinges.

1331 Builder's Hardware for housing.

1567 Wood door frames and lining nails.

1202 Nails

1203 Specifications for synthetic resin adhesive for plywood.

1204 Synthetic resin adhesives for wood.

1282 Guide to choose, use and application of wood preservatives.

1494 Fixing accessories for building purposes.

1579 Connectors for timer.

3842 Treatment of plywood with preservatives.

3. SUBMITTALS

3.1 Wood Treatment Data:

a. Submit chemical treatment as well as manufacturer's instructions for the proper use of each type of treated material.

b. For pressure treatment and each type specified, include certification by treating plant stating chemicals and process used, net amount of salts retained and conformance with applicable standards.

c. For water-borne preservatives, include statement that moisture content of treated materials was reduced to the levels indicated prior to shipment to project site.

d. For fire-retardant treatment, include certification by the treating plant that the treated material complies with the specified requirements and that treatment will not bleed through finished surfaces.

3.2 Provide manufacturer's literature completely describing products.

a. Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.

b. Provide certificates stating that doors were constructed with timber of the species specified having moisture content and meeting equilibrium and relative humidity requirements.

c. Submit samples of plywood for selection of colour and grain.

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d. Procurement of materials shall be made only after the shop drawings and samples have been approved by the Engineer.

4. TRANSPORTATION, HANDLING AND STORAGE

4.1 Delivery and Storage:

a. Keep materials dry, stack products off the ground on level platforms, fully protected from weather, including direct sunlight during delivery and storage.

b. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood while providing air circulation within stacks during storage.

c. Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

d. Identify type, size and location of each door before delivery in order to permit installation at correct location.

5. QUALITY ASSURANCE

5.1 This Work shall be executed and tested in accordance with the current editions of applicable codes and standards specified herein.

5.2 Lumber Standards: Comply with US Department of Commerce Standard PS-20 **American Softwood Lumber Standards** for each indicated use, including moisture content and actual sizes related to the indicated nominal sizes.

5.3 Factory Markings and Certificates:

a. Factory-mark each piece of lumber with type, grade, mill, and grading agency identification, except omit marking from surfaces to receive transparent finish, and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

b. Certificate of inspection and grading by a recognized agency may be submitted with each shipment, in lieu of factory-marking, at Contractor's option.

c. Fire-Retardant Marking: Fire-retardant treated wood shall be tested in accordance with ASTM E 84, maximum flame spread of 25. Label materials with Underwriters' Laboratory Seals, showing grade and rating.

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d. Shop-fabricate carpentry work to the greatest possible extent, using equipment and workmanship control methods which will result in work of better quality than is feasible for on-site fabrication.

e. Lumber and wood carpentry materials shall be preservative pressure treated.

6. JOB CONDITIONS

6.1 Examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed, and remedy any conditions detrimental to work. Do not proceed with installation until the satisfactory conditions have been corrected in a manner acceptable to the Installer.

6.2 Fit carpentry work to other works scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

7. MATERIALS

7.1 Timber

a. Hard Wood:

Hard wood shall comprise of Oak, beech, Walnut, Mahogany, Teak, Iroko and Sheesham.

b. Soft Wood:

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deodar (referred in the document as deodar), wood locally known as 'Partal' to be used in shutter core where specified.

c. General Characteristics:

All the timber shall be in accordance with the requirements of BSI No: 1186, 'Quality of Timber and Workmanship in Joinery'.

The whole of the timber shall be from the heart of sound and fully-grown tree, uniform in substance, straight in fibre, first class quality properly seasoned, free from large or loose dead-knots, open shakes and excessive sapwood. The scantlings of all timbers shall be bright, sound and square edged. The moisture content of timber shall not be more than 10 (ten) percent in case of soft wood and 7 (seven) percent in case of hard wood.

d. Preservation of Wood:

Prior to installation of all finish wood works in their respective positions, preservatives shall be applied to safeguard the wood work against fungus, termite and bores.

The preservatives shall be of the best available quality as approved by the Engineer. The method of application shall be strictly in accordance with the manufacturer's instructions. The treatment and application of all the preservatives shall comply with the requirements of BS-CP 98:1964.

e. Adhesive:

The adhesives shall conform to the requirements of BSI No. 745 "Animal Glues for Wood" by approved manufactured or as directed and approved by the Engineer.

f. Nails and Screws :

All nails and screws shall comply with requirements of BSI NO. 1202 and BSI NO. 1210 respectively.

7.2 Ply Wood

The ply wood shall comply in all respects with BSI No. 1455:1963. All the ply wood shall only be obtained from manufacturers approved by the Engineer. All plywood shall be manufactured with phenol pharamaldihide or any other approved water proof adhesive but not with urea pharamaldihide.

Ply wood used for doors, and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other similar defects. The surfaces shall be free, smooth for painting or polishing.

7.3 Medium Density Fibre (MDF) Board

Medium density fibre board to be used on the project shall be LASANI of approved manufacturers of required thicknesses as specified in the drawings/details. Board shall be manufactured with water proof resinous glues and shall be guaranteed by the manufacturer. All boards required for the exterior surfaces of cabinets shall be laminated with formica in approved colour and texture in factory as specified elsewhere.

8. SAMPLES

All samples of the material used for the work under this Section of Specification shall be approved by the Engineer and same type of material shall be used throughout the work. If the Engineer desires to get the material tested, this will be got done by the Contractor at his own cost from a laboratory approved by the Engineer.

9. FABRICATION

`Unwrought' timber shall be used. Sawing shall be done with sufficient oversize margin to finally meet the requirements of specified sizes and dimensions of the finished work.

All framing shall be joined and glued properly as shown on the Drawings or as directed by the Engineer. All joints shall be secured with sufficient number of nails. The Contractor shall perform all necessary mortizing, tenoning, grooving, matching, tangoing, housing, rebating and all operations required for the correct jointing. The Contractor shall also provide all metal plates, screws, nails and other fixing material that may be ordered by the Engineer for the proper execution of the joinery work. Fabrication that develop defects due to bad workmanship or unsound materials not conforming to these specifications and the directions of the Engineer, shall be cut out and replaced at Contractor's own expense before the expiry of the maintenance period.

10. WOODEN DOORS

10.1 Materials

a. Door frame shall be of approved Mahogany wood 2"X7" in size.

b. Door shutter main & lock frame shall be of approved Mahogany wood 4"X1", Inner core shall be of 1"X1" Partal wood.

c. 3mm thick plain commercial ply shall be pasted on pressed shutter both side.

d. At top 5mm thick Mahogany veneer pannel ply shall be pasted/pressed on both sides.

d. The core of shutter shall be ½" Mahogany wood lipping all around.

f. Architraves, beads, lippings shall be of Mahogany wood of specified sizes and fixed as per details shown on Drawings.

10.2 Ground, Blocking & Nailing Strips

Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

Except as otherwise shown or specified, ground blocking and nailing strips shall be secured in place as follows:

a. To steel--- by means of 3/8" diameter bolts spaced not over 900mm.

b. To block wall ---- by the use of cut nails spaced not more than 1500 mm apart and driven directly into the block.

c. To poured concrete ---- by means of 6 mm diameter galvanized expansion bolts spaced not more than 1500 mm part or by any approved method.

10.3 Exterior and Interior Door Frames

All exterior and interior door frames shall be Mahogany wood as approved by the Engineer shall be used for door frames as shown on drawings.

All exposed surfaces of frames and architraves/beads shall be lacquer polished with of approved shade as per the instructions of the Engineer.

The door frames shall be fixed in block masonry/concrete wall/columns with heavy duty holdfast as shown on drawings.

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10.4 Door Shutters

The shutters will be fixed to the frames with approved quality fittings as per hardware schedule.

a. All doors, shutters shall be fabricated in a workman like manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer.

b. The door shutters shall be built in sections, properly jointed and glued together. The surfaces shall be prepared for painting or polishing.

c. All door shutters shall be engineered, fabricated from first class Mahogany wood as shown on drawings.

d. Each door shall be constructed so as to permit the installation of hinges, knobs and locks in the position shown on the Drawings.

e. Completed doors shall be sound, rigid and free from defects and warp. All edges shall be aligned and smooth, joints shall be close fitting, hard wood doweled or mortised framed and of a strength to maintain frame and of strength to maintain the structural properties of the member connected. All adjoining faces and edges shall be flush and smooth. Edges shall be rectangular and solid.

f. All exposed surfaces of wooden frames and wooden shutters shall be polished of approved shade as per the instructions of the Engineer.

g. Chamfers shall be made as shown on the drawings or as directed by the Engineer.

10.5 Fitting, Hanging and trimming

All the doors shall be fitted, hung and trimmed as hereinafter specified and as indicated on the Drawings.

Doors shall have a clearance of 3 mm at sides and top unless otherwise directed by the Engineer and shall have 5 mm clearance at bottom. Doors shall be hung and trimmed with hardware as specified. All the locks shall be installed at the same height and shall be located at height as directed by the Engineer. Where directed by the Engineer margin for carpet shall be incorporated in the door shutter.

10.6 Hardware

Hardware shall be of best quality extra heavy duty and first class finished material except door locks and door closures which shall be imported of as per attached hardware schedule from recommended list of vendors. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials.

Hardware shall be carefully and securely fitted. Upon handing over the work, hardware shall be demonstrated to operate freely. Keys shall be placed into respective locks and upon acceptance of the work keys shall be tagged and delivered to the Engineer.

10.7 Quality Assurance

a. Tolerances: Doors shall be fabricated to following tolerances

- Size: Plus or minus 1.5 mm in overall dimensions
- Maximum Warp: 3 mm
- Squareness: Maximum diagonal difference 3 mm of (between length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

b. Manufacturer's Qualifications: The manufacturer of doors herein specified shall have been in business of manufacturing doors of type specified for minimum period of five years.

10.8 Installation

a. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate the work with a minimum of joints or the optimum jointing arrangement.

b. Fit carpentry work to other work. Scribe and cope as required for accurate fit. Set carpentry work accurately to required levels and lines with members plumb and true.

c. Shim with metal or slate for bearing on concrete and masonry substrate. Where indicated, provide with 1-3 Portland cement-sand grout for full-bearing.

d. Securely attach carpentry work to substrates by anchoring and fastening as shown and as required by recognized standards. Provide washers under bolt heads and nuts in contact with wood. Countersink nail heads on exposed carpentry work and fill holes.

e. Fasteners: Use common wire nails, except as otherwise shown or specified herein. Use finishing nails for exposed work. Do not wax or lubricate fasteners that depend on friction for holding power. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required. Do not drive threaded friction-type fasteners; turn into place. Tighten bolts and lag screws at installation and retighten as required for tight connections prior to closing in or at completion of work.

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f. Wood Grounds, Nailers, Blocking, and Sleepers: Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as

shown and cut as required for true line and level of work to be attached or screeded. Coordinate location with related carpentry work; refer to shop drawings for such work when required.

g. Wood Furring: Install plumb and level with closure strips at edges and openings. Shim with wood as required. Fire stop furred spaces on walls at each floor level, with wood blocking or incombustible materials, accurately fitted to close furred spaces. Comply with governing regulations.

h. Plywood: Where required, shall be complying with the recommendations of the American Plywood Association (APA) for the fabrication and installation of plywood work.

i. Install doors at correct openings and assure smooth swing and proper closer with frames.

j. Install finish hardware in accordance with manufacturer directions.

11. LAVATORY/VANITY COUNTERTOPS

11.1 Countertop: Shall be ¾" thick granite with ¾" thick backsplash and apron, constructed to profiles and dimensions shown on Drawings.

Type, Color, Texture and Finish: As approved by the Engineer.

12. ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

12.1 Repair damaged and defective woodwork wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

12.2 Clean hardware, lubricate and make final adjustments for proper operation.

12.3 Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

12.4 Complete the finishing work specified as work of this section, to whatever extent not complete at the shop or prior to installation of woodwork.

12.5 Protection: Protect architectural woodwork and maintain conditions necessary to ensure that the work will be without damage or deterioration at the time of acceptance.

12.6 Anti-Corrosion Measure:

a. Incompatible materials are to be isolated with approved materials which can withstand compression.

b. Use only non-ferrous fixing where applicable.

c. Use approved rust inhibitors as pre-primers after primary preparation.

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13. SURFACE PREPARATION

The surfaces of all wood works shall be prepared in the manner as directed by the Engineer for polishing.

14. MOCK-UP SAMPLE

After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of wood works complete with all fixing, fixtures accessories prior to the actual fabrication of the bulk.

The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

15. MEASUREMENT & PAYMENT

15.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective/items of the Bills of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specifications in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

a. Glazing where required and all finished hardware fittings in carpentry and joinery works, including locks, hydraulic door closers, kick and push plate, architrave, beading, handles, locking arrangements etc.

b. lacquer polish in carpentry and joinery works.

c. Anti termite treatment to wood works and adhesives.

d. Mahogany and Partal wood blocking, shipping & base frame work in cabinets.

e. Mock-up sample.

f. M.S. Ribs covered with Dossai wood.

g. Marble and Granite counter tops.

h. Concrete and structural steel supports.

i. Doors, Drawers, Shelves and Panels.

15.2 Wooden Door

15.2.1 Measurement

Measurement of acceptably completed works of all types of wooden doors will be made on the basis of net actual area in square meter/foot fabricated/making and installed in position as shown on the Drawings or

as directed by the Engineer. Net area will be measured in accordance with plastered masonry opening in between jambs and plastered head and bottom of shutter.

15.2.2 Payment

Payment will be made for acceptable measured quantity of all types of wooden doors on the basis of unit rate per square meter/foot quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works including all hardware & fittings like locks, hydraulic door closers, tower bolts, push plates etc. as per details mentioned in Bidding & Contract Document related to the item.

15.3 Kitchen Cabinets (Floor & Wall Mounted)

15.3.1Measurement

Measurement of acceptably completed works of Kitchen Cabinets will be made on the basis of net actual length in running meter/foot fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

15.3.2 Payment

Payment will be made for acceptable measured quantity of Kitchen Cabinets on the basis of unit rate per meter/foot quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works related to the item.

15.4 Wardrobes & Laundry Wardrobes

15.4.1 Measurement

Measurement of acceptably completed works of Wardrobes & Laundry Wardrobes will be made on the basis of the unit rate in square meter/foot fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

15.4.2 Payment

Payment will be made for acceptable measured quantity of Wardrobes & Laundry Wardrobes on the basis of unit rate per square meter/foot quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works related to the item.

15.5 M.S. Ribs with wooden cladding

15.5.1 Measurement

Measurement of acceptably completed works of M.S. Ribs with wooden cladding will be made on the basis of entire job fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

15.5.2 Payment

Payment will be made for acceptable measured quantity of M.S. Ribs with wooden cladding will be made on the basis of entire job quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works related to the item.

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15.6 Lavatory/Vanity Countertops

15.6.1 Measurement

Measurement of acceptably completed works of Lavatory/Vanity Countertops will be made on the basis of net actual area in square meter/foot fabricated and installed in position as shown on the Drawings or as directed by the Engineer.

15.6.2 Payment

Payment will be made for acceptable measured quantity of Lavatory/Vanity Countertops rooms on the basis of unit rate per square meter/foot quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works related to the item.

** End of Section 4600 ***

SECTION - 6220

ALUMINIUM WORKS

1. SCOPE

The work covered under this section of the specifications consists of providing all material, labour, equipment, performing all operations required for providing and installation of powder coated aluminum doors, windows, ventilators & louvers doors and Partitions including all related items such as sealants, gasket, netting, rollers, hinges, latches, fastenings, anchor bolts, door locks, locking devices and glass complete in strict accordance with this section of specifications, the applicable drawings and as scheduled. Any additional information required in this connection and not stated in these specifications, shall be obtained from the Engineer's Representative.

2. APPLICABLE STANDARDS

Latest editions of following ISO and British Standards are relevant to these Specifications wherever applicable.

2.1 ISO (International Organisation for Standardisation)

1804	Doors	-	Terminology
6442	Door Leaves	-	Measurement of defects of general flatness.
6443	Door Leaves	-	Measurement of dimensions and defects of squareness.
6444	Door Leaves	-	Test of behaviour under humidity Variations (successive uniform climates)
6612	Windows & Doors	-	wind resistance tests.
6613	Windows & Door	-	Air permeability test.

2.2 BSI (British Standard Institution)

1227 Hinges

4873 Aluminum alloy windows.

6696 Powder coated Aluminium.

2.3 AAMA (American Architectural Manufacturer Association)

AAMA 101 Aluminum Prime windows and Sliding Glass Doors

AAMA 603.8 Pigmented Organic Coating on Extruded Aluminum

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AAMA 605.2	High Performance Organic Coatings on Architectural Extrusions and Panels
AAMA 606.1	Color Anodic Finishes for Architectural Aluminum
AAMA 607.1	Clear Anodic Finishes for Architectural Aluminum
AAMA 701.2	Voluntary Specification for Pile Weather Stripping
AAMA 2605	Powder coating Process

2.4 **AA - Aluminum Association**

Aluminum Association Designation System for Aluminum Finishes

2.5 **ANSI - American National Standards Institute**

A134.1 Specification for Aluminum Prime windows.

2.6 **ASTM - American Society for Testing and Materials**

ASTM B 136	Stain Resistance of Anodic Coatings on Aluminum
ASTM B 137	Weight of Coatings on Anodically Coated Aluminum
ASTM B 209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 211	Aluminum and Aluminum-Alloy Bars, Rods and Wire
ASTM B 221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 244	Thickness of Anodic Coatings on Aluminum with Eddy-Current Instrument
ASTM D 2287	Non-Rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
ASTM D 3656	Insect Screening and Louver Cloth Woven From Vinyl-Coated Glass fiber Yarn
ASTM E 283	Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors
ASTM E 330	Structural Performance of Exterior Windows, Curtain Walls and Doors Under the Influence of Wind Loads.
ASTM E 331	Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Pressure Difference Loads
ASTM E 547	Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Difference Loads

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ASTM F 468 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

2.7 DIN - Deutsches Institute fuer Normung

DIN 4108 Heat Insulation in Buildings

DIN 18055 Windows; Air Permeability of Joints, Water Tightness and Mechanical Strain

2.8 AWS - American Welding Society:

D1.1 - Structural Welding Code, Steel

D1.2 - Structural Welding Code, Aluminum

3. SUBMITTALS

3.1 Product Data: Submit Manufacturer's specifications, standard details, and installation recommendations for components of aluminum doors, windows, ventilators, louvers and framing required for project, including data that products have been tested and comply with performance requirements.

3.2 Shop Drawings: Submit shop drawings for fabrication and installation of aluminum doors, windows, ventilators, louvers and framing, including elevations, detail sections of typical composite members, anchorages, reinforcement, expansion provisions, and glazing

3.3 Certification: Submit statement certified by registered structural engineer that systems including glass will withstand specified wind-loads.

3.4 Samples: Submit samples of each type and color of aluminum finish, on 300 mm long sections of extrusions or formed shapes and on 150 mm square sheets.

4. TRANSPORTATION, HANDLING AND STORAGE

Deliver aluminum entrance material to the site in packages or containers; labeled for identification with the Manufacturer's name, brand and contents. Store aluminum entrance material in weather tight and dry storage facility. Protect from damage from handling, weather and construction operations before, during and after installation.

5. WARRANTY

Submit 2 copies of written guarantee signed by the Manufacturer, Installer and Contractor, agreeing to replace aluminum doors, windows, ventilators, louvers and framing units that fail in material or workmanship within 2 years of date of substantial handing over.

Such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturers and the Contractor may have by law or by other provisions of the Contract Documents.

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6. QUALITY ASSURANCE

6.1 Standards: Comply with applicable provisions of **Powder coated aluminum partitions, doors, louver doors, windows and ventilators Guide Specifications Manual - AAMA.**

6.2 Performance and Testing:

6.2.1 Thermal Movement: Fabricate exterior components from Manufacturer's stock systems which have been designed to provide for expansion and contraction resulting from ambient temperature range of 48°C.

6.3 Wind Loading: Fabricate exterior components from Manufacturer's stock systems which have been tested in accordance with ASTM E 330 to withstand at least the following loadings:

6.3.1 Uniform Pressure: 97.6 kg/m² inward; 97.6 kg/m² outward.

6.3.2 Maximum Deflection: 1/175 of clear span any framing member.

6.4 Weather Resistance: Fabricate exterior components from Manufacturer's stock systems which have been tested to demonstrate permanent resistance to leakages as follows with test pressure differential of 10 percent of design loading (excluding operable door edges).

6.4.1 Air Infiltration: Tested in accordance with ASTM E 283 and shall have a minimum of 0.6 m^3/min/m of crack.

6.4.2 Water penetration and leakage shall not be allowed when tested in accordance with ASTM E 331 at a water application rate 10 percent more than the design rate.

7. GENERAL

7.1 Doors, Windows, ventilators, louvers doors, partitions and other items to be provided shall be aluminum, of profile pattern and design shown on drawings and shop drawings manufactured by reputable manufacturer approved by the Engineer. The Contractor shall provide manufacture literature completely describing the product instructions for installation and maintenance.

7.2 All sections used for doors, windows, ventilators, louvers and fly screens shall be of best quality aluminum products such as equal and unequal angles, channels, tubes, corrugated strips, mouldings etc., in accordance with International standards conforming to ASTM B 308 & B 221.

7.3 All doors, windows. ventilators and louvers shall be of type and size indicated on drawings and shall conform to the requirements shown and specified herein.

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7.4 Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each door, window, ventilator and louvers type at the maker's works or any laboratory specified by the Engineer for the material supplied by him to be tested in the presence of the Engineer's Inspector, to whom test certificates,

proof sheets, etc. shall be furnished. The models shall be submitted to the Engineer for approval prior to testing. Nevertheless, neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer to reject, after delivery of materials found not in accordance with these specifications.

7.5 The Contractor shall submit shop drawings conforming to design concept which shall show full construction details, quantities and locations, fastenings, stiffening members and attachments to adjacent construction and materials. Shop drawings and calculations shall be submitted at the proper time to allow for checking, revisions, and agreement and to permit manufacturer's product delivery and start of site work to suit the building programme. The Contractor shall submit representative samples of finished doors, windows, anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval.

After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of aluminum works complete with glazing, all components assembly method and required fittings and accessories prior to the actual fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

Fabricate and assemble all work in the shop of the approved manufacturer to reduce field fabrication to a minimum unless otherwise directed by the Engineer.

7.6 The glass shall conform to specification laid down under chapter 'Glazing' and shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in window members.

7.7 The structural shape of the Aluminium members shall be of uniform quality, colour and temper, clean, round, commercially straight and free from injurious defects.

7.8 All doors, windows, ventilators and louvers shall be fabricated as a complete unit, fully airtight and watertight, including rubber gasket for glazing, hinges, stays, rollers, latch, locking arrangement, handles, etc anodized in specified colour, inclusive of glass sheet, necessary holes for fixing, door locks, door closures and window locking requirements, all as approved by the engineer.

7.9 Contractor shall, provide certificate signed by the manufacturer stating that each lot has been sampled, tested and inspected and has met the requirements in accordance with these specifications and the same shall be furnished to the Engineer.

7.10 The shop drawings shall clearly show that there shall be no penetration of rainwater from the exterior to the interior in case of severe wind and rainstorm. This has to be specially ensured in sill section.

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8. MATERIALS AND ACCESSORIES

8.1 Aluminum Members:

8.1.1 Extrusions of Bars, Rods and Tubes: 6063-T6 Alloy conforming to ASTM B 221.

8.1.2 Sheets and Plates: 5005-H14 alloy conforming to ASTM B 209.

8.1.3 Doors, windows, ventilators, louvers and frames shall be manufacturer standard systems of extrusions not less than 1.6 mm thick.

8.1.4 Use manufacturer's standard thermal-break sections for all aluminum doors, windows, ventilators and louvers unless otherwise shown on Drawings.

8.1.5 Fasteners: Aluminum, or non-magnetic stainless steel, or other materials warranted by Manufacturer to be non-corrosive and compatible with aluminum components.

8.2.1 Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.

8.2.1 Provide Phillips flat-head machine screws for exposed fasteners.

8.2 Glazing Gasket: Manufacturer's standard vinyl glazing gasket.

8.4 Brackets and Reinforcements: Manufacturer's high- strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot-dip galvanized complying with ASTM A 386.

8.5 Concrete/Masonry Inserts: Cast iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386.

8.6 Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC - Paint 12, compounded for 20 mil thickness per coat.

8.7 Glass: Glass and glazing materials shall be as specified in Section 6250 - GLAZING and as indicated on Drawings with all doors, windows, ventilators and louvers factory glazed.

8.8 Hardware: Provide aluminum doors, windows, ventilators and louvers with Manufacturer's standard, factory-installed hardware. Finish of hardware shall be satin stainless steel, as approved by the Engineer.

9. FINISH

Powder coating Finish: Conform to AAMA 2605; coating thickness 70~90 micron. Color shall be as approved by the Engineer.

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10. DESIGN REQUIREMENT

The Contractor shall design the installation to meet the following requirements.

10.1 Tolerances

The Contractor shall be responsible for agreeing to all dimensions with the Engineer before proceeding with the manufacture and for making provision to allow for building tolerances required by the Engineer. Contractor shall also take site measurements of the structure completed before manufacturing.

10.2 Thermal & Seismic Movements

The window and glazing assemblies are to be constructed and installed in the openings with sufficient tolerance and, where necessary, to provide for joints incorporated in couplings, to provide for expansion and contraction as will be caused by the local seismic and climatic conditions and temperature changes, winter to summer - day to night without buckling, distortion of joints, or other harmful effects.

11. FABRICATION

11.1 Door Types: Types include double leaf swing doors and sliding doors, as shown on drawings. Provide manufacturer's standard electric door operator for motor-operated sliding doors.

11.2 Sizes and Profiles: Required sizes for door, windows, ventilators, louvers and frame units including profile requirements shall be as shown on Drawings. Variable dimensions shall be indicated, together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.

11.3 Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

11.4 Sequence: Complete cutting, fitting, forming, drilling, and grinding of metal work prior to cleaning, finishing, surface treatment, and application of finishes. Remove arises from cut edges and ease edges and corners.

11.5 Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

11.6 Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.

11.7 Provide continuous steel reinforcing stiffening members within jambs and heads of all doorframes, except omit at jambs that are secured to adjacent fixed walls.

11.8 Cut vertical reinforcing 50 mm less than mullion height and cut horizontal reinforcing 75 mm less than door head framing member.

11.9 Securely fasten in a manner so that fasteners will not be visible in finished work. Fasten aluminum sections to steel reinforcing 150 mm from each end and intermediately at a maximum spacing of 600 mm on centers.

11.10 Doorframes shall be free of vibration and distortion when doors are used.

11.11 Maintain accurate relation of planes and angles, with hairline fit of contacting members.

11.12 Fasteners: Conceal fasteners wherever possible.

11.13 Weather stripping: For exterior doors, windows, ventilators, louvers and frames provide compression weather stripping against fixed strip; at other edges, provide sliding weather stripping retained in adjustable strips mortised in other edge.

12. WORKMANSHIP

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workman like manner in accordance with the manufacturer's instruction and as specified herein. The Contractor shall be responsible for the protection of installed items from damage by other trades. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before the final acceptance.

The glass panes shall firmly be secured in the rebates with the rubber gasket. Ensure that the beads and grooves are clean, dry and unobstructed at the time of glazing. The complete unit shall be airtight and watertight on completion. No doors, windows and ventilator shall be considered complete until and unless the fingerprints and other stains and marks have been removed from the surface of glass and aluminum.

13. ERECTION

13.1 Comply with Manufacturer's instructions and recommendations for installation of aluminum doors and frames.

13.2 Set units plumb, level, and true to line, without warp or rack of framing members, doors, windows, ventilators, louvers and frames or panels. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials with bituminous coating.

13.3 Set sill members and other members in bed of compound as shown, or with joint fillers or gaskets as shown to provided weather-tight construction.

13.4 Expansion and Contraction: Allow for expansion and contraction due to temperature and building movement, and for practical building tolerances in

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connections to basic structure and in connections to work by others. At no place should window wall grid or framing impart any expansion or contraction forces on panels or glass.

13.5 Hardware Preparation and Installation: Cut, reinforce, drill and tap aluminum work for application of finish hardware. Provide cover boxes in frames back of cutouts for hardware also install finish hardware in accordance with hardware Manufacturer's instructions and template requirements also use concealed fasteners wherever possible.

13.6 Caulking: Seal joints between metal members and between metal and adjacent surfaces.

13.7 Refer to Section 6250 - GLAZING for installation of glass and glazing requirements.

13.8 Rawal plugs and anchoring bolts shall be embedded into the concrete or block masonry for holding the doors windows, ventilators and louvers in their correct positions.

13.9 Should any scale or scratch appears on the surface of doors, windows and ventilators the contractor shall at his own expense and at the Engineer's direction have all exposed surfaces cleaned to bare bright specified colour.

14. SCAFFOLDING

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate of items.

Damage to existing works from scaffolding or from any other object shall be repaired by the Contractor at his own cost.

15. ADJUST PROTECTION AND CLEANING

15.1 Temporary protection shall be achieved by applying water-soluble protective coating capable of withstanding the action of lime mortar.

15.2 Apply coating in the manufacturer's plant to the exposed surfaces of all components.

15.3 Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.

15.4 Adjust operating hardware to function properly, without binding, and to provide tight fit at contact points and weather stripping.

15.5 Clean completed systems, inside and out, promptly after erection and installation of glass and sealants. Remove excess glazing and sealant compounds, dirt, and other substances from aluminum surfaces.

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15.6 Remove protective coating when completion of adjoining works and construction activities no longer requires its retention.

15.7 Institute protective measures and other precautions required to assure that aluminum doors, windows, ventilators, lovers and frames will be without damage or deterioration, other than normal weathering, at time of acceptance.

16. DEFECTIVE WORK

In the event of non-conformance to specifications and drawings the aluminum works shall be rejected by the Engineer and the Contractor shall remove and replace the rejected works by new work of same specifications.

17. MEASUREMENT AND PAYMENT

17.1 General

Except otherwise specified herein or else where in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

17.1.1 Aluminium extrusions tubular frame and sash member as per drawings.

17.1.2 Polyurethane thermal break material.

17.1.3 Rawal plugs, brackets, rubber gasket, sealants, rollers, heavy duty hinges, stays, concealed type floor mounted double action door closures, hinges, heavy duty stays, vetting latches and any other embedded fixture required for fixing the doors windows and ventilator.

17.1.4 Providing and fixing fly screens, weather stripping, backer rods, locks, stays, latches, push/pull bars, handles and door closures where ever required in the aluminum works as approved by the engineer.

17.1.5 Cleaning of aluminum after installation.

17.1.6 Sealing all around both from inside and outside and also of the screw holes with silicone sealant to avoid water leakage.

17.1.7 Fly screen including wire/fly mesh etc. in windows and ventilators.

17.1.8 Powder coating of Aluminum works.

17.1.9 Providing and fixing glazing

17.1.10 All samples & tests

17.1.11 Scaffolding/Plat-form to work at Height.

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17.2 **Aluminum Works**

17.2.1 Measurement

Measurement of acceptably completed works of aluminum doors, windows, ventilators, louvers doors and partitions will be made on the basis of net actual area in square foot/meter provided and installed in position as shown on drawings or as directed by the Engineer.

17.2.2 Payment

Payment will be made for acceptable measured quantity of all finished anodized aluminum doors, windows, ventilators, louvers doors and partitions on the basis of unit rate per square foot/meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item including all reinforcing/stiffening arrangements.

*** End of Section 6220 ***

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SECTION - 6250

GLAZING

1. SCOPE

The work under this section of the Specifications consists of furnishing all labour, equipment, tools, appliances, scaffolding and providing in any floor and at any height glass, gaskets, sealants, compound and other materials required for performing all operations in connection with the installation and setting of all types of glass and glazing complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of Specifications is covered with detailed Specifications as laid down herein.

2. APPLICABLE STANDARDS

Latest editions of following American Society of Testing and Materials, Flat Glass Marketing Association, Federal Specifications, American National Standard Institute, National Fire Protection Association and British Standards are relevant to these Specifications wherever applicable.

2.1 ASTM - American Society of Testing and Materials

ASTM C 920 Elastomeric Joint Sealant

ASTM C 1036 Flat Glass

ASTM C 1048 Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass

ASTM C 1172 Laminated Architectural Glass

ASTM E 774 Sealed Insulating Glass Units

2.2 FGMA - Flat Glass Marketing Association

Glazing Sealing Systems Manual

Glazing Manual

2.3 FS - Federal Specifications

DD-G-451 Glass, Float or Plate, Sheet, Figured (Flat, for Glazing, Mirrors and other Uses)

DD-G-1403 Glass, Plate (Float), Sheet, Figured, and Spandrel (Heat Strengthened and Fully Tempered)

DD-M-411 Mirrors, Plate, Glass, Framed

2.4 ANSI - American National Standards Institute, Inc.

Z97.1 Performance Specification and Methods of Test for Safety Glazing Material Used in Buildings

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2.5 **NFPA - National Fire Protection Association**

Glazing Manual

2.6 **BSI (British Standards Institution)**

952 Glass for glazing

5051 Security glazing part I & II

CP.152 Glazing

3. SUBMITTALS

3.1 Product Data: Submit manufacturers technical data for glazing material and fabricated glass product required, including installation and maintenance instructions.

3.2 Samples: Submit 300 mm x 300 mm samples of each type of glass to be used.

3.3 Certificates: Submit certificates from manufacturer attesting that glass and glazing materials furnished for the project comply with requirements.

4. TRANSPORTATION, HANDLING AND STORAGE

4.1 Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's written directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes, including high altitude limitations for insulating glass.

4.2 Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.

4.3 Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.

5. WARRANTY

5.1 Submit a written guarantee signed by Manufacturer and Installer of glazing for a period of 1 year from the date of substantial completion. The Guarantee shall cover the replacement of defective materials and workmanship as directed by the Engineer.

6. QUALITY ASSURANCE

6.1 Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) - **Glazing Manual** and **Sealant Manual** except where more stringent requirements are indicated. Refer to those publications for

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definitions of glass and glazing terms not otherwise defined in this Section or other referenced standards.

6.2 Safety Glazing Standard: Where safety glass is indicated, provide type of products which comply with ANSI Z97.1.

6.3 Provide insulating glass units permanently marked either on spacers or at least one component pane of unit with appropriate certification label of inspecting and testing organizations.

7. PROJECT CONDITIONS

7.1 Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other cause.

7.2 Install sealant at ambient and substrate temperatures permitted by sealant manufacturers.

8. GLASS PRODUCTS - GENERAL

8.1 Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and if applicable, form, finish, mesh and pattern.

8.2 Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

9. GLASS

9.1 Tempered Float Glass:

9.2 Grade B (fully tempered), Style I (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), quality q^3 (glazing select), 12 mm thick for frameless windows, and for fully glazed doors, unless otherwise indicated on Drawings.

9.3 Provide 6 and 5 mm thick tinted glass for windows and ventilators indicated on Drawings.

10. SEALED INSULATED GLASS UNITS:

10.1 Provide pre-assembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and desiccant. Units shall have a U-Value of 2.5 $W/m^2/K$ and an overall Shading Coefficient of 0.3. Spacer material shall be manufacturer's standard aluminum or stainless steel. Desiccant shall be either molecular sieve or silica gel or blend of both. Provide insulated laminated glass units with reflective coating on outer pane and clear laminated inner pane for vision panels; and reflective single tempered glass for spandrel panels. Thickness of glass shall be as indicated on drawings. Color of reflective coating

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shall be as selected by the Engineer from manufacturer's full range of color.

10.2 Provide sealed insulating glass units for entrance doors indicated on Drawings to have double-glazing.

10.3 **MIRRORS**

Type I, Class I, Quality q^2, Clear float mirror, fully silvered electrically copper-plated, 6 mm thick, exposed edges ground and face corners cased, guaranteed against silver spoilage for 15 years.

Size and location of mirrors shall be as indicated on Drawings.

11. GLAZING MATERIALS AND ACCESSORIES

11.1 Glazing Gaskets: Dense elastomeric seal gaskets shall be continuous neoprene or polyvinyl chloride extrusions, of 50 Shore A durometer hardness plus or minus 5 complying with ASTM C 864.

11.2 Lock-Strip Gaskets: Conform to ASTM C 542, neoprene extrusions of required size and shape. Frames fabricated with injection molded corners. Provide with separate lock (zipper) strips, Shore A durometer 10 points harder than gasket body.

11.3 Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

11.4 Spacers: Neoprene blocks, 40 to 50 Shore A durometer hardness, self-adhesive on one face only; compatible with sealant used. Use EPDM spacers for units set with silicone glazing sealant.

11.5 Joint Cleaner, Primer and Sealer: As recommended by the glazing manufacturer.

11.6 Compressible Filler Rod: Closed-celled or a waterproof-jacketed rod stock of synthetic rubber or plastic foam, compatible with sealants used, flexible and resilient, with 34.5 to 68.9 kPa compression strength for 25 percent deflection.

11.7 Preformed Butyl-Polyisobutylene Glazing Tape: Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.

12. INSTALLATION OF GLAZING

12.1 General: Unless otherwise shown or specified, comply with recommendations and requirements of the FGMA **Glazing Sealing Systems Manual** and **Glazing Manual**. For the installation of all glass comply with glass manufacturers and glazing materials manufacturer's written instructions and recommendations. Provide watertight and airtight installation of each piece of glass, so as to withstand temperature changes and wind loading normal at the site. Operating sash and doors shall withstand impact loading without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to

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remain watertight and airtight, and deterioration of glazing materials. Install butt-joint glazing according to the glass manufacturer's recommendations.

12.2 Inspection: Inspect each piece of glass immediately before installation. Do not install any pieces which are improperly sized or have damaged edges, scratches or abrasion or any other evidence of damage. Use suction cups to shift glass units within openings; do not drift glass with pry bars. Remove labels from glass immediately after installation.

12.3 Setting Blocks: Locate setting blocks at sill rabbet one-quarter in from each end of the glass, unless otherwise recommended by the glass manufacturer. Use blocks of proper size to support the glass in accordance with manufacturer's recommendations. Set blocks in thin course of sealant that is acceptable for heel bead use.

12.4 Spacers: Provide spacers for all glass sizes larger than a combined total of 1.27 m or more for any two adjacent sides to separate glass from stops, except where continuous glazing gaskets are provided. Locate spacers no farther than 600 mm apart and no closer than 300 mm to a corner. Place spacers opposite one another. Make bite of spacer on glass a nominal 6 mm or greater.

12.5 Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

12.6 Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

12.7 Sealants: Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

12.8 Glazing Gaskets: Miter-cut and seal joints of glazing gaskets in accordance with manufacturer's written instructions.

12.9 Lock-Strip Gaskets: Comply with gasket manufacturer's written instructions and recommendations. Miter-cut corners of loose zipper strips slightly longer to provide permanent compression at joints. Use special tool to install and remove filler strips; lubricate in accordance with manufacturer's instructions.

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Comply with glass manufacturer's written instructions for the use of setting blocks, liquid or tape sealants, and weep holes in the glazing recess of lock strip gaskets.

12.10 Examine each piece of glass and discard and replace glass with edge damage or face imperfection. All glazing shall be wind tight and fully water tight on completion.

12.11 Clean glazing channels and other framing members indicated to receive glass. Remove coatings which are not firmly bonded to the substrate, remove lacquer

from metal surfaces wherever elastomeric sealants are to be used. Apply primer and sealer to joint surfaces wherever recommended by the sealant manufacturer and as shown on the drawings.

12.12 Trim and clean excess glazing materials from surrounding surfaces immediately after installation and eliminate stains and discolorations.

12.13 Cure glazing sealants and compounds in compliance with manufacturer's instructions to obtain high early bond strength internal cohesive strength and surface durability.

12.14 While glazing operation is in progress great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be refixed at Contractor's expense.

12.15 No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass ad checked by the Engineer for water tightness.

13. PROTECTION AND CLEANING OF GLAZING

13.1 Protect glass from breakage immediately upon installation by use of crossed streamers or ribbons attached to framing and held away from glass. Do not apply markings to surfaces of glass. Remove nonpermanent labels and clean surfaces.

13.2 Protect glass from contact with contaminating substances resulting from construction operations. Cover glass as required to protect it from additives that might abrade the glass surface. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

13.3 Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

13.4 Maintenance: Maintain glass in a reasonably clean condition during construction.

13.5 Cleaning: Wash glass on both faces not more than 4 days prior to acceptance. Comply with instructions and recommendations of the glass manufacturer and glazing materials manufacturer for cleaning in each case.

14. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost there of shall be deemed to be included in the quoted unit rate of the relevant item of the Bill of Quantities.

*** End of Section 6250 ***

SECTION - 6411

WATER PROOFING/EXPANSION JOINT FILLING & BUILTUP ROOFING

1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in any floor and at any height in connection with installation of insulation, water-proofing and built-up roofing, including water proof treatment to foundations and basement structures complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. SUBMITTAL

2.1 Shop Drawings: Shop drawings shall be submitted showing layout and all the details for construction.

2.2 Samples of all materials proposed for use under this section, shall be submitted to the Engineer for approval.

3. MATERIALS

As per drawings / detail

4. DELIVERY STORAGE AND HANDLING

Materials shall be protected from damage during loading shipment delivery and storage Non-staining materials shall be used for blocking and packing.

5. PREPARATORY WORK

5.1 All scuppers and roof drains shall be placed and metal flashing flanges etc. shall be provided in time to be installed alongwith the roofing assembly.

5.2 All surfaces, to be treated shall be dust free and dry. Application of roof finishes shall not start unless the preparatory work has been inspected and approved by the Engineer.

6. APPLICATION OF ROOFING

6.1 Roofing shall not be applied during rain or while surfaces are damp, it shall be applied only to surfaces that are clean and dry.

6.2 Mopping of surface with bitumen shall be performed so that the surface shall be completely covered. Coats of bitumen shall be as specified in drawings. All bitumen shall be applied with mops except that the hot surfacing application shall be poured from a dipper.

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6.3 Polyethylene sheet shall be laid in position wherever shown in drawings. Where joint is necessary at the side or end of the sheet, this shall be a double weld folded joint made by placing the edges together and folding over twice

continuously taking the top edge prior to plastering or screeding. The Contractor shall protect the sheets from damages during laying and subsequent operation and shall replace at his own cost all damaged sheets to the satisfaction of the Engineer.

6.4 Thermopore (expanded polystyrene) shall be laid in places as designated on drawings or as directed by the Engineer.

7. WATER PROOFING & BUILT UP ROOFING

The water proofing treatment to reinforced cement concrete roof slabs shall be done as per drawings/details complete in all respects or as directed by the Engineer.

8. WATER PROOFING TREATMENT IN FOUNDATION SUB-STRUCTURES, UNDER FLOORS

a) Bitumen Painting

All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire brushing or as directed by the Engineer. The surface shall be primed with a coat or asphalt oil used at the rate of not less than 1 gallon /100 square feet. Two coats of hot bitumen paint shall be applied at the rate of 40 lbs/100 Sft. each coat. The first coat shall be allowed to dry for about 6 hours before applying the second coat. During operation of painting great care shall be taken to avoid air bubbles. The manufacturers shall be taken to avoid air bubbles. The manufacturer's instructions and Engineer's directions shall be followed.

b) Water Proofing of Basement & around exterior surfaces

The water proofing treatment to basement & around surfaces shall be done as per drawings/details complete in all respects or as directed by the Engineer.

9. CURING

Tiles after laying, grouting and flush pointing shall be kept wet throughout for at least 7 days.

10. MEASUREMENT AND PAYMENT

10.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

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The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specifications in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and

the Contractor shall not be entitled to any claim or claim any compensation on this account.

10.1.1 All preparatory work, scrapping, scratching, cleaning, cant strips, gravels strips, etc.

10.1.2 Formwork

10.1.3 Roof treatment inclusive of all items/material specified on drawings.

10.1.4 Coats of bitumen.

10.1.5 Wall, Raft (Base sides & top) exterior inclusive of all items/material specified on drawings.

10.2 Water Proofing & Built-up Roofing

10.2.1 Measurement

Measurement of acceptably completed works respective type of water proofing & built-up roofing over will be made on the basis of net actual area in square feet/meter as shown on the Drawings or as directed by the Engineer.

10.2.2 Payment

Payment will be made for acceptable measured quantity of respective type of water proofing & built-up roofing on the basis of unit rate per square feet/meter quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

10.3 Bitumen Painting/Coating

10.3.1 Measurement

Measurement of acceptably completed works of bitumen painting/coating will be made on the basis of net actual area in square feet/meter as shown on the Drawings or as directed by the Engineer.

10.3.2 Payment

Payment will be made for acceptable measured quantity of bitumen painting/coating on the basis of unit rate per square feet/meter quoted in the Bills of Quantities. The unit rate shall include all cost of surface preparation and shall constitute full compensation for all the works related to the item.

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*** End of Section 6411 ***

SECTION - 6560

FALSE CEILING

1. SCOPE

The work under this section of the specifications, consists of furnishing all plant, labour, equipment, appliances and materials in any floor and at any height and in performing all operations in connection with providing and installing different types of false ceiling including suspension system complete, in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. GENERAL

False ceiling shall be installed wherever indicated on the drawings by skilled technicians experienced in this type of work. Installation shall not commence in any room or space before completion of plasterwork on structural roofing / internal walling/external surfaces.

3. MATERIALS

3.1 Tiles

Tiles shall be of approved size, shape and colour as shown on drawing or as approved by the Engineer shall be used.

All four edges shall be revealed to be installed by an approved recessed suspension system, strictly in accordance with the approved shop drawings, manufacturer's recommendations or instructions of the Engineer.

3.2 Aluminum Strips

Aluminum strip ceiling shall be aluminum 4 inches wide strips, plain surfaced, with mineral wool insulation, manufactured by DAMPA (Denmark) brand, Elephant or DFB or Boral or equivalent.

3.3 Gypsum Board Sheet

Water resistant gypsum board sheet shall be of size as that shown on the drawing.

After cutting the sheet in to approved size tiles, all four edges shall be revealed to be installed by an approved recessed suspension system, strictly in accordance with the approved shop drawings, manufacturer's recommendations or instructions of the Engineer.

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3.4 Suspension System

The suspension system for all types of false ceiling shall be in accordance with the recommendations of the approved false ceiling manufacturer and approved shop drawings, consisting of painted aluminum universal U-channels / main T/

Cross-T Bars, wall mouldings/ edge trims, hold down/adjustment clips, galvanized hanger strips with adjustment mechanism, etc.

4. SUBMITTALS

4.1 Shop drawings shall be submitted showing reflected ceiling plan, locations of built in products and access facilities, dimensions, layout arrangements, hanger locations, structural connection, details of level changes, direction of pattern and panel joint details. The shop drawings shall be got approved by the Contractor from the Engineer in advance of under taking this item of works.

4.2 No materials shall be procured prior to approval of shop drawings and details.

4.3 The Contractor shall incorporate the required access panels of false ceiling as per approved shop drawings.

5. PRODUCT DELIVERY, STORAGE AND HANDLING

5.1 Material shall be delivered in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.

5.2 Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.

5.3 Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

6. JOB SITE CONDITIONS

6.1 Work which will be concealed by false ceilings shall be completed, tested, inspected and accepted before ceiling work is started.

6.2 False ceiling installation shall not begin until the area has been closed in, and temperature and humidity approximate occupancy conditions. Wet work shall be cured and dry before ceiling work is started.

6.3 Surface which will support the ceilings, and those to which the ceiling abut, shall be inspected and accepted for completeness and adequacy to receive the ceilings before the work begins.

7. INSTALLATION AND WORKMANSHIP

False ceiling suspension system and panels shall be installed in accordance with the requirements of BSI-CP.290 and with the manufacturer's recommendations as approved by the Engineer.

7.1 Suspension System

The hangers as specified shall be evenly disposed as per drawings, details and place and position as indicated. The suspension system should be installed by making holes directly in the roof and shall be made good as directed by the

Engineer. Their lengths clear of roofing slab shall be as per shop drawing details.

The framing of the specified section and run at spacing as per shop drawings. The jointing of runners to hangers shall be as per approved shop drawing details. The extra framing if required shall be provided for light receptacles as per approved shop drawing details.

Wall hangers shall be positively and rigidly connected to the structure and to cross runners.

7.2 False Ceiling tiles.

Tiles shall be installed in the grid system after completion of installation of the suspension of lighting and air conditioning fixtures.

Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per shop drawings approved by the Engineer.

All panels shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

8. FIXTURES

Light fixtures shall be installed as per approved pattern and supported in accordance with manufacturer's recommendations.

9. FINISHING

After installation, dirty, soiled or discoloured surfaces shall be cleaned and left free from defects and ready to receive any painted finish if required.

The panels which are damaged or improperly installed shall be removed and replaced by the Contractor at his cost.

10. MEASUREMENT AND PAYMENT

10.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

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- Approved suspension system including main channels, main tee/cross tee bars, wall moulding and edge trims, hanger strips and accessories hold down clips.

10.2 False Ceiling

10.2.1 Measurement

Measurement of acceptably completed works of respective types of false ceiling will be made on the basis of net actual area in square feet / square meter of false ceiling provided and installed in position as shown on the Drawings or as directed by the Engineer.

10.2.2 Payment

Payment will be made for acceptable measured quantity of respective type of false ceiling on the basis of unit rate per square feet/square meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 6560 ***

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SECTION – 6600

FLOOR AND WALL FINISHES

1. SCOPE

The work under this section of the Specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the installation of cement concrete floors and floor finishes including bases, skirting and external surface treatments, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. MATERIAL

2.1 Cement

Cement shall be ordinary portland cement conforming to B.S. 12.

2.2 Sand

All fine sand shall be obtained from sources approved by the Engineer. The grading shall conform to B.S 882 Grading Zone 1 and 2 of which the gradation limits are as follows:

Percentage (by weight) passing

B.S. Sieve	Grading Zone 1	Grading Zone 2
9.53 mm	100	100
4.765 mm	90-100	90-100
No. 7	60-95	75-100
No. 14	30-70	55-90
No. 25	15-34	35-59
No. 52	5-20	8-30
No. 100	0-10	0-10

2.3 Coarse Aggregate

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BSS NO.882 and shall be graded as follows:

B.S. Sieve	% Passing by weight
25.40 mm	100
19.05 mm	90-100
9.53 mm	20-55
4.765 mm	0-10

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The aggregate shall be stored on properly constructed paving or as directed by the Engineer.

There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site with-out delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the Contractor.

2.4 Stone Ballast

Stone ballast to be used as soling shall comprise of strong, hard, durable stone of approved size. The stone shall be obtained from approved quary and shall be sound, free from laminations and weak cleavages and shall conform to specifications of "Stone Soling".

2.5 Water

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes:

2.6 Porcelain Tiles

All tiles shall be of premium quality, plain white/coloured or printed from approved manufacturer. Tiles shall be of sizes as specified on the drawings and shall conform to BS 1281 as per samples.

2.7 Epoxy Coating

Epoxy floor coating 400-micron minimum dft NITO Floor FC150 or equivalent from an approved manufacturer.

2.8 Stone for external facade

Silbata Stone of approved colour, size shall be used on external façade.

2.9 Granite for stairs / Entrance Steps / Vanity Top Black Galaxy

Granite for stairs / Entrance Steps / Vanity Top Black Galaxy granite shall be premium quality non-porous as per approved size specified on the drawings.

2.10 Terracotta Tile

Terracotta tile shall be of approved make, color and size as specified on the drawings or as directed by the Engineer.

3. CEMENT CONCRETE FLOORING

The materials for C.C flooring shall be same as already specified under clause 3, "Materials".

3.1 Composition of Concrete

Concrete shall be composed of Portland Cement, sand, coarse, aggregate and water, all well mixed and brought to the proper consistency. The Contractor shall mix the ingredients as indicated on the Drawings. The proportions of the various ingredients shall be determined from time to time during the progress of the work and tests shall be made of samples of the aggregates and the resulting concrete. The mix proportions and appropriate water-cement ratio will be determined on the basis of the production of concrete having required workability, density, impermeability, durability and required strength.

3.2 Mixing Concrete

The concrete ingredients shall be mixed in a batch mixer for not less than 1-1/2 minutes after all ingredients, except the full amount of water, are in the mixer. The Engineer reserves the right to increase the mixing time when the charging and mixing operations fail to produce a concrete batch in which the ingredients are uniformly distributed and the consistency is not uniform. The concrete shall be uniform in composition and consistency from batch to batch except when changes in composition or consistency are required. Water shall be added prior to, during and following the mixer charge. Excessive over-mixing requiring addition of water to preserve the required concrete consistency will not be permitted. The concrete ingredients shall be mixed by volumetric measurement in purpose made boxes approved by the Engineer.

3.3 Construction

The base course of the floor shall comprise of stone ballast of 150 mm size. The base course shall be thoroughly compacted by suitable power rammers to the total consolidated thickness as shown on the Drawings and as approved by the Engineer. The interstices shall be filled with smaller size stones. The base course shall be blinded with sand and the whole surface watered. Over the well compacted base course, a layer of concrete of the required grade and thickness shall be laid of the sizes as indicated on the Drawing and as approved by the Engineer.

After the C.C bed has been cured, as directed by the Engineer, it shall be roughened and well watered before floor finishing is laid. The floor finish shall comprise of cement concrete of required grade and shall be laid in panels to the required thickness as shown on the Drawings or as directed by the Engineer. The concrete after laying will be thoroughly rammed and mortar worked up to the top and smoothed with a steel trowel. The edge of each section into which the floor is divided should be defined by wooden screeds of the approved width and of a depth equal to the depth of the floor concrete.

Freshly placed concrete floor and completed floor portions as finished shall be protected to prevent loss of water by covering with damp hessian, water proof paper, damp sand or other approved material, and shall be kept constantly damp for a period of four days or longer after concreting as directed by the Engineer. The concrete shall be allowed to dry out slowly over a period of three days after wet curing is completed.

The expansion joints shall be filled in with hot bitumen, of the approved grade, as directed by the engineer.

4. INSTALLATION OF TILE FLOORING

When setting out the tiles, care shall be taken to establish the correct elevation for the floor. A gauge rod shall be used, indicating the overall measurement of a given number of tiles with specified joint width to reduce cutting.

After the floor has been machine finished, it should be covered with white, non-staining sand or rags to protect it while other work is being done. After removal, the floor shall be thoroughly scrubbed.

4.1 General

The base shall be prepared by laying cement concrete of specified grade and of thickness as shown on the drawings, or specified in the Bill of Quantities.

The curing period of the setting bed shall be as directed by the Engineer. As large an area of setting bed shall be spread at one time as can be covered with tiles before the mortar has set. Surplus mortar shall be removed. The thickness of setting bed in any space shall not be less than 12mm.

Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust, oil and other objectionable matters. Tiles shall be laid out from the centre line of each space in an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles as directed by the engineer.

Joints between the tiles shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges.

4.2 Porcelain/Terracotta Tiles/Stone for wall cladding/Granite for steps

The tiles/stone shall be laid to the required lines, levels and grades over a setting bed of specified cement sand mortar and the joints filled with neat white or grey cement including vertical and horizontal covers. The tile floor shall be kept wet for at least 72 hours and no traffic should be allowed on the tiles during curing period. Moreover, the acid resistant tiles shall be laid as per manufacturer's instructions and as approved by the Engineer.

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4.3 Epoxy Coating

The epoxy coating shall be done on trowelled finish Class C concrete 50mm thick.

5. MEASUREMENT AND PAYMENT

5.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities.

The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

5.1.1 Loss and wastage of material due to consolidation, erosion and settlement.

5.1.2 All type of joints (expansion, contraction and construction joint etc.).

5.1.3 Class 'C' cement concrete screed base and 1:3 cement sand mortar under tiles/stone on edge floor and skirting/dado/walls etc.

5.1.4 Bull-nozing, chamfering of edges of vanity tops including base mortar and making holes for wash basin including all necessary fixing accessories if required.

5.1.5 Anchoring system for stone tile on external façade with base jointing mortar.

5.2 Cement Concrete Screed Floor

5.2.1 Measurement

Measurement of acceptably completed works of cement concrete floor steel trowelled finish will be made on the basis of net actual area in square meter/feet laid in position as shown on the Drawings or as directed by the Engineer.

5.2.2 Payment

Payment will be made for acceptable measured quantity of cement concrete floor steel trowelled finish on the basis of unit rate per square meter/feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

5.3 Porcelain/Granite/Stone/Terracotta Tiles

5.3.1 Measurement

Measurement of acceptably completed works of any type of tile/stone will be made on the basis of net actual area in square meter/feet laid in position as shown on the drawing or as directed by the Engineer.

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5.3.2 Payment

Payment will be made for acceptable measured quantity of any type of tile/stone on the basis of unit rate per square meter/feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

5.4 Porcelain Tile Dado/Skirting

5.4.1 Measurement

Measurement of acceptably completed works of any type of tile in dado/skirting will be made on the basis of net actual area in square meter/feet of dado/skirting laid in position as shown on the Drawing or as directed by the Engineer.

5.4.2 Payment

Payment will be made for acceptable measured quantity of any type of tile in dado/skirting on the basis of unit rate per square meter/feet quoted in the Bills of Quantities. The unit rate shall include all cost of cement, sand, mortar and shall constitute full compensation for all the works related to the items.

5.5 Epoxy Coating

5.5.1 Measurement

Measurement of acceptably completed works of epoxy coating in floor will be made on the basis of net actual area in square meter/feet of floor laid in position as shown on the Drawing or as directed by the Engineer.

5.5.2 Payment

Payment will be made for acceptable measured quantity of epoxy coating in floor on the basis of unit rate per square meter/feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

5.6 Stone on facade

5.6.1 Measurement

Measurement of acceptably completed works of stone tile on external facade will be made on the basis of net actual area in square meter/feet laid in position as shown on the drawing or as directed by the Engineer.

5.6.2 Payment

Payment will be made for acceptable measured quantity of stone tile on the basis of unit rate per square meter/feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 6600***

SECTION 6610

TILES

1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height connection with providing and installation of Ceramic tiles for interior floor, wall finishes and exterior wall cladding, Porcelain floor tiles complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. APPLICABLE STANDARDS

2.1 ANSI - American National Standards Institute:

A108.1	Installation of Glazed Wall Tiles
A108.4	Ceramic Tiles Installed with Water-Resistant Organic Adhesives
A118.1	Dry-Set Portland Cement Mortar
A118.2	Conductive Dry-Set Portland Cement Mortar
A118.3	Chemical-Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
A118.6	Ceramic Tile Grouts
E136.1	Organic Adhesive for Installation of Ceramic Tiles
A137.1	Standard Specification for Ceramic Tiles

2.2 ASTM - American Society for Testing and Materials:

ASTM C 150	Specification for Portland Cement
ASTM C 206	Specification for Finishing Hydrated Lime
ASTM C 373	Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware
ASTM C 648	Breaking Strength of Ceramic Tile
ASTM C 1027	Abrasion Resistance of Glazed Ceramic Tile

2.3 TCA - Tile Council of America:

TCA 137.1	Standard Specification for Ceramic Tile

TCA Handbook for Ceramic Tile Installation

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3. SUBMITTALS

3.1 Complete set of samples of manufacturer's standard products for color selection.

3.2 Certification from manufacturer of tile certifying the following:

- Materials provided are suitable for intended use.
- Materials meet or exceed appropriate ANSI Standard .

3.3 Tile manufacturer's complete installation instructions.

3.4 Shop drawing layout showing the tile arrangements.

4. TRANSPORTATION, HANDLING AND STORAGE

Deliver materials in containers with labels legible and intact and grade- seals unbroken. Store material so as to prevent damage or contamination.

5. QUALITY ASSURANCE

5.1 Source Limitations for Tile: Obtain all tiles of same type and color or finish from one source or producer.

5.2 Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each adhesive, and grout component from a single manufacturer.

5.3 Mockups: Build mockups for the approval of the Engineer to verify qualities of materials and execution. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

5.4 Variation in plane of sub-floor, including concrete fills: Not more than 6 mm in 3 meters from required elevation where Portland cement mortar setting bed is used and not more than 3 mm in 3 meters where dry-set Portland cement, and latex-Portland cement mortar setting beds and chemical resistant bond coats are used.

5.5 Variation in plane of wall surfaces and surface of scratch coat: Not more than 6 mm in 2.40 meters from required plane where Portland cement mortar setting bed is used and not more than 3 mm in 2.40 meters where dry-set or latex-Portland cement mortar or organic adhesive setting materials are used.

6. MATERIAL

6.1 CERAMIC TILES

6.1.1 General:

a. Ceramic tiles shall have a standard grade quality in accordance with the Grade Specifications of ANSI A137.1 or DIN 18166 or BS 1286. Tiles shall be stain resistant, impact resistant and slip resistant (floor).

b. Unless otherwise indicated, minimum requirements for ceramic wall and floor tiles shall be Grade-1, best quality glazed tiles, 6 mm thick for walls and 8 mm thick for floors.

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c. Accessories: Provide manufacturer's standard trim including bullnose, cove base and related corners, and half pieces required for the complete installation.

d. Selection and Size: Type, color and pattern shall be as indicated on Drawings unless otherwise approved by the Engineer.

6.1.2 Physical Properties:

a. Breaking strength: Minimum 250 kg for floor 100 kg for wall tiles to ASTM C 648.

b. Water absorption: Maximum 0.5 % for floor and 11% for wall tiles to ASTM C 373.

c. Coefficient of Friction (COF): Minimum 0.5 (wet & dry) to ASTM C 1028.

d. MOH's: Minimum 7.

6.2 PORCELAIN TILES

6.2.1 Fine porcelain stoneware tiles shall be manufactured by using top quality fine porcelain stoneware, obtained by raw materials wet grinding, followed by partial drying by spraying, silo storage to allow homogenization of properties, and pressing by hydraulic pressure exceeding 500 kg/cm^2, and heat treatment in excess of 1200^{0}C.

6.2.2 Porcelain tiles shall be of sizes, pattern and color as shown on drawings. Physical properties of porcelain tiles shall be as follows:

Properties	Applicable Standard	Value
Dimensions and appearance	EN 98	Compliant
Water absorption	EN 99 IIIIIISO PROJECT 10545/3	≤ 0.1%
Flexural strength	EN 100	≥ 50 N/mm^2
Scratch resistance	EN 101	≥ 6 MOHS
Deep abrasion resistance	EN 102	140 mm^3
Linear thermal expansion coefficient	EN 103	6 x 10^{-6} deg C^{-1}
Resistance to sudden temperature changes	EN 104	Compliant
Resistance to chemical etching by acids and bases	EN 106	Compliant
Color stability to light	DIN 51094	Compliant
Specific weight	DIN 51057	2.52 g/cm^3
Weight of unit of volume	DIN 5165	2.40/cm^3

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6.3 MISCELLANEOUS MATERIALS

6.3.1 Adhesive and Grout:

Tile Adhesive: Shall be white cement-based polymer modified ready-mixed powder adhesive conforming to BS 5980:1980, Type 1, Class AA, or equivalent standards. Use 3-6 mm bed thickness mixed with admixture as per manufacturers written recommendations.

6.3.2 Grouting Material: Shall be cement-based polymer modified ready-mixed powder conforming to BS 5750:Part 2 or equivalent standards. Use grout with admixture as per manufacturers written recommendations. Color of grout shall be as approved by Engineer.

6.3.3 Sealants: Elastomeric type, in conformance with the requirements specified.

7. EXECUTION

7.1 GENERAL

7.1.1 Installation of floor and wall tiles shall comply with the requirement of ANSI A108.1 through A108.6 and the TCA **Handbook for Ceramic Tile Installation**, unless otherwise indicated.

7.1.2 Protection and Curing:

Spaces in which tile is being set shall be closed to traffic and other work. Keep closed until tile is firmly set. Protect tile from damage.

Damp cure for at least 3 days; add dampness as needed to achieve a hard cure.

7.1.3 Jointing Pattern:

Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are the same size. layout tile work and center tile fields both directions in each space or on each wall area. Adjust as necessary to avoid use of widths less than 1/2 tile at edge of walls. Provide uniform joints, not less than 5 mm and not more than 7 mm unless otherwise shown.

7.2 INSTALLATION OF WALL TILES

7.2.1 Ceramic tiles on concrete and CMU walls shall be installed with tile adhesive on cured cement plaster. Tiles shall not be soaked prior to installation.

7.2.2 Tiles shall be pressed firmly into freshly notched 3 to 6 mm thick tile adhesive and shall be tapped and beaten to a true surface.

7.2.3 Joint width shall be determined by spacers on tile or by strings or pegs if tile without spacers are used.

7.2.4 Tiles shall be pressed and beaten into place to obtain full coverage by adhesive on back.

7.2.5 Tiles shall be adjusted before initial set of adhesive takes place.

7.2.6 Grouting Wall Tiles: Grouting shall be in strict accordance with the manufacturer's recommendations and shall be cured as required to produce a hard grout.

7.3 INSTALLATION OF FLOOR TILES

7.3.1 Install tiles with adhesive 3 - 6 mm thick tile adhesive as per manufacturer's written recommendations over Portland cement screed sloped to drains, not less than 20 mm thick and not more than 30 mm thick.

7.3.2 Press tiles firmly into the adhesive to obtain full contact with adhesive with no voids.

7.3.3 Grouting Floor Tiles: Grouting shall be in strict accordance with the manufacturer's recommendations and shall be cured as required to produce a hard grout.

7.4 CLEANING AND PROTECTION

7.4.1 Upon completion of placement and grouting, all ceramic and quarry tiles surfaces shall be cleaned free of foreign matter.

7.4.2 Glazed tiles surfaces shall be sponged and washed thoroughly diagonally across joints and finally polished with clean, dry clothes.

7.4.3 Unglazed tiles may be cleaned with cleaners and/or solvents recommended by tile manufacturer after completion of installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of cleaning materials. Flush and surface with clean water before and after cleaning.

7.4.4 Finished installation shall be left clean and free of cracked, chipped, broken, un-bonded or otherwise defective tile work.

7.4.5 Apply a protective clear sealer coat(s) for unglazed tiles. Number of coats shall be as recommended by manufacturer. Protect installed tile work with Kraft paper or other heavy covering during the construction period to prevent damage.

7.4.6 Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

7.4.7 Seal plumbing and electrical penetrations through wall tile with sealants.

8. MEASUREMENT AND PAYMENT

8.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective item of the Bill of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and

the Contractor shall not be entitled to any claim or claim any compensation on this account.

8.1.1 Submittals

8.1.2 Transportation, Handling and Storage

8.1.3 Quality Assurance

8.1.4 Adhesive and Grout

8.1.5 Cleaning and protection

8.1.6 Cement sand mortar

8.1.7 Protection and curing

8.2 Ceramic tiles

8.2.1 Measurement

Measurement of acceptably completed works of Ceramic tiles will be made on the basis of actual area in square foot / meter of Ceramic tiles provided and fixed in position as shown on the Drawings and as directed by the Engineer.

8.2.2 Payment

Payment will be made for acceptable measured quantity of Ceramic tiles on the basis of unit rate per square foot / meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

8.3 Porcelain tiles

8.3.1 Measurement

Measurement of acceptably completed works of Porcelain tiles will be made on the basis of actual area in square foot / meter of Porcelain tiles provided and fixed in position as shown on the Drawings and as directed by the Engineer.

8.3.2 Payment

Payment will be made for acceptable measured quantity of Porcelain tiles on the basis of unit rate per square foot / meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 6610 ***

SECTION - 7510

PRECAST CONCRETE PAVING BLOCKS / TILES

1.0 SCOPE

The work shall consist of precast concrete paving blocks intended for the construction of low speed roads, parking areas, lay byes, industrial and other paved surfaces subjected to all categories of static and vehicular loading and pedestrian traffic. Paving blocks covered by these Specifications are designed to form a structural element and the surfacing of pavements, having the block to block joints filled, so as to develop frictional interlock and placed in conformity with the fines, grades, thicknesses and typical cross- section shown on the drawings or as directed by the Engineer.

2.0 MATERIAL REQUIRMENTS

For execution of this item provisions made in BS 6717 shall be applicable. Detailed requirement of materials and construction shall be as under:

2.1 Binders and Binder Constituents

Paving blocks shall be made using one or more of the following binders or binder constituents complying with the requirements of the relevant standards:

Ordinary Portland Cement	BS 12
Portland Blastfurnace Cement	BS 146 : Part 2
Portland Pulverized Fuel ash Cement	BS 6588
Pulverized fuel ash	BS 3892: Part 1
Ground granulated Blast furnace slag	BS 6699

Where pulverized fuel ash is used, the proportions and properties of the combination with Portland Cement shall comply with BS 6588.

Where ground granulated blastfurnace slag is used, the proportions and properties of the combination with Portland Cement shall comply with BS 146 : Part 2.

2.2 Aggregates

Paving blocks shall be made using one or more of the following aggregates complying with the relevant standards:

Natural Aggregates (Crushed or Uncrushed)	BS 882 : 1983 (except grading requirements in clause 5)
Air Cooled blastfurnace slag	BS 1047 : 1083 (except grading requirements in 4.8)
Pulverized fuel ash	BS 3892 : Part-1 or Part-2
Ground granulated blastfurnace slag	BS 6699

2.2.1 Acid Soluble Material (Fine Aggregate)

When tested as described in BS 812 : Part 119, the fine aggregate (material passing a 5mm sieve complying with BS 410) shall contain not more than 25% by mass of

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acid soluble material either in the fraction retained on, or in the fraction passing, a 600 μ m sieve.

2.3 Water

The water shall be. of drinking quality or in accordance with the recommendations of appendix A of BS 3148: 1980.

2.4 Admixtures and Pigments

Proprietary accelerating, retarding and water reducing agents shall comply with BS 5075: Part 1.

Pigments shall comply with BS 1014.

Calcium chloride shall comply with BS 3587

2.5 Finishes

The finish should be agreed between the manufacturer and the Engineer.

Concrete described as "natural colour shall contain no pigment.

In composite paving blocks the surface layer shall be formed as an integral part of the block and shall be not less than 5 mm thick.

2.6 Binder Content

The cement content of the compacted concrete shall be not less than 380 kg/m^3 for equivalent durability, paving blocks made with binder constituents other than ordinary Portland cement shall have higher binder content than paving blocks made in a similar way using only Portland Cement. The Engineer will decide the additional binder content. The compressive strength test will be the only guide to the amount of additional binder needed.

2.7 Sizes and Tolerances

2.7.1 Sizes

Paving blocks shall have a work size thickness of not less than 60 mm. Type-R blocks shall be rectangular with a work size length of 200 mm and a work size width of 100 mm. Type-S blocks shall be of any shape fitting within a 295 mm square coordinating space and shall have a work size width not less than 80 mm.

The preferred work size thicknesses are 60 mm, 65 mm, 80 mm & 100 mm.

A chamfer around the wearing surface with a work size not exceeding 7 mm in width or depth shall be permitted.

All arises shall be of uniform shape.

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2.7.2 Tolerances

The maximum dimensional deviations from the stated work sizes for paving blocks shall be as follows:

length	±	2mm
width	±	2mm
thickness	±	3mm

Where a paving block includes profiled sides, the profile shall not deviate from the manufacturer's specification by more than 2 mm.

2.8 Compressive Strength

The compressive strength of paving blocks shall be not less than 49 N/mM^2 and the crushing strength of any individual block shall be not less than 40 N/mM^2.

2.9 Sampling

The following sampling procedure shall be used for the compressive strength test.

a) Before laying paving blocks, divide each designated section, comprising not more than 5000 blocks, in a consignment into eight approximately equal groups, Clearly mark all samples at the time of sampling in such a way that the designated section or part thereof and the consignment represented by the sample are clearly defined. Take two (2) blocks from each group.

b) Dispatch the sample to the test laboratory, taking precautions to avoid damage to the paving blocks in transit. Each sample shall be accompanied by a certificate from the person responsible for taking the sample, stating that sampling was carried out in accordance with this Part of BS 6717.

c) Protect the paving blocks from damage and contamination until they have been tested. Carry out any tests as soon as possible after the sample has been taken.

3.0 CONSTRUCTION REQUIREMENTS

3.1 Laying the Concrete Blocks

Before laying the concrete blocks sand cushion shall be placed on the prepared surface of aggregate base course or lean concrete as per specification/drawings.

The total area will thereby be divided with nylon strings into sectors of not more than 1.5 square meters. This shall be done to control the alignment of paving blocks and to avoid multiplication of deviation in sizes of paving blocks.

3.2 Tolerance

The surface will be tested with a four (4) meter straight edge by the Engineer at selected locations. The variation of the surface from the testing edge of the straight edge between any two (2) contacts with the surface shall at no point exceed four (4) millimeters when placed on or parallel to the centerline or three (3) millimeters when placed perpendicular to the centerline of the

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roadway. The top of the base shall not vary from the required elevation by more than five (5) millimeters. All humps and depressions exceeding the specified tolerance shall be corrected by removing the defective work and replacing it with new material as directed by the Engineer.

4.0 MEASUREMENT AND PAYMENT

4.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective item (s) of the Bill of Quantities.

4.1.1 Providing, fixing, striking etc. of formwork.
4.1.2 Curing and testing of concrete.
4.1.3 Sand cushion in bed/joints for laying paving blocks/ tiles.
4.1.4 Edge precast blocks and cut units.
4.1.5 Cast insitu concrete to stablise edge precast blocks.

4.2 Pre-Cast Concrete Paving Blocks

4.2.1 Measurement

Measurement of acceptably completed works of pre-cast concrete paving blocks will be made on the basis of actual area in square foot / metre of concrete paving blocks provided and laid in position to the line, level and grade as shown on drawing or as directed by the Engineer.

4.2.2 Payment

Payment will be made for acceptable measured quantity of pre-cast concrete paving blocks on the basis of unit rate per square foot / metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

4.3 Pre-Cast Concrete Paving Tiles

4.3.1 Measurement

Measurement of acceptably completed works of pre-cast concrete paving tiles will be made on the basis of actual area in square foot / metre of concrete tiles provided and laid in position to the line, level and grade as shown on drawing or as directed by the Engineer.

4.3.2 Payment

Payment will be made for acceptable measured quantity of pre-cast concrete paving tiles on the basis of unit rate per square foot / metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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4.4 Pre-Cast Concrete kerb block

4.4.1 Measurement

Measurement of acceptably completed works of pre-cast concrete kerb block will be made on the basis of actual area in running foot/metre of concrete tiles provided and laid in position to the line, level and grade as shown on drawing or as directed by the Engineer.

4.4.2 Payment

Payment will be made for acceptable measured quantity of pre-cast concrete kerb block on the basis of unit rate per running foot/metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 7510 ***

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SECTION - 8001

GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS

1. SCOPE OF WORK

The works related to the Electrical system, which are included in the scope of this Contract, are shown on the Drawings, stated in the Specifications and Bill of Quantities and explained in these specifications. The works shall broadly include but not limited to the following:

- LV DG Set
- Indoor Power Transformer
- High Tension Switchboard
- LT Switchboard
- LT Distribution Boards
- Light Fixtures
- Uninterruptable Power Supply (UPS) System
- High Tension Cable
- Low Tension Cable
- Wiring Accessories
- Pipes and Conduits
- Earthing / Grounding System
- Lightning Protection System
- Isolated Power Supply
- Miscellaneous items
- Structured Cabling Network
- IP Private Automatic Branch Exchange (IP-PABX)
- Intelligent Addressable Fire Alarm System
- Closed Circuit Television System (CCTV)
- Public Address &Amp; Voice Evacuation System
- IP Nurse Call System
- Cable Antenna TV System (CATV)
- Access Control System

The Contractor shall also be responsible to supply any other equipment not specifically mentioned in these documents but which is necessary for proper operation of the system as intended in the scope of this Contract. The Contractor shall solely be responsible for ensuring proper functional requirements of various equipment and shall be responsible for furnishing any additional piece of equipment and for making modifications in the equipment as desired and/or approved by the Engineer to achieve proper co-ordination with various equipment offered in the bid and also with those installed by others.

Contractor shall timely carry out field survey to identify the route of feeders and exact location of new 11 KV VCB Panels which are to be connected with the existing 11 KV VCB panels in the utility room via bus bar extension, along with the connection of this new substation HT panels to the same through HT Cable.

2. RULES & REGULATIONS

The entire electrical installation/work shall be carried out by licensed Contractor, authorized to undertake such work under the provisions of the Electricity Act 1910 and

The Electricity Rules 1937 as adopted and modified upto date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers-London, the Tender Documents, The Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these Specifications and any other rules and regulations shall be brought to the notice of Engineer for his instructions and the decision of the Engineer shall be final and conclusive.

The Contractor shall ensure that the connection of 11kV cable with the existing 11KV switchgears at utility substation is certified by / acceptable to K-Electric.

3. AMBIENT CONDITIONS

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material/equipment.

Maximum indoor ambient temperature	:	50	Degree Celsius
Minimum indoor ambient temperature	:	Zero	Degree Celsius
Maximum outdoor ambient temperature	:	50	Degree Celsius
Minimum outdoor ambient temperature	:	Zero	Degree Celsius
Maximum Relative humidity	:	100	Percent
Minimum Relative humidity	:	20	Percent
Maximum Altitude of project	:	6	meters
Design basic wind speed	:	80miles/hr Fastest mile wind velocity as Per UBC 1997	
Seismic Zone	:	2A as per UBC 1997	

The atmospheric condition is highly humid. The wind loading shall also be considered as per applicable local Codes and Standards.

All the offered/supplied electrical equipment, devices and material etc., shall be strictly in line with the project site conditions.

4. STANDARDS

The latest standards, codes and recommendations of reputable institutions shall be applicable for the material and equipment specified herein and for installation work. Such institutions to be BSS, VDE, IEC, NEC, NFPA, HTM etc. In case the Specifications laid down herein differ from those given in the standards, then the equivalent or better specifications shall govern. Wherever applicable the equipment shall also conform to the requirements of Pakistan Standards and Quality Control Authority (PSQCA) and Pakistan Standard Institution (PSI).

Contractor shall maintain at the site office one copy of the standards/codes/ recommendations as applicable to the works and will furnish the same as and when required by the Engineer / Employer.

5. SYSTEM DATA

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate satisfactorily with the following minimum requirements without any de-rating.

a) Voltage rating of equipment : HT: 11kV, 3 phase ±10%
LT: 400V, 3 phase ± 10%

230 V, 1 phase ± 10%

b) Frequency : 50 Hz ± 2 Hz

In general, the electrical colour coding of switchgear cubicles, control panels, desks etc., shall be in accordance with the respective IEC Recommendations.

Live parts of electrical connections shall be colour coded according to IEC 60445:2017 & BS7671:2008 as follows:

	Conductor Designation	**Coding Alphanumeric**	**Colour**
A.C. Network	Phase 1	L 1	red
	Phase 2	L 2	yellow
	Phase 3	L 3	blue
	Neutral	N	black
D.C. Network	Positive	L+	white
	Negative	L-	black
Earthing	Protective Earth	PE	green/yellow
	Earth	E	green/yellow

Control Cables

The Control Cables shall be manufactured according to specifications for L.T. Cables. The Control Cables shall be of multi-core, PVC insulated type withstanding, without deterioration, the conditions prevailing at the place of installation. The cross section of cable shall be as per the requirement of the system. For size/type selection of control cables, the Contractor shall submit calculation to verify with the sizes of selected cables

All the cores should be numbered and/or colour coded or otherwise properly identified. At-least 20% spare cores shall be provided in all Control Cables.

No separate payment is admissible for supplying, installing, testing and commissioning of control cables and is deemed to have been included in the BOQ rates of the respective equipment.

Distance in between power, communication and control cables shall be kept as per requirements laid down by NEC800, NFPA 70 and BS EN 50174-2:2009+A2:2014.

6. EQUIPMENT

6.1. Equipment Manufacturer

All equipment and material supplied for the project shall be standard products of reputable and ISO certified manufacturers having similar manufacturing experience of at-least five years.

For imported equipment, required for the project, only authorized local distributors/suppliers of the Original Equipment Manufacturer (OEM) shall be considered.

For all Original Equipment Manufacturer (OEM) equipment, the Contractor shall clearly identify the brand of the equipment, the country where the equipment has been manufactured, as well as the local agent in Pakistan who is able to provide local maintenance assistance.

Authorized Local agents reference shall include at least (but not limited to)

- Company name,
- Address in Pakistan,
- Contact persons,
- Phone numbers,
- Valid Email,
- Reference of the company in similar fields.
- Authorized Distribution Certificate from OEM.
- Certified Engineer's Certificate.

After sales, service, spare and support of all offered local/imported equipment and material shall be available with the manufacturer/authorized distributors.

OEM/Distributors failing the above-mentioned requirements are liable not to be considered.

6.2. Country of Origin

Equipment manufactured in **Israel** and **India** are not acceptable. The Contractor shall clearly mention in his bid the origin of the equipment that he is proposing. In case any subassembly or part assembly is from any country other than that the country where the equipment has been manufactured, the Contractor shall disclose this information with his bid. No relaxation/acceptance of equipment from the non-listed countries will be entertained after award of Contract.

6.3 Quality Assurance

All materials and equipment shall be new, unused and of best quality. Standard components of suppliers regularly engaged in their manufacture shall be offered. All equipment and components shall have been thoroughly tested and proven in actual use. Equipment shall have current year of manufacturing.

Manufacturers quality control shall be in accordance with the ISO 9000 - series (or DIN equivalent) recommendations. Manufacturers whose quality control has been certified according to ISO 9000 – series will only be acceptable. Certified copy shall be attached to bid.

6.4. IP Degree of Protection

The equipment shall have IP degree of protection as follows, unless mentioned otherwise:

- IP 42 for indoor areas
- IP 54 for indoor damp areas
- IP 65 for outdoor areas

After installation, the contractor shall be responsible to provide high performance epoxy paint on all Switchboards and related electrical equipment. If properly rated equipment is not available, the Contractor shall provide field enclosures to attain the required IP degree of protection. If necessary cooling/exhaust fans and / or anti condensate heaters shall also be provided. No separate payment shall be made to attain the required IP degree of protection and it deemed to have been included in the relevant BoQ item.

6.5. Nameplate

All equipment shall be provided with stainless steel name plates which shall be mounted in a visible position. The entries on the name plate shall be indelibly marked in English by engraving and shall include the data in accordance with

relevant IEC and other relevant standard applicable to each equipment. In addition, any specified requirement stated in these specifications shall also be complied.
The Contractor shall also supply all labels, instruction and warning plates necessary for the identification and safe operation of the plant/site and all instructions shall be in English and where specified in Urdu languages. All labels, nameplates, instructions and warning plates shall be securely fixed to items of plant and equipment with stainless steel rivets, plated self-tapping screws or by other approved means. The use of adhesives will not be permitted.

6.6. Identification & Labeling

All devices, meters cabling, wiring and auxiliaries shall be properly labeled for identification. Labeling of equipment shall be done by means of flameproof material using indelible ink/marking. The labeling shall be such as to ensure uniformity and shall facilitate study of control diagrams/ drawings during operation and maintenance.

All labeling shall be of suitable size to be visible from the operating conditions/positions at site.

6.7. Lamp Test Facility

All equipment / Switchboards, etc. shall be provided with common lamp test facility.

7. SHOP DRAWINGS, MATERIAL SUBMITTALS, AND TECHNICAL DATA TO BE FURNISHED BY THE CONTRACTOR

7.1. The shop drawings, comprehensive material submittals and/or technical data to be furnished by the Contractor for each electrical equipment shall include, but not limited to the following:

a) Structural drawings showing foundations, RCC details dimensional plans, elevation and sections on a suitable scale including loading details of the equipment.

b) Electrical drawings showing:

- Line/Schematic diagrams of:
  - HT Switchboards
  - LT Switchboards/ Automatic Transfer Switch (ATS) / Synchronization Panel
  - LT Distribution Boards
  - Detailed wiring / control diagrams, elevations / internal component layout / Top & Bottom / Side views and other standard / required details.

c) Complete shop drawings of all systems with necessary execution / fixing/ installation details such as no. of wires, size of conduit, cable routes, cable schedules etc. for the following layouts unless required otherwise:

- Lighting Layouts including Facade Lighting Layout
- Power Layouts
- Cable Tray Layouts
- Grounding Layouts
- Lighting Protection System Layouts

- MV and LV Cabling details including complete cable routing / conduiting / piping and other required details
- Manhole / Duct woks
- Danger Sign Board Dimensional and installation Details.
- Combined and Coordinated ceiling Layouts.

d) Equipment installation details for Power Transformer, LV DG Set, H.T Switchboard(s), L.T Switchboard(s) / Automatic Transfer Switch (ATS) / Synchronization Panel and L.T Distribution board(s)

e) Technical literature and manufacturer's characteristic data with the description of materials and weights of all equipment as instructed by the Engineer.

f) As-Built Drawings of existing conditions.

g) Combined Services Layout Diagrams (Coordinated with existing services)

h) Foundation and Trench Arrangement Drawings

i) Technical submittals of Equipment for:

- Low Voltage D.G. Set
- Power Transformer
- HT Switchboard
- LT Switchboards / Automatic Transfer Switch (ATS Panel) / Synchronization Panel
- LT Distribution Boards
- Uninterruptable Power Supply (UPS) System
- Miscellaneous Items (Isolated Power supply Panel)

j) Technical submittals of Equipment along with material sample for:

- Light Fixtures
- HT / LT Cables
- Wiring Accessories
- Conduits / Pipes & Fittings
- Earthing & Lightning Protection System
- Miscellaneous Items (Cable Trays / Ladders, Under floor metal trunking, Ceiling / Bracket Fans, Switch disconnector / LBS with weatherproof Enclosure box)

  For details, refer the relevant sections of the specifications to ensure compliance as required therein.

  Technical submittals of equipment for which the material sample is not submitted, shall be liable to rejection.

k) Testing and commissioning time table

l) Testing and commissioning protocols

m) Design Calculations/ software-based simulations:

Based on the final approved / selected equipment/ fixture/ protective device etc. Contractor shall perform and submit calculations to the Engineer for review and approval. In this regard, Contractor shall perform following software based simulations, calculations, assessment, analysis unless required otherwise by the Engineer.

- Illumination calculations (for Indoor / Outdoor Area / Building Facade) based on finally selected light fixtures.
- Voltage drop calculation for each feeder / circuit starting from Power Supply source (Transformer) up to point of utilization.
- Comprehensive Short Circuit software design simulations / calculations determining the maximum possible short circuit current levels at the Utility's main LT Switchboard
- Selective coordination Analysis based on finally selected circuit breakers / fuses.

  The entire LV Distribution network, starting at main Switchboards and extending up to last downstream LT Switchboard / Distribution Board / Apparatus Control Panel (ACP) / Termination device (Circuit Breaker / Load Disconnecting Switch), shall be properly coordinated through selection of appropriate type of circuit breaker / fuse. No additional payment shall be admissible if any higher rating of circuit breaker / fuse is required to achieve the selectivity.
- Thermal soil resistivity measurement through field testing at site
- Lightning Protection Risk Assessment and rolling sphere protection angle method based analysis and assessment.
- Earthing calculations based on actual thermal soil resistivity measured at site.

For details, refer the relevant sections of the specifications to ensure compliance as required therein.

No separate payment shall be admissible for performing any software-based simulations, design calculations, analysis, measurement, field testing assessment, etc. Cost incurrence associated with all such scope shall deem to have been included in the item rate of the relevant BOQ item. Any additional payment, whatsoever, shall not be admissible in this regard.

7.2. At least three (3) copies of the shop drawings, comprehensive material submittals and/or technical data of the equipment shall be submitted to the Engineer for review and approval.

The Engineer will review all drawings, material submittals, manufacturer's catalogues and design calculations and make changes as required, in order to assist in the overall job coordination and to ensure conformance to the technical specifications and applicable standard. The Contractor shall ensure full compliance as commented by the Engineer on the submitted drawing, document, material submittal, technical data, calculations and schedules etc.

Engineer's approval must be obtained before any equipment, device & material is purchased or material fabrication is commenced. The Engineer's approval will be general and shall in no way relieve the Contractor of this responsibility for any work required under the Contract.

7.3. One copy of each drawing and descriptive data will be returned to the Contractor generally marked.

(a) "APPROVED"

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(b) "APPROVED EXCEPT AS NOTED"
(c) "REVISE AND RESUBMIT"
(a) "NOT APPROVED"

Each drawing, document, material submittal, technical data, calculations and schedules etc., which is noted as "NOT APPROVED" shall be considered Rejected and the Contractor shall offer alternates and re-submit after making required corrections/ compliance for Engineer's review and approval. The Contractor shall submit four (4) copies of the alternative offer.

Each drawing, document, material submittal, technical data, calculations and schedules etc., which is noted as "REVISE AND RESUBMIT" shall be re-submitted after making corrections/ compliance for Engineer's review and approval. The Contractor shall submit four (4) copies of each revised issue thereof.

Minor corrections/modifications will be necessary in the drawings, documents, material submittal, technical data, calculations and schedules etc. marked as "APPROVED EXCEPT AS NOTED". The Contractor may proceed ahead. However, he shall incorporate the changes, comments, corrections etc. as marked but does not necessarily resubmit the drawings/submittals/documents etc. for further approval. But if the Engineer considers necessary then he may ask the Contractor for the resubmission to verify the incorporation of changes/comments/corrections.

Contractor is bound to submit the revised submittal within 7 days.

7.4. The Contractor must consider 21 working days (from date of receipt by Engineer to date of dispatch from Engineer's Office) for Engineer's review of each set of drawings/material submittals/documents etc. in his consideration of schedule of work and in the time allowed for completion of the Contract.

7.5. The Contractor shall be responsible for any discrepancies, shortcomings, errors or omissions in any drawings or other particulars supplied by him whether such drawings or particulars have been reviewed by the Engineer or not.

7.6. Any delay; in the approval of the submitted material submittal, drawing, document, technical data, calculations, and schedules etc., which is caused due to incompleteness, shortcomings, non-submission of required information / data etc. shall be totally attributable to the Contractor and will not be considered a reason for extension of time (EOT).

7.7. The symbols used for the simplified representation of electrical equipment shown on the drawings must conform to applicable NFPA, NEC, IEEE, IEC, and/or DIN etc. Soft copies of all the applicable codes / standards as specified in relevant clauses of different specification sections will be provided by the Contractor to the Engineer for his reference and record.

7.8. All circuit diagrams shall be drawn in a way that they can be assembled in a standard hard core, non-detachable binder and can be unfolded without having to be detached.

8. MANUFACTURER'S INSTRUCTIONS

The Contractor shall supply to the Engineer in properly bound form six (6) copies of manufacturer's instruction manuals for installation, testing, commissioning, operation and maintenance of the specified equipment including manuals of spare parts and tools of the equipment. At least two copies of the documents shall be submitted in original. The installation instructions shall be submitted 2 weeks prior to commencement of installation of each equipment, and operation and maintenance instruction at the time of

commissioning. If the Contractor fails to provide the documents, The Engineer shall withhold issuance of requisite certificates and deduct suitable amount from the payments to the Contractor.

9. GUARANTEE

The Contractor shall furnish written guarantee of the manufacturer or supplier with respect to satisfactory performance of each equipment. Guarantee shall be given for replacement and repair of part or whole of the equipment, which may be found defective in material or workmanship. The guarantee shall cover the duration of Defects Liability Period as defined in the Conditions of Contract. This guarantee shall not relieve the Contractor of his obligations and he will be fully responsible for the repair or replacement of any defective material in time, so as not to cause any undue delay in carrying out the repairs and/or replacements.

10. DANGER BOARDS WITH SIGNS, DESIGNATION AND SHOCK / FIRST AND CHARTS AND FIRE FIGHTING EQUIPMENT

Danger Boards having signs and designation of the room shall be installed on the external door of DG Set Room, HT, LT, and Power transformer rooms whereas, Painted Danger Sign and Designations shall be provided. Shock/First Aid Charts shall be installed in H.T, L.T, Low Voltage DG Set, and Transformer Rooms.

Potable firefighting extinguisher suitable to control electrical fire shall be provided in H.T, L.T, and Power Transformer Rooms.

All the above items shall also be provided, wherever required to comply the requirements of the Pakistan Electricity Rules/Electric Inspector.

Laminated single line and adequate detail drawings on proper boards highlighting the main system features shall be displayed/ fixed in respective electrical and communication rooms.

No additional payment shall be made for such works as the same is deemed to have been included in relevant BOQ item.

11. ASSOCIATED CIVIL WORKS

Except where separately stated in the Bill of Quantities the cost of all civil works associated with any BOQ item of electrical works, such as excavation and backfilling of earth, compaction of the earth, foundation pads, thrust boring, chiseling, making openings, etc. shall deemed to be included in the price quoted against respective electrical items.

All openings made in external/internal walls, slab, ceiling, etc. for electrical works shall be filled in after installation of equipment, laying of trays/cables etc. with suitable heat and fire-resistant mortar, suitably rated with respect to the building fire zones so as to ensure no ingress of water, spread of fire from one fire zone to another. All unutilized conduit/pipe/slab opening shall be sealed with same material. Such works will also include repair of any damage to civil works caused by the Contractor during electrical installation.

No separate payment for such works will be made. Such works will also include repair of any damage to civil works caused by the Contractor during electrical installation.

12. INSTALLATION INSTRUCTIONS – GENERAL

The Contractor shall install all systems components and appurtenance in accordance with manufacturer's recommendation and provide all necessary interconnections, services and adjustments required for a complete functional system.

The Contractor shall provide instrumentation and communication grounding as necessary. All penetration shall be sealed to preclude the entry of water using a silicone material.

The Contractor shall furnish all labour, materials, tools and equipment required to install, connect, test and commission all electrical equipment specified herein, whether or not such equipment is furnished by him or by others.

For all equipment to be installed by the Contractor, the Contractor shall supply and install all erection materials such as foundation bolts, washers, nuts, etc. as required and without any additional costs.

The Contractor shall set out the works himself as per Specifications and Drawings and shall properly position the equipment on specified foundation/location. In general, the manufacturer's instructions for installation shall be followed. Any defect or faulty operation of equipment due to the Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost.

For any deviation from the working drawings that are deemed necessary by the Contractor due to site conditions, he shall submit the details and obtain the Engineer approval before starting such works.

13. FACTORY ACCEPTANCE TESTS (FAT)

13.1. Scope

Factory tests are to be carried out in the presence of both the Employer and the Engineer. All type and routine tests on D.G Sets, HT Switchboards, Power Transformers, LT Switchboard, Automatic Transfer Switch (ATS), Synchronization Panel, LT Distribution Boards, H.T Cables, L.T Cables, Control Cables. Miscellaneous Items and all other equipment shall be performed at the manufacturer's works in the presence of the Engineer and the Employer or their representative.

Type tests may be waived off in case test certificates are submitted as certified by an Engineer approved standard laboratory of international repute; but merely producing the type test certificates will not relieve the manufacturer to carry out the required standard/routine tests.

The Contractor shall submit the test procedure to the Engineer/Employer for approval at least 4 (four) weeks before carrying out the tests. Factory test procedures shall be drawn in accordance with relevant code/standards, standards practices and manufacturer's recommendation.

The Contractor shall inform the Engineer/Employer about the date and time of test of each equipment at least two weeks in advance to allow time to the Engineer and the Employer for preparation and travelling. This shall, however, be done after the Contractor has got the test procedures duly approved by the Engineer.

The Contractor shall make necessary arrangements and provide all the facilities required for the representatives of Employer / Engineer for conducting such inspection, at the Contractor's cost. The cost of travel shall be responsibility of the Contractor.

The witnessing of test by the Engineer and the Employer shall not absolve the Contractor from his responsibility for the proper functioning of the equipment, and for furnishing the guarantees referred to in **clause 9.0**. All test results shall

be supplied in quadruplicate. All observations agreed on and discrepancies noted during the inspection are to be corrected by the Contractor prior to shipment of the equipment. Only tested equipment will be released for shipment. All test results shall be supplied in quadruplicate.

Equipment to be supplied under this Contract shall be subject to inspection and testing by one representative of Employer and one representative of Engineer at its point of original manufacture or final shop assembly before its packing & and dispatch to site. The Contractor shall make necessary arrangements and provide all the facilities required for the representatives of Employer / Engineer for conducting such inspection, at Contractor's cost. The cost of travel including overseas travel, arranging of Visas, boarding and lodging of Employer's and Engineer's representatives shall be the responsibility of the Contractor.

In addition, the Contractor shall provide daily allowance (US$ 200/man day) for out of pocket expenses to each of Employer's and Engineer's representatives nominated for inspection. The number of days shall be actual days spent in travel calculated from the dates of travel from and to hometown of the concerned representative. The daily allowance in cash (US$) shall be provided before start of travel from hometown.

The Contractor shall submit tests procedures for approval of Engineer well in advance to the set date of pre-shipment inspection. All relevant submittals, shop drawings and requisite technical data should be approved by the Engineer prior to the start of production.

The Contractor shall give at least 3 (three) weeks' notice to the Employer/Engineer for attending such inspections/tests.

All domestic and foreign FATs shall be carried out in the presence of the Employer and the Engineer or their representatives.

13.2. Transformer Tests

The following routine tests shall be performed on the power transformer at the manufacturer's premises in accordance with the latest edition of IEC 60076 as minimum, unless required otherwise by the Engineer:

- Measurement of Polarity and Phase relationship
- Measurement of Load Losses & Current
- Measurement of No-load losses & Current
- Induced Over-Voltage Withstand Test
- Separate Source Voltage Withstand Test
- Measurement of Winding resistance for both MV & LV
- Measurement of Insulation resistance of Windings using megger
- Measurement of Short Circuit Impedance and Load Losses
- Measurement of Dielectric Strength of Oil
- Functional Test of Bucholz Relay

13.3. Diesel D.G Set

13.3.1 Standard Witness Test

The approved D.G Set shall be subject to the following standard inductive load duration tests at the manufacturer's premises in

accordance with the applicable codes / standards as minimum unless required otherwise by the Engineer:

i. Inspection of Generator Set prior to Set Test

ii. Demonstration of Load Acceptance (at normal operating temperature)

- Application of single step load (or as instructed by the Engineer) prior to commencement of the test to the DG Set when at no load and at normal operating temperature
- Initial load to be applied will be mutually agreed between the Engineer and the Generator manufacturer.

iii. Load Duration Test

- DG Set shall be load tested at 100% of rated machine at 0.8pf for the first hour and at 1.0pf for the second hour.
- Prime rated sets above 100kW shall be load tested for 90 mins at 100% and an additional 30 mins at 110% overload rating.
- Two hours standard test will be split as per below:
  - 1 hour at 0.8pf (45mins at 100% & 15mins at 110%)
  - 1 hour at 1.0pf (45mins at 100% & 15mins at 110%)

iv. Load Duration Test - Demonstration

- During the load test, the following information & generator control parameters shall be recorded every 15 minutes or duration as recommended by the manufacturer:
  - Time
  - kW
  - Power Factor
  - All L-L Voltages
  - All Line Currents
  - Frequency
  - Oil Pressure
  - Engine Coolant Temperature
  - Alternator Temperature – (Air In, Air Out, case and ambient)

v. Load Duration Test - Readings

- The following control and protection features will be demonstrated:
  - Manual Control
  - Automatic Starting and Rest Attempts
  - Emergency Stop Control (Local & Remote)
  - Automatic Mode Cooling Run

13.3.2 Documentation

The following document will be presented as part of the standard documentation provided to the Engineer / Employer upon conclusion of the agreed testing process:

i. Extended Load Run Certificate

ii. Copy of the Standard Factory Test Certificate

iii. Certificate of Inspection

iv. Copy of the Engine Test Certificate

v. Copy of the Alternator Test Certificate

vi. Transient graphs for requested load steps

vii. Calibration Certificates for test equipment used during the testing process.

13.4. H.T Switchboards, L.T. Switchboards, Automatic Transfer Switch (ATS), Synchronization Panel, / Distribution Boards, / Apparatus Control Panel (ACP)

Contractor shall submit the proforma / list for essential routine tests in accordance with the latest edition of IEC 62271-1 & 62271-200 which are to be carried out on the proposed HT Switchboard at the manufacturer's / assembler's premises during FAT for Engineer's review during submittal review stage.

Likewise, Contractor shall also submit the proforma / list for essential routine tests in accordance with the latest edition of IEC 61439 which are to be carried out on the proposed LT Switchboard, Automatic Transfer Switch (ATS), Synchronization Panel, at the manufacturer's / assembler's premises during FAT for Engineer's review during submittal review stage.

Routine tests on the proposed L.T Distribution Boards, & Apparatus Control Panel (ACP) shall be carried out at the manufacturer's / assembler's premises as per relevant international standards.

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for connections to give proper phase sequence. Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses, disconnect switches, number of interlocks, indicating lights, alarms and remote control devices shall be in accordance with approved manufacturer drawings. Nameplates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment. Lamp test facility will also be checked.

13.5. H.T Cables / L.T Cables

Contractor shall submit the proforma / list for essential routine tests in accordance with the latest edition of IEC 60502-2 which are to be carried out at the manufacturer's premises on the offered size / rating of 8.76/15kV volt grade H.T Cables for Engineer's review during submittal review stage.

Contractor shall submit the proforma / list for essential routine tests in accordance with the latest edition of IEC 60502-1 / BS 6346 which are to be carried out at the manufacturer's premises on the offered size / rating / types of 600/1000 volt grade Multicore L.T Cables, for Engineer's review during submittal review stage.

Contractor shall submit the proforma / list for essential routine tests in accordance with the latest edition of BS 6004 which are to be carried out at the

manufacturer's premises on the offered size / rating / types of 450/750 volt grade Single-core L.T Cables as well as on the offered size / rating / types of 300/500 volt grade Single-core / Multi-core L.T Cables, for Engineer's review during submittal review stage.

14. SITE ACCEPTANCE TEST (SAT) / FIELD TESTING

14.1. Scope

Upon completion of the installation, the Contractor shall perform field tests on all equipment, cables, materials and systems. All tests shall be conducted in the presence of the Engineer or his representative for demonstrating equipment or system compliance with Specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc. and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four (4) copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams, etc.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship, or as any other obligations of Contract.

14.2. Low Voltage D.G. Set

14.2.1 General

Prior to the tests, the contractor shall submit manufacturer's recommended detailed description of the test procedures to be conducted for Engineer's approval.

The Contractor shall carry out full site load and no-load tests in accordance with the latest edition of applicable IEC, ISO, IEEE, BS Standards for site commissioning. The inspection and tests shall include but not be limited to:

Basic Tests:	Insulation Resistance Earth Continuity Earth Loop Impedance Polarity Phase Rotation Voltage and Frequency Starting System Protection Equipment
Battery:	Nominal Voltage Discharge Voltage Specific Gravity of Electrolyte

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	Level of Electrolyte Charging System
Lubrication:	Check as required by manufacturer
Operational Check at Start-up	Oil Pressure Fuel Oil Leaks Operation of Safety Devices Operational Speed Automatic Control Instrument Check Exhaust Check Undue Vibration
Operational Check After one hour's run:	Oil Pressure Oil Leaks Cooling System Oil Temperature
Commissioning Test:	25% of full load 2 hrs. 50% of full load 5 hrs. 75% of full load 8 hrs. 100% of full load 8 hrs. 110% of full load 1 hr.

All commissioning and test results shall be recorded and compared with design data. A retest/commissioning shall take place if results are not satisfactory. All the tools, labour, POL, required for the testing and commissioning shall be provided by the Contractor at no extra cost. If required load is not available at site for testing the generators, the Contractor shall provide dummy load at site at no extra cost to the Employer. The correct functioning of the control equipment shall also be proved.

14.2.2 Battery Charger

Battery charger shall be static type and shall provide for both trickle and boost charging of the batteries when the engine is not in operation. The charger shall be of suitable capacity to fully recharge the completely discharged batteries within four hours at boost charge

14.2.3 Control Panel

The Control Panel shall provide all the necessary control and monitoring devices of the Diesel Generating Sets. All the control and monitoring of the safety devices, alarms, protections, meters, lamps, etc. as mentioned in this Specifications and required as per good engineering practices for such an installation shall be provided in the Control Panel.

14.3. Insulation Resistance Test

Insulation resistance test shall be made on all electrical equipment by using a meggar of 500 volts for circuits upto 250 volts and 1000 volt for circuits between 250 and 500 volts. For testing of 11 kV circuits, upto 5 kV meggar shall be used. The exact voltage shall be as advised by the equipment manufacturer unless otherwise advised by the Engineer.

The insulation resistance values of cables, switchgears, etc., shall be as per BSS, IEEE, NEC, ICEA and Pakistan Electricity Rules.

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Before making connections at the ends of each cable run or joint between cables, the insulation resistance test of each cable section shall be made. All cables shall be subjected to high voltage test as per recommendations of standard to which the cable is manufactured. Each conductor of a multi-core cable shall be tested individually with each of the other conductor of the group and also with earth. If insulation resistance test readings are found to be less than the specified minimum in any conductor, the entire cable shall be replaced and tests repeated on new cable. If cable joint is provided, then each cable section shall be tested, and joint made only after the tests have been made satisfactorily. Finally, the completed cable length including the joints shall be tested.

The switchgears shall be given an insulation resistance measurement test after installation, but before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than the specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the insulation resistance readings shall be taken after the correction has been made and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required. Polarity test shall be made on single pole switching devices.

14.4. Earth Resistance Test

Earth resistance tests shall be made by the Contractor on the earthing system, separating and reconnecting each earth connection.

If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the ECC together with the resistance of the earthing leads measured from the connection with earth electrode to any other position in the complete installation shall not exceed one Ohm. Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earth electrodes are installed, the earth resistance test of each electrode shall be measured by means of resistance bridge instrument.

The complete lightning protection system shall be tested for continuity and earth resistance. The combined earth resistance at any point in the lightning protection system shall not exceed 10 ohms.

14.5. Special System Test

All the tests pertaining to components of various special systems such as, Lightning protection system etc. shall be tested according to the requirement laid down in the respective sections of the technical specifications. However, any specific test recommended by the OEM/Local Vendor/ Govts' inspector etc. shall also be carried out as approved by the Engineer without claiming additional cost.

14.6. Completed Tests

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer the Contractor shall be responsible for the proper

protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

14.7. Expenses

All expenses, i.e., traveling, documentation, boarding and lodging, allowances etc. for carrying out the tests and witnessing by the Engineer and Employer shall be borne by the Contractor and are deemed to have been included in the BOQ rates of the respective equipment(s) by the Contractor.

15. SPARE PARTS

Contractor shall provide spare parts as identified in **Appendix-D** as mentioned. Total amount of such spares shall be carried over to relevant BOQ item.

16. SPECIAL TOOLS

The contractor shall provide special tools as indicated in **Appendix-C** and as may be deemed essential for assembly, adjustment, dismantling, installation and operation & maintenance (O&M) reasons. The total amount of Special Tools shall be carried to relevant BoQ item.

17. STATEMENT OF COMPLIANCE

Contractor shall submit an overall in writing compliance signed and stamped with the items of these specifications in the form of Statement of Compliance. No consideration will be given to the bid without this important document at the bidding stage. However, during the material submittal review stage, contractor shall submit his own proposal and OEMs para wise compliance of relevant specification section along with each material submittal. In absence of such compliance from the contractor and his proposed OEM, the submittal shall be considered incomplete and will lead to rejection.

18. WARRANTY OF GOODS

The Contractor shall provide warranty of equipment upto expiration of Defects liability period unless noted.

19. APPENDICES TO BE FILLED IN BY THE TENDERER

The details regarding equipment manufacturers, deviations, technical data, special tools, spare parts etc. are to be furnished in the appendices attached with form of tenders, in accordance with the provision of the Clause "Requirements of Electrical Works" given in the instructions to Tenderer.

20. PAYMENT

No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.

*** End of Section - 8001 ***

SECTION – 8111

LOW VOLTAGE DIESEL GENERATOR SET

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of the complete Diesel Generator set including Synchronizing / Load Sharing Panel, ATS/AMF Panel and other equipment, as specified herein, shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact location and position of the D.G set, electrical equipment, underground fuel storage tanks and routing of cables.

The Diesel Generator set, Generator Control Panel, Synchronizing / Load Sharing Panel, ATS / AMF Panel and accessories shall comply with the General Specifications for Electrical Works, Section-8001, and other relevant provisions of the Contract Document.

2. GENERAL

The Diesel generator set shall be a standard design of reputed manufacturer, brand new and used, having current year of manufacturing. Manufacturer shall have similar units in operations for similar applications and field conditions. The manufacturer shall also have adequate maintenance facilities with technically qualified and experienced personnel trained for operation and on-site maintenance of equipment offered by the Contractor in the tender bid.

The set shall be rated for prime duty in accordance with ISO 8528 and suitable for indoor installation with protection rating IP23. It shall be capable for unbalance loads upto 30% of actual load and for varying load for unlimited time operation. The set shall be capable of starting and operation at the project environment conditions. The ratings must be substantiated with manufacturer's standard published data.

The D.G set shall, after reducing the power absorbed by the auxiliaries, deliver prime rated power output with overload capability for operation at least 10% above the rated capacity for 1 hour continuously in any 12 hours operating in accordance with ISO 3046, and BS 5514 under the site conditions. All auxiliaries, accessories and connections between systems along with all necessary cables, fittings, hardware, etc., for complete installation of Diesel Engine, Generator, Generator Control Panel, Synchronizing / Load Sharing Panel, ATS / AMF Panel, Neutral Disconnect Switch, Fuel Storage, Batteries, Exhaust System, etc., shall be furnished by the Contractor.

The engine shall be directly coupled to the generator, and shall have a rated speed of 1500 rpm. The set shall be capable of sustaining without damage, 25% over speed under any abnormal operating condition.

The engine-generator set shall be mounted on suitable rigid steel frame skid with vibration isolators. Heavy duty lifting eyes and jacking screws shall be provided on the skid. The foundation bolts and all other material / hardware for complete installation of the set shall be furnished with the set. Any excessive torsional vibration shall be avoided for both engine and alternator.

The set shall be suitable for full load starting. When the generator is operating at no-load, the application of full load current, taking into account the surge due to starting of equipment, should be possible with maximum transient voltage drop of 15% of the rated voltage, and the time taken to restore the generator voltage to 97% of rated value should not exceed 1.5 seconds.

The set shall be capable for parallel operation.

The Contractor shall submit the equipment layout and other installation details as per manufacturer's recommendations for approval of the Engineer at least 30 days prior to the installation of the set.

Necessary provision, including connections and a Local / OFF / Remote control switch shall be made in the Generator Control Panel. The cost of such provision, connection, testing and commissioning are deemed to be included in the Cost of D.G Set and no separate payment shall be made against such works.

3. APPLICABLE STANDARDS/CODES

The Diesel engine and generator shall conform to the following standards as applicable.

BS 5514	-	Reciprocating Internal Combustion Engine.
BS 4999	-	General Requirements for Rotating Electrical Machines.
BS 5000-99	-	Rotating Electrical Machines of particular types or for particular application.
IEC 60034	-	Rotating Electrical Machine

For other equipment and materials related to the Diesel generator set, the Contractor shall follow relevant international standards, details of which shall be submitted to the Engineer for approval.

4. MATERIAL

4.1. Diesel Engine

The Diesel Engine shall be four strokes, compression ignition, suitable for prime duty.

Starting shall be through electric starter motor operated on DC supply from lead acid batteries mounted on the skid. The batteries shall be furnished with the set.

The engine shall be equipped with an alternator type automatic charging system to charge the batteries during running of engine. A static battery charger installed in the control panel shall also be provided to charge the batteries when the engine is not running. Suitable interlocks shall be provided to prevent simultaneous operation of both charging systems.

The batteries shall be adequate to satisfy the following requirements:

a. Crank the engine at firing speed for at least 15 seconds.

b. If the engine does not start on the first attempt, crank the engine two more times for the above duration at an interval of 30 seconds between each cranking operation.

Engine shall be rated for prime duty with overload capability for operating at least 10% above the rated capacity for 1 hour continuously in any 12 hours operation.

4.1.1 Air Intake

Air intake shall be through turbo charger and equipped with dry type filter. Suitable attenuators shall be installed to reduce noise at the air inlet.

4.1.2 Engine Lubrication

A gear type positive pressure lubrication pump shall be provided with efficient filtration arrangement for the lubrication system. A 230V AC

mains operated heater with thermostat shall be provided in the crankcase.

The heater shall be designed for automatic switching to ensure that temperature of oil is maintained for proper operation of the engine.

Engine shall have a constant oil level regulator, gravity fed from an engine mounted lube oil reservoir. Reservoir shall be equipped with an oil level gauge.

A crank case pressure release valve shall be provided to operate during excess pressure.

4.1.3 Engine Cooling

Engine shall have a forced air draft, water-cooled radiator supplied with a core guard. The radiator shall be set mounted and suitable for tropical 50oC ambient conditions. The radiator shall be complete with flexible exhaust duct. Cooling system shall have an engine driven centrifugal pump for cooling water circulation. Cooling shall be thermostatically controlled. An engine shut down timer shall be provided to keep the engine running on no-load after any operation of set, so that the engine is sufficiently cooled to start again instantly, if required, without rise in temperature above safe limits.

4.1.4 Exhaust System, Noise, Pollution

Exhaust system shall be equipped with a residential type silencer complete with muffler, exhaust manifold, flexible connector, exhaust elbow, exhaust pipe, rain cap, and associated fittings. The exhaust line shall be taken outside the building through the shortest possible and practical route, without any undue bends. This exhaust line shall be adequately covered with thermal insulation material over its entire length i.e. from the engine to the termination point. All supports for exhaust system shall be furnished.

The exhaust fumes shall be burnt completely and be free of solid matters before escaping to the air. Necessary protection arrangement is to be provided to avoid soot deposit on adjacent buildings.

4.1.5 Speed Governor

The speed governor shall be electronic type. Governor shall regulate engine speed so as to maintain the generator frequency within plus or minus 2% of the rated frequency. Stable engine speed shall be attained within 15 seconds after the engine has been started. Stable engine speed shall be restored within 10 seconds of any sudden change in load, from no load to full load. During this change of load or surge, the speed shall not vary by more than plus or minus 5% of the rated speed.

4.2. Fuel System

Engine of the generator shall operate on commercial high speed Diesel oil. A fuel oil strainer/filter shall be provided in the fuel line. Fuel system for Diesel engine shall be through explosion proof self-priming pump. The fuel system shall comprise:

- Underground fuel storage tank. (Common for all D.G. Sets)
- Fuel transfer pump(s). (Separate for each D.G. Set)
- Fuel piping network. (Separate for each D.G. Set)

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- Fuel day tank. (Separate for each D.G. Set)

4.2.1. Underground Fuel Storage Tank

The underground outdoor fuel storage tank shall have the capacity as mentioned in BOQ item or shown on the drawings to store fuel for operation of the set at the rated output. The tank shall have high and low level float switches for monitoring the fuel level in the tank. The high and low level switches shall provide an annunciation while the low level switch shall in addition to above annunciation also prevent starting of set and to stop the set when the fuel in storage tank is at this level. The tank shall be provided with overflow, vent, supply and discharge valves, inspection cover, drain valve and glass sight gauge.

The fuel storage tank shall be of mild steel plates and shall be designed, fabricated and finished in accordance with the requirements of DIN 6608.

a) Horizontal Steel Tanks for underground storage of Petroleum Products in Liquid Form.

Underground fuel storage tank and supports shall be fabricated in accordance with the specified code and the following:

b) Tank shall be capable to withstand maximum loads encountered during installation and operation for all conditions from empty tank to tank filled to capacity or overflow.

c) Tank shall be in accordance with the relevant BOCA or UBC code requirement for seismic load whichever is more stringent.

d) Tanks shall be capable to withstand safely the forces and moments imposed by connecting piping

e) The buried tank shall be capable of sustaining lateral backfilling load of equivalent fluid pressure.

f) The tank shall be capable of resisting flotation by providing concrete beams or saddles installed over the top of the tank or by hold-down straps bolted to a concrete foundation pad.

g) The thickness of tank elements shall be increased over the thickness required by code requirements by 2mm for corrosion allowances.

h) The tanks shall be of welded construction in compliance with specified DIN standard and/or section VIII of the ASME code, DIV I.

i) The tanks shall be provided with at least two lifting eyes.

j) A nameplate shall be attached to manhole flange marked in accordance with the requirements of the code, and shall include following information:

- Manufacturer's name/mark and year of fabrication,
- Manufacturer's serial number,
- Design gauge pressure,
- Test gauge pressure,
- Design temperature,
- Applicable code stamp,
- Fluid stored,

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- Storage capacity,
- Tank size.

Welding procedure qualifications, electrodes, preheat, post weld treatment, welder performance tests and submittals shall be in accordance with relevant international codes and standards.

Shell plate joints shall be butt welded with complete penetration and fusion. All joints in the attachments to the shell shall be fully seal welded to prevent rust staining.

Sharp welds and sharp corners shall be ground smooth and blended into the base material. All bottoms of the shell connections shall be flush with the inside of the shell unless otherwise indicated.

The interior surfaces of the tank shall be cleaned of all mill scale, cuttings, weld spatter and other foreign matter and shall receive a commercial sandblast in accordance with SSPC-SP 5.

All openings shall be sealed immediately after the last shell joint is made.

The exterior surfaces of all tank and piping shall be given a protective coating of the epoxy-phenolic-amine type.

All interconnecting steel pipes shall be seamless in accordance with ASTM-A 53 or approved equivalent. Pipefittings shall be butt-welded type according with ASTM-A 53. All underground pipe and fittings shall be buried in accordance with ASTM D 1557. The pipe surface shall be given a protective coating of the epoxy-phenolic-amine type.

Welds shall be inspected in accordance with section VIII of the ASME Code, DIV-I.

Non-destructive examination procedures shall be submitted for approval before they are implemented.

Results of non-destructive inspection shall be submitted prior to installation as per requirement of section VIII, DIV-I of the ASME Code.

Tank shall be hydrostatically shop tested as required by ASME code, section VIII DIV-I, and shall be dried immediately after the test.

Before a hydrostatic test procedure is implemented it shall be submitted for approval, and shall include the recommended minimum and maximum hydro-test pressure with the corresponding minimum and maximum temperature.

All test results shall be submitted.

4.2.2. Fuel Transfer Pumps

An explosion proof electric self-priming, fuel pump of suitable capacity to fill the fuel day tank from the outdoor underground fuel storage tank in 30 minutes or lesser time shall be provided. A manual fuel pump shall also be furnished and connected in parallel to the electric fuel pump, with a capacity to fill the tank in 2 hours maximum. All interconnected piping, valves, etc., for parallel connection of the two pumps shall be furnished. The electric starter, circuit breaker, wiring, etc., for the electric pump shall be provided along with the Fuel Storage Tank by the Contractor without any extra cost.

The fuel piping network separate for each D.G. set to be furnished shall include fuel supply pipe from storage tank to day tank in the skid of the D.G. set, over flow pipe from the tank to the set, drain pipe from the tank to a location approved by the Engineer.

The arrangement of pipe work with respect to the location of equipment shall be prepared by the Contractor and submitted to Engineer for approval. A full flow oil filter shall be installed in the fuel supply lines with a by-pass arrangement

4.2.3. Fuel Day Tank

The engine generator skid mounted fuel day tank for each D.G. Set shall have capacity to store fuel for 8 hours operation of the set at the rated output. The tank shall have level switch for monitoring low fuel level in the tank. The low level switch shall provide an annunciation and prevent starting of set and to stop the set when the fuel in storage tank is at this level. The tank shall be provided with overflow, vent, supply and discharge valves, inspection cover, drain valve and glass sight gauge.

The fuel day tank shall be connected with the bulk / fuel storage system including Necessary arrangements for integration shall be available in the fuel day tank. For Day tank other than skid mounted, all details related to integration, civil works and mechanical works etc. refer to structure and mechanical drawings and Specifications 8470.

4.3. Generator

Generator shall be synchronous. The generator shall be capable of carrying continuously for 1 hour in every 12 hours, overload equal to 10% of rated output with field set for normal rated load excitation.

4.3.1 Excitation

Permanent magnet excitation with brush less rotating diodes mounted on the main shaft for 3-phase full wave rectification.

4.3.2 Windings

Alternator shall have two third pitch winding, Class-F insulation and shall be impregnated for tropical use. The temperature rise of winding under normal operating conditions and at rated load shall not exceed the limits specified for Class-B insulation. Anti-condensate heaters shall be provided for windings. The heaters shall be thermostatically controlled for switching ON after the set has stopped. The thermostat range shall be adjustable and set to prevent overheating of windings. For protection of windings from damage due to overheating, thermistors shall be embedded to stop the set in case the temperature of winding rises above the safe value.

4.3.3 Voltage Regulation

Voltage regulator shall be solid state with provision for manual setting. Regulator shall be so designed to protect the exciter when the set is running at reduced speed during starting or idling of the prime mover.

Voltage regulation shall be plus or minus 2.5% from no-load to full load. Transient voltage drop shall be less than 15% at full load and 0.8 power factor. Time required to restore to steady state conditions after transient voltage fluctuation shall not exceed 10 seconds.

4.3.4 Short Circuit Capability

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Generator shall be capable of withstanding without injury, a 30 seconds three-phase short circuit at its terminal when operating at rated output and power factor with fixed excitation.

4.3.5 Deviation Factor

The deviation factor of the open-circuit line-to-line terminal voltage shall not exceed 0.1

4.4. Generator Control Panel

The Generator Control Panel shall be designed for front access, completely assembled, wired and tested. The control panel shall conform to the constructional requirements as stated in Specifications Section – 8132 for L.T Switchboards. The panel shall comprise but not limited to the following main components.

4.4.1 Circuit Breaker

The circuit breaker shall be triple pole with adjustable releases for thermal overload, instantaneous over current, under voltage, over voltage and reverse power protections.

4.4.2 Instrumentation

LED/LCD display with adjustable contrast and backlight with auto power off providing following details:

AC metering

i) Volts 3-phase (L-L & L-N)
ii) Amps (per phase & Average)
iii) Frequency (Hz)
iv) kW (total & per phase)
v) kVA (total & per phase)
vi) kVAr (total & per phase)
vii) Power Factor (overall & per phase)
viii) kW hours
ix) kVAr hours

A kWh (energy meter) shall be provided in compliance to the requirements of Electrical Inspector covering the region (area), in addition to the above mentioned metering.

DC metering

i) Battery Volts
ii) Engine hours run
iii) Engine Jacket Water Temperature
iv) Lube Oil Pressure
v) Lube Oil Temperature
vi) Crank attempt counter
vii) Start counter
viii) Engine Speed
ix) Fuel Oil Level

4.4.3 Safety Devices (Protections)

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Following safety devices shall be provided. The audible alarm shall operate on any fault condition and shall be resettable manually and automatically through a timer after 15 minutes whichever is earlier:

A = Alarm, SD = Shutdown, TD = Adjustable Time Delay

i)	Engine Over speed/under speed	A SD
ii)	Low lube oil pressure	A SD
iii)	High water temperature	A SD
iv)	Over voltage	A SD (TD=0-30 Sec)
v)	Under voltage	A
vi)	Short circuit and tripping of circuit breaker	A SD (TD=0-1 min.)
vii)	Reverse Power	A SD
viii)	Low level in fuel day tank	A SD (TD=0-5 min.)
ix)	High level in fuel day tank	A
x)	Battery Charger failure	A
xi)	Winding temperature high	A SD (TD=0-2 min.)
xii)	Over crank – Fail to start	A SD
xiii)	Under/Over frequency	A SD
xiv)	Low/High battery voltage	A
xv)	Charging alternator failure	A

After shut down, the set shall lockout and it shall not be possible to start it unless manually reset after the cause of fault has been removed.

4.4.4 Controls

Following Controls shall be provided as a minimum:

i) Auto-Manual-Test-Stop key with LED indicator
ii) Lamp test key
iii) Alarm acknowledge key
iv) Status indicators (1 red shutdown, 1 amber warning)
v) Lock down emergency stop push button.

4.4.5 Battery Charger

Battery charger shall be static type and shall provide for both trickle and boost charging of the batteries when the engine is not in operation. The charger shall be of suitable capacity to fully recharge the completely discharged batteries within four hours at boost charge. Charger shall operate on 220V, 50 Hz power supply.

4.5. Automatic Transfer Switch (ATS) / Auto Main Failure (AMF) Panel

The Automatic Transfer Switch(ATS) shall be 4 pole, rated for the capacity of the generator. ATS shall employ magnetic contactor /motorized MCCB/ ACB to achieve the desired switching of power supplies to feed the load from the main supply or generator of rating given in the drawings / BOQ.

The ATS/AMF panel shall comprise of atleast the following components:

a) Two (02) nos. of appropriately rated Air break, Four pole, 400 VAC, AC3 duty Magnetic Contactors for incoming Normal and Emergency supply.

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b) Three (03) nos. of appropriately rated Four pole, Air Circuit Breakers (ACB) for Normal / Emergency supply bypass & ATS supply with Electrical / Mechanical Interlocking arrangement.

c) Appropriately rated 99.99% pure high conductivity electrolytic tinned copper busbars for Phase, Neutral & Earth.

All necessary controls, timers, relays and instruments as shown on drawing and as required for satisfactory & safe operation shall be provided with the ATS/AMF Panel.

The ATS/AMF panel shall incorporate automatic changeover system and shall be designed for the following functions:

a) To start the set immediately when the main supply fails.

b) To start the set whenever the main supply voltage drops to 360 volts or rise to 440 volts. The setting voltages shall be adjustable within - 5% and +5% respectively for the lower and upper ranges.

c) To transfer the load from generator to main supply whenever the mains voltage returns and persists for at least 3 minutes.

d) To make two successive attempts, in case the set fails to start in the first attempt.

e) The system shall provide for immediate transfer of load to the generator, after the rated speed/frequency and voltage have been achieved.

f) The system shall be self-resetting after each cycle of operation.

g) A four-position selector switch shall be provided for selecting the operation mode i.e. Test-Manual-Automatic-Stop/Maintenance mode to facilitate the operation as described in 4.6.

4.6. Synchronizing / Load Sharing Panel and Auto Main Failure (AMF) Panel

The synchronizing panel shall have suitable no of motorized ACB/MCCB as shown on drawings.

Four diesel generator sets are provided to supply power in case of Mains (utility) power supply failure. The sets shall be capable for parallel operation and will share the load to meet the system load demand.

The Synchronizing / Load Sharing Panel / AMF panel shall be broadly designed for the following operations.

a) When the mains supply fails or main supply voltage drops to 360 volts or rises to 440 volts (the setting voltages shall be adjustable within –5% and +5% respectively for the lower and upper ranges), the D.G Sets shall start immediately and synchronize. If the sets fail to start in first attempt then two successive attempts shall be made.

b) Incoming ACB of Transformer in LT Switchboard shall be opened.

c) D.G Set-1, D.G Set-2, D.G Set-3 and D.G Set-4 shall start and after rated speed/frequency and voltage has been achieved the relevant ACB/MCCB of D.G Set-1 in the Synchronizing / Load Sharing Panel shall be closed. The relevant ACB for power supply in the main LT Switch board shall also be opened.

d) Genset-1 and Genset-2 shall be synchronized after achieving the required synchronizing conditions and the relevant ACB of D.G Set-2 in the Synchronizing / Load Sharing Panel shall be closed.

e) Consecutively DG Set -3 and DG Set-4 shall close after synchronization and after sensing the load requirement. All the loads shall be transferred to the DG Sets.

f) The D.G Sets assume their proportional share of the total load on the bus based on the adjustable load sharing devices' setting.

g) If the total load on the bus is less than 80% of the D.G Set rating then the D.G Set in reverse order of duty shall shut down automatically, after a delay of 5 minutes.

h) If the load increases or on failure of an operating D.G Set, the idle unit shall automatically start, parallel and share system load as per values set through load sharing.

i) The system shall transfer the load from the D.G Set to main supply whenever the voltage returns and persists for at least 3 minutes.

j) The system shall be self-resetting after each cycle of operation.

k) The sequence of DG Sets in operation shall be finalized by the Engineer as per Clients requirement.

l) A four-position selector switch shall be provided for selecting the operation mode i.e. Test-Manual-Automatic-Stop/Maintenance mode to facilitate the following operation:-

I. Automatic

As described above.

II. Manual

Manual starting of the D.G Sets and load transfer from transformer to D.G Set and vice versa.

III. Test

Testing the changeover operation when so desired, and also for starting and running the set without interrupting the normal operation. In case of failure of main supply during testing, the set shall automatically revert to automatic mode of operation.

IV. Stop/Maintenance

Provision shall be made to isolate the system for troubleshooting and maintenance without interruption of mains power supply. The set shall not be capable of starting in this condition.

m) The Duty Selection Switch shall be provided so that either of the four D.G Sets can be used as Duty-I, Duty-II, Duty-III and Duty-IV Generator.

n) Four normally open and two normally close potential free contacts rated for 3 Amps at 230V AC shall be provided, which shall operate when the set is started with the operation mode selector switch in auto or manual position. The contacts shall be wired up to the terminal block in panel.

All necessary controls and instruments including the synchronizing device, synchroscope, power factor meters, voltmeters, percentage adjustable load sharing device shall be provided with the Synchronizing / Load Sharing Panel. All necessary coordination, provision and connections for control logic of the above D.G Sets with [illegible] in LT Switchboard shall be made by the Contractor.

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Contractor shall coordinate the laying of the control cable from DG Sets to the Synchronization Panel. The size of this control cable shall be calculated considering distance between Substation and LT room.

Specification Section – 8132 for LT Switchboards shall be applicable for the constructional requirements / component Specifications of the Synchronizing / Load Sharing Panel and ATS/AMF Panel.

The manufacturer shall discuss the scheme with the Engineer and obtain approval prior to manufacturing, final testing and commissioning.

4.7. Generator Neutral Disconnecting Switch

A motorized switch for generator neutral disconnection shall be provided for each D.G. Set neutral earthing. The switch shall be rated for the maximum current carrying capacity expected through the path during operation.

It is desirable to operate with only one generator neutral disconnecting switch closed at a time during operation of D.G. Sets, to eliminate any circulating harmonics or zero sequence currents through neutral.

No separate payment is admissible for supplying, installing, testing and commissioning of Generator Neutral Disconnect Switch and is deemed to have been included in the BOQ rates of the respective equipment.

4.8. Weather Proof and Sound Attenuated Canopy

Sound and weather proof canopy suitable for the Diesel Generating sets. The canopy shall attenuate the sound level to below 85 dB at a distance of 1 meter or less than 75 dB at a distance of 3 meters from it. Noise services should not exceed the existing daytime background noise level or 50dB LA90, whichever is greater. The same shall be checked after installation at site. Texture insulation materials, comprising of fire-retardant resin, organic glass / rock fiber to ensure uniform long-lasting absorption of sound. The canopy shall be constructed with weather proof corrosion resistant material and shall be modular in design. All sheet components pre-treated with cold fast prior to powder coating. All gas-kits / joints shall be of EPDM {**ethylene propylene diene monomer** (M-class)} rubber. The canopy shall be suitable for tropical climate.

a) The enclosure shall allow easy access to the engine, alternator and radiator filler cap, lube oil filling, filter replacement and control cubicle for easy maintenance purpose.

b) Hinged and lockable doors all around canopy for easy access to DG set for routine maintenance and major over hauling.

c) At least 2 foot clearance between the DG set and canopy shall be maintained from sites / directions.

d) The enclosure shall be designed to be water and weather-proof.

e) The intake area for air must be 1.8 times the size of radiator.

f) The enclosure base frame should be designed with supports for easy transferred using forklift and crane.

g) Canopy shall be capable of anti-corrosion to withstand high humidity.

h) Proper grouting of both generator and canopy.

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i) The thickness of sheet for canopy body must be 3mm (minimum) whereas thickness of door sheet 2mm (minimum).

j) Glass wool will be of pure fiber.

k) The canvas is to be place between radiator and the canopy that can be easily removed during troubleshooting.

l) GENSET control panel should be visible from outside the canopy by means of plane glass.

m) 4 nos. canopy lifting eyes arrangement from top of canopy.

n) Sufficient air intake through Acoustic Louvers from both side & control panel side.

For Duly painted with good quality water proof and weather proof paint.

4.9. Manufacture Technical Data

Following parameters shall be provided for Diesel Generator Set at material submittal review stage.

4.7.1 Engine

- Manufacturer's Name
- Maximum Engine Rating – BHP
- Continuous Output Rating – BHP
- De-rating Factors:
  - For Altitude of 6 meters above MSL
  - For Inlet Air Temperature of zero degree centigrade
  - Others, if any
- Engine Rating at Site – BHP
- Period of Maximum Engine Rating - Hours
- Operating Speed - RPM
- Bore and Stroke - Inches/mm
- No. of Cylinders
- Arrangement of Cylinders – n line/v
- Engine Capacity - cu.in./cc
- Compression Ratio
- Coupling
- Mounting
- Cooling System
- Ignition System
- Overload Capability

- Governor

  - Type
  - Make

- Efficiency (%)

  - At 100% rated load =
  - At 75% rated load =
  - At 50% rated load =
  - At 25% rated load =

- Fuel consumption (Lit./hr.)

  - At 100% rated load =
  - At 75% rated load =
  - At 50% rated load =
  - At 25% rated load =
  - At 0% rated load =

4.7.2 Generator

- Manufacturer's Name

- Design Output Rating - kVA

- Continuous Output at Site - kVA

- Net power available – kVA

  - At Mean Sea Level (MSL) – kVA
  - At 250 meter from MSL – kVA
  - At 500 meter from MSL – kVA
  - At 750 meter from MSL – kVA
  - At 1000 meter from MSL – kVA

- Power Consumption in auxiliaries – kVA

- Net power available - kVA

- Rated Voltage - Volts

- Rated Current per phase - Amps

- Power Factor

- Speed - RPM

- Frequency - Hz

- Insulation Class

  - Stator
  - Rotor
  - Exciter

- Overload Capability

- Harmonic Content - %

- Temperature Rise - Degree Celsius

- Frequency Regulation - %

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- Deviation Factor - %

- Voltage Regulation:

  - Type
  - Regulator
  - Regulation - %
  - Voltage - %
  - Response time - Sec.

- Efficiency, %

  - At 100% rated load =
  - At 75% rated load =
  - At 50% rated load =
  - At 25% rated load =

- Exciter:

  - Type
  - Rated Voltage - Volts
  - Full load Current - Amps

- Radio Frequency Interference

- Telephone Influence / Interference Factor

- Charger Capacity

- Batteries:

  - Type
  - Rating - AH

- Noise Output Level of Set (db)

  - At 100% rated load =
  - At 75% rated load =
  - At 50% rated load =
  - At 25% rated load =
  - At 0% rated load =

- De-rating Factor

  - For altitude of 355 meters above MSL
  - For Ambient Temperature of 50oC
  - Humidity of 90%
  - Others, if any

- Special Features, if any

4.7.3 Accessories

Contractor to state whether or not these accessories are provided

- Crankcase Heater/Jacket Water Heater

- Automatic Water Makeup System

- Ducting for Radiator

- Exhaust System

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- Residential
-
- Industrial

- Meters / Gauges to indicates

  - Engine Speed in RPM
  - Lube Oil Pressure in Bars
  - Lube Oil Temperature in 0C
  - Engine Water Temperature in 0C
  - Engine running hours in Hrs.
  - Battery Charging Current in Amps

- Alarm / Indicating Lamps for:

  - Engine Over speed
  - Low Lube Oil Pressure
  - High Engine Water Temperature
  - Over Voltage
  - Under Voltage
  - Short circuit / tripping of main circuit breaker
  - Low Fuel level
  - High Fuel level
  - Charger failure
  - Winding temperature high
  - Over cranking
  - Charging alternator failure

- Safety devices for instantaneous shut down due to:

  - Engine Over Speed
  - Low Lube Oil Pressure
  - High water temperature shut down
  - Under Voltage

- Safety Devices for adjustable delayed shut down, through shut down timer due to:

  - Over Voltage
  - Reverse Power
  - Short circuit/tripping of main circuit breaker
  - Low fuel level in tank
  - Winding temperature high

4.10. Warranty

All proposed Diesel Generator Sets (complete set including all equipment, devices, components, parts etc.) will include a warranty of at least 2 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

5. INSTALLATIONS & TESTING

The Diesel generator set and associated equipment with accessories shall be installed at location shown on the drawing. The concrete foundation pad shall be constructed as a part of civil works covered in relevant BOQ item of this section. The Contractor shall ensure provision of all related civil works for providing any openings, holes, etc. to avoid any breakage to completed works. In case the provisions in civil works for installation of electrical equipment are not provided by the Contractor or made incorrect the same shall

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be rectified by the Contractor at his own cost and to the satisfaction of Engineer. No separate payment shall be admissible for civil works and deemed to include in the relevant BOQ Item. The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.

All installation materials for physically installing the Diesel generator set and associated equipment, such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The generator shall be installed upright and in level and shall be firmly and rigidly bolted to the steel frame skid with vibration isolators.

The Diesel generator set shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking of meter, relays, etc., provided by the manufacturer for safe transport shall be released only after the generator/ control panel is erected in position.

The incoming and outgoing cables shall be connected as recommended by cable manufacturer. The cable armour shall be connected effectively to ground.

The Generator Control Panel, Synchronizing Panel and ATS/AMF Panel shall be installed as per given guidelines in Specification Section 8132 for LT Switchboards. The Diesel generator and associated equipment body shall be connected to earth as per instructions given in Specification Section 8240.

The Diesel generator set shall be tested and commissioned in the presence of the Engineer. The tests to be carried out are described in article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

The tank shall be installed in accordance with best engineering practice / International codes, the approved shop drawings, applicable code requirements and manufacturer's instructions.

No separate payment is admissible for testing and commissioning of low voltage D.G set and associated equipment and is deemed to have been included in the BOQ rates of the Low Voltage D.G set.

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against each item of Bill of Quantities as given below shall include supply, installation, testing, commissioning and completion for all associated works specified herein and/or as shown on the Tender Drawing/B.O.Q.

6.2. Diesel Generator Set

6.2.1 Measurement

Measurement shall be made for total number of jobs for Diesel Generator Set with all accessories including Fuel Day Tank, Generator Neutral Disconnecting Switch, Generator Control Panel and Control Wiring to Generator Control Panel, control wiring between DG Sets and Synchronization panel, Synchronizing / Load Sharing Panel, ATS/AMF Panel, L.T Switchboard and associated civil works etc. acceptably supplied and installed by the Contractor as a complete job.

6.2.2 Payment:

Payment shall be made for the number of jobs measured as provided above at the Contract unit price each for supplying, installing, testing, commissioning and completion of the Diesel Generator Set, including all associated civil works i.e. reinforced concrete foundation, Fuel Day

Tank, Generator Control Panel and accessories, control wiring between D.G. set and Generator Control Panel, control wiring between DG Sets and Synchronization panel, Synchronizing / Load Sharing Panel, ATS/AMF Panel, L.T Switchboard, all testing arrangements, etc.

6.3. Fuel System

6.3.1. Measurement:

Measurement shall be made for Fuel System comprising underground Fuel Storage Tank of capacity mentioned in BOQ/drawings including pumps all accessories and piping acceptably supplied and installed by the Contractor as a complete Job.

6.3.2. Payment

Payment shall be made for the number of jobs measured, as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, testing and commissioning of underground fuel storage tank with excavation, backfilling, sand filling, reinforced concrete foundation/structure (including reinforcement) and fixing/supporting structure and all other accessories complete with all type of valves, fuel transfer pumps (both electric and manual) float switches control/power wiring, control panel for automatic operation of the pumps, for each generator fuel piping network with required filters for each generator as per Specifications and required for normal operation

6 4. Synchronizing / Load Sharing Panel/ AMF Panel

6.3.1 Measurement:

Measurement shall be made for total number of jobs for Synchronizing Panel as given in BOQ acceptably supplied and installed by the Contractor as a complete job.

6.3.2 Payment:

Payment shall be made for the total number of job measured as provided above at the Contract unit price each and shall constitute full compensation of design, fabrication, supplying, installing, connecting, testing and commissioning of Synchronizing / Load Sharing Panel with all erecting material such as foundation bolts, supporting steel channel, nuts, washers, cable glands, etc.

6.5. ATS / AMF Panel

6.4.1 Measurement:

Measurement shall be made for total number of jobs for ATS / AMF Panel as given in BOQ acceptably supplied and installed by the Contractor as a complete job.

6.4.2 Payment:

Payment shall be made for the total number of job measured as provided above at the Contract unit price each and shall constitute full compensation of design, fabrication, supplying, installing, connecting, testing and commissioning of ATS / AMF Panel with all erecting material

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such as foundation bolts, supporting steel channel, nuts, washers, cable glands, etc.

6.6. Spare Parts

6.5.1 Measurement:

Measurement shall be made for number of jobs for the spare parts of Diesel generator set as listed in Appendix - D, attached with Bill of Quantities

6.5.2 Payment:

Payment will be made for the complete job of spare parts as provided above at the Contract unit price and shall constitute full compensation for supplying, tagging, and packing of spare parts including wooden/steel storage boxes as required.

*** End of Section 8111 ***

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SECTION - 8121

INDOOR POWER TRANSFORMER

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing, connecting and commissioning of all materials and services of the complete Indoor Power Transformer as specified herein, or as given in the Bidding Drawings and in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact location and position of the equipment.

The Indoor Power Transformer with accessories shall also comply with the General Specifications for Electrical Works, Section-8001 and with other relevant provisions of the Bidding Documents.

2. GENERAL

The capacity of transformers to be provided are shown on the drawings and mentioned in Bill of Quantities. The transformers shall be complete, with all accessories and attachments as detailed in these specifications or otherwise required for satisfactory service.

All pertinent details, drawings, data, etc. shall be provided to the Engineer for approval prior to manufacturing.

Transformer built to these specifications and the standards given in this section or other relevant standards approved by the Engineer will be acceptable.

3. APPLICABLE STANDARDS / CODES

The following standards and codes shall be applicable for all materials in scope of this section: -

IEC 60076-1	-	Power Transformers – Part 1: General
IEC 60076-2	-	Power Transformers – Part 2: Temperature rise for liquid Immersed transformer
IEC 60076-3	-	Power Transformers – Part 3: Insulations levels, dielectric tests and external clearance in air
IEC 60076-4	-	Power Transformers – Part 4: Guide to lighting impulse and switching impulse testing
IEC 60076-5	-	Power Transformers – Part 5: Ability to withstand short circuit
IEC 60076-7	-	Power Transformers – Part 7: Loading guide for mineral oil immersed Power Transformer
IEC 60076-8	-	Power Transformers – Part 8: Application grid for power Transformer
IEC 60076-10	-	Power Transformers – Part 10: Determination of sound level
IEC 60076-11	-	Power Transformers – Part 11: Dry type Power Transformer

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IEC 60076-12	-	Power Transformers – Part 12: Loading guide for dry-type power transformers.
IEC 60296	-	Specification for unused mineral insulating oils for transformers and switchgear
IEC 60815	-	Selection and dimensioning of high voltage insulators intended for use in polluted conditions
IEC 60137	-	Insulated bushings for alternating voltages above 1000 V
DIN 42561	-	Transformer Rollers
NFPA - 70	-	National Electric Code
ISO-12944	-	Corrosion Protection of Steel Structures by Protective Paint Systems

4. MATERIAL

4.1. Power Transformer Construction

The transformer tank shall be constructed of welded boilerplates and provided with external radiating tubes. The tank and radiating tubes shall be designed to withstand, without developing any deformation, pressure at least 25% greater than the maximum operating pressure. The steel cover plate shall be bolted to the tank-using gasket for perfect oil seal. Inspection hole with cover shall be provided on top of the tank. Two earth terminals shall be provided diagonally at the base of the transformer tank. The transformer shall be anti-corrosive painted and finished in grey colour.

The oil preservation system shall have a conservator tank fitted with silica gel breather and oil level indicator.

The transformer core shall be built of non-aging, cold-rolled, electrical silicon steel lamination and each lamination insulated to reduce eddy current losses. The core laminations shall be clamped and bolted effectively to reduce humming.

The winding coils shall be of high-grade electrolytic copper conductor, flat or round, paper insulated, thoroughly dried and impregnated as required.

The high tension (H.T) lead on transformer shall be brought out to glazed porcelain insulator bushings for external connections to cables. Protective arcing horn spark gaps shall be provided on H.T bushings to protect the transformer from surge voltages.

The three L.T and neutral phase leads shall be brought out and terminated at glazed porcelain insulator bushings for connection to L.T side by copper bus-duct or cables.

Off-load tap changer shall be provided on H.T side at suitable location preferably on the side of transformer tank. A clear marking, illustrated by diagram, shall be provided to indicate the tap positions.

Double float Buchholz relay shall be provided. It shall have required number of contacts for connection to tripping and alarm circuits.

The bushings, tap changers and other auxiliary equipment shall be selected so as not to restrict the loading capability of the transformer.

4.2. Principal Data of Power Transformer

The transformers shall be fully tropicalized, three phase, step down, oil filled, self cooled, core type, double wound, suitable for parallel operation, and for indoor installation.

The transformer shall meet the following specifications:

-	Capacity (Rated continuous output at full load)	:	As stated on drawings and BOQ
-	Voltage ratio at no-load	:	11000/415 Volts
-	Frequency	:	50 Hz
-	Vector group	:	Dyn 11
-	Off load tapping arrangement on H.T side	:	$\pm$2.5%, $\pm$5%, -7.5%
-	H.T connection	:	11 kV Delta
-	L.T connection	:	415 V with grounded star point.
-	Neutral on L.T side	:	Brought out & solidly earthed
-	Temperature rise of oil over ambient temperature	:	40^{0}C maximum
-	Temperature rise of winding over ambient temperature	:	50^{0}C maximum
-	Impedance voltage	:	4% to 5% (max) for 630KVA 5% Max to 1250KVA
-	Voltage regulation at	:	Not to exceed 3.4% (630KVA) Not to exceed 4.0% (1250KV) of no-load Secondary voltage at 0.8 p.f and related current
-	Rated maximum voltage HT/LT	:	15kV / 0.6 kV
-	Rated short-time current	:	in kA (To be calculated by the manufacturer as per design parameters)
-	Rated Basic Impulse Level (BIL)	:	75 kV
-	Cooling	:	mineral oil immersed Natural cooled type (ONAN)

The design data alongwith support calculations, to be furnished by the Contractor for approval of the Engineer, shall include but not limited to the following:

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- Iron losses.
- Copper losses.
- Rated short-time current (in kA).
- Voltage regulation.
- Switching in-rush current.
- Efficiencies at different loads.
- Heat dissipation at different loads.
- Type and quantity of oil for complete filling of transformer.
- Transformer weight.
- Insulation Class.
- Dimensional Sketch.
- Details of Name Plate and Wiring Diagram.
- Details of cable tray / ladder support for supporting termination & connection of incoming / outgoing cables.

4.3. Accessories

In addition to the standard accessories of the power transformer as offered by the manufacturer, the transformer shall also be provided with following accessories without any additional cost:

- Oil drain Valve with plug.
- Oil Filling Hole and Plug
- Oil Conservator
- Oil Level Indicator
- Corrugated Fins / Cooling Tubes or Radiators
- Silica gel Breather
- Inspection Hole with Cover
- Bi-directional roller wheels.
- Lifting lugs.
- Haulage holes on chassis
- 2 number diagonally located earthing terminals
- Rivetted Stainless Steel Rating & diagram plate (HV side)
- "Electrical hazard" warning labels
- Off circuit tapping links with padlocking mechanism, operational when transformer is de energized, acting on the highest voltage to adapt the transformer to the true supply voltage.
- MV connection bras with connections from above
- MV Cable Box
- LV connections from above
- Marshaling Box
- Manufacturer recommended appropriate cable tray/ladder for supporting termination/connection of incoming HT cables from floor trench.
- Test certificate and an installation, commissioning and maintenance manual along with calibration certificates

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- Double Float Bucholz Relay with alarm and trip contacts.
- Max. Oil Temperature Relay (26) with alarm and trip contacts.
- Dial type thermometer with maximum temperature indicator and two adjustable normally open contacts for temperature alarm and tripping.
- Stainless steel diagram and rating plate according to IEC-60076-1.
- Pressure release safety valve.

4.4. Warranty

All proposed Power Transformers (complete set including all equipment, devices, components, parts etc.) will include a warranty of at least 2 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

5. INSTALLATION

Install and anchor transformers on concrete bases according to manufacturer's written instructions and according to seismic codes applicable to project.

5.1. Lifting

- Transformers shall be provided with permanently fitted lifting lugs or eye bolts to facilities handling by crane or hoist.
- Transformers shall be equipped with jacking points to facilitate the removal and or insulation pads.
- The bottom supporting steel work shall be fitting with holes or have lugs attached for the attachment of hauling apparatus.

5.2. Frame Wheels

- Transformers shall be designed for floor mounting and be provided with removable bi-directional or steerable rollers.
- The rollers shall be lockable or means provided to prevent movement of the transformers after installation.

5.3. Connection Methods

- Connection methods shall comply with IEC 60076. Provision shall be made by the manufacturer for the mounting and connection of cable boxes and / or bus bars as specified for the H.V and L.V conductor connections.
- Where HV and LV cable boxes and /or bus bars are specified these shall generally be arranged on opposite sides of the transformer. However exact positions shall suit the specified requirement of each individual situation.
- LV cable terminations shall be kept separate from the HV cable connections and insulated to the specified requirements of each individual situation.

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- LV cable terminations shall be kept separate from the HV cable connections and insulated to the specified voltage and be safely able to withstand the specified short circuit currents.

- An earthing terminal shall be provided at a convenient point on the supporting steel work. All steel work shall be bonded to the earthing terminal if it is not electrically continuous. Provision shall be made for making an earth connection to the neutral of the LV windings, should this be required.

- Manufacturer recommended cable tray/ladder for supporting the incoming HT cables from floor trench to ensure its appropriate termination / connection at flanged terminals.

5.4. Terminal Marking

- HV and LV winding terminals shall be clearly marked with characters in accordance with IEC 60076.

- The characters shall be stamped or engraved on securely fixed durable and non-corrodible plates.

5.5. Tap Connections and Links

- Each transformer shall be provided with tapping on the HV winding to cater for supply voltage variations in compliance with IEC Tap changing shall be off-circuit tapping links.

- A visible warning notice shall be fixed adjacent to the tapping links and worded as follows:

5.6. Rating Plates

- Rating plates shall be fitted complying with IEC 60076-11.

Transformer shall be installed in transformer room as shown on drawings. All civil works, including provision of cable trench, transformer oil pit, openings in wall, steel channel, etc., shall be carried out under civil works. The Contractor shall be responsible for general checking and co-ordination with civil works to ensure compliance with the requirements of transformer manufacturer for installation of equipment. For installation, connecting, testing and commissioning of transformers, the Contractor shall provide all required labour, materials, tools and testing equipment.

The transformer installation shall be carried out in accordance with specifications and the best-accepted practice. Any loose components supplied by manufacturer shall be assembled, installed and connected in place as to form a complete assembly as per manufacturer instructions. After the transformer is placed in position and aligned for H.T & L.T termination, the roller wheels shall be locked with the foundation steel channel to avoid any unintentional movement of the wheels.

The H.T cable shall terminate at the flange terminals on the H.T side. The supporting channels, fixing material, etc., required for H.T cable shall be furnished by the Contractor, details of which shall be approved by the Engineer prior to installation. The cable end box/termination kit will be supplied with the cable.

After the transformer is installed and connected, a thorough check shall again be made for the proper fixing of accessories, neutral connections, oil level, etc. The transformer shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications for Electrical Works, Section – 8001 of these Specifications.

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawings related to the item.

6.2. Indoor Power Transformer

6.2.1 Measurement

Measurement shall be made for each size of Indoor Power Transformer as given in BOQ acceptably supplied and installed by the Contractor, as a complete Job.

6.2.2 Payment

Payment shall be made for the number of Job measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the Power Transformer with all accessories as mentioned above, and/or required additional otherwise including control wiring to the H.T and L.T switchboard.

6.3. Spare Parts

6.3.1 Measurement

Measurement shall be made for the spare parts of Indoor Power Transformer as per list in **Appendix-D** to the bill of quantities, acceptably supplied by the Contractor as a complete lot.

6.3.2 Payment

Payment shall be made for the complete job of spare parts as provided above, at the Contract Unit Price each and shall constitute full compensations for supplying, tagging, and packing of spare parts including wooden / steel storage boxes.

*** End of Section – 8121 ***

SECTION - 8131

HIGH TENSION SWITCHBOARD

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing, connecting, and commissioning of all material and services of the complete HT Switchboard, as specified herein or stated on the Bidding Drawings and in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the electrical lines and equipment.

The HT Switchboard with accessories shall also comply with the General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Bidding Document

2. GENERAL

The HT switchboard shall be sheet steel fabricated, cubicle type, totally enclosed, dust tight vermin proof and with suitable protective provisions for operating in tropical and humid environment. It shall be complete in all respect with material and accessories, manufactured and **TYPE-TESTED** in accordance with the latest edition of IEC 62271 and shall fulfill and conform to the following requirements as minimum:

- Loss of service continuity category: LSC 2B (metallic partition, i.e. separate partitions for busbar, switching device and connection compartments)
- Opened accessible compartments and high-voltage live parts inside HT Switchboard shall be surrounded / separated by means of "Metal partitions and/or shutters" that are intended to be earthed. Therefore, switchgear should satisfy the partition class of "PM"
- Should be Internal Arc Classified Switchgear fully satisfying test Criterion 1 to 5 as per Clause 6.106.5 of IEC 62271-200.

The switchboard shall be suitable for front operation only and shall:

- Be completely type tested along with all proposed components
- Be suitable for addition of units, on either side, in future.
- Be provided with adequate clearance from live parts so that flashovers cannot be caused by switching surges, vermin, pests, etc.
- Be designed for flush mounting of all instruments on the front side.
- Have all incoming and outgoing connections from the bottom.
- Have rear accessibility with rear access cable compartment
- Have the components mounted so as to facilitate ease of maintenance from the front.
- Have lamp test, alarm test, alarm accept and reset facilities.
- Be mounted on cable trench having their own supporting structure of angular or U steel profiles.
- Have busbar chamber and instrument chamber protected according to

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International / Ingress Protection Classification IP-4X.

- Be provided with anti-condensate heater in each individual enclosure controlled automatically through adjustable humidistats for maintaining required safe operating condition inside the panel and also to avoid condensation. The heater shall also be manually operable and provided with protective miniature circuit breaker and ON indication lamp.
- Have stainless steel name plate.
- Have pocket for wiring diagram in suitable location/door of instrument chamber.

All pertinent details and drawings shall be provided to the Engineer for approval prior to manufacturing by the Contractor.

Contractor shall submit duly verified type test certificates for the offered complete HT Switchboard from independent laboratories for following tests in accordance with the latest edition of IEC 62271-200:

- Temperature-rise tests
- Rated Peak and rated short-time withstand currents
- Verification of making and breaking capacities
  - Verification of the protection
  - Verification of the IP Coding
- Verification of the IK Coding
- Internal Arc Test (for Switchgear & control gear classification IAC)
- Mechanical Operation Tests
  - Switching devices and removable parts
  - Mechanical and electromechanical interlocks
- Test to verify the insulation level of the equipment
- Electromagnetic compatibility tests (EMC)

The submission of type test reports from manufacturer's own laboratories or laboratories of any subsidiary company shall not be acceptable. Moreover, submission of type test reports for individual components or device shall not be considered to establish that the offered HT Switchboard is type-tested. Instead, comprehensive type test report of the complete HT Switchboard must be submitted to authenticate that the offered HT Switchboard is a type tested HT Switchboard.

2.1. Capacity and Basic Data

The switchboard shall be designed to conform to the following minimum requirements unless required otherwise for satisfactory and safe operation:

Rated Current	:	As shown on drawings.
Rated Frequency	:	50 Hz
Operating / Service Voltage	:	11 kV
Rated Voltage	:	12 kV

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Rated Power Frequency Withstand Voltage.	:	28kV for 1 minute
Rated Short Circuit Capacity	:	500 MVA at 11 kV for one second.
Rated Short Time Withstand Current	:	25 kA
Rated Duration of Short Circuit	:	1 second
Rated Peak Withstand Current	:	63 kA
Rated Short Circuit Breaking Current	:	25 kA
Rated Short Circuit Making Current	:	63 kA
Ambient Air Temperature	:	45°C
Operating Duty	:	B - 0.3" - MB - 3' - B
Rated Impulse withstands Voltage	:	95 kV
Degree of Protection	:	IP- 4X
Loss of Service Continuity Category	:	LSC2B
Partition Class	:	PM
Internal Arc Classification	:	IAC
Type of Accessibility	:	A FLR (Front / Lateral / Rear)
Internal Arc Fault Current	:	25 kA
Arc Fault Duration	:	1 second
Control Voltage:		
a) Indication/Metering	:	110V AC from Capacitor trip units as a backup provision.
b) Tripping	:	110V AC from Capacitor trip units as a backup provision.
Heaters and audible alarm	:	220 V AC from substation LT switchboard.
Auxiliary Contacts	:	Provision for remote indication and/or as required.

2.2. Interlocking

Any interlocking if required inside the switchboard and between HT switchboard and other equipment shall be provided as per system operational requirement.

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However, following interlocking conditions according to IEC 62271-200 must be fulfilled:

- Feeder earthing switch can only be operated with switching device in disconnected position
- Switching device can only be racked on the movable part with the associated switching device in OPEN position and with feeder earthing switch OPEN
- Switching device can only be operated in interlocked disconnected or service position
- Switching of switching device in ON position only possible with plugged low voltage connection

3. APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials within the scope of this section:

IEC 62271-1	-	Common specifications for high voltage Switch gear and control gear
IEC 62271-100	-	High voltage AC circuit breakers
IEC 62271-101	-	High voltage AC circuit breakers-Synthetic testing
IEC 62271-102	-	High voltage AC disconnector and earthing switches
IEC 62271-103	-	High voltage switches for rated voltage above 1 kV and upto and including 52 kV
IEC 62271-105	-	Alternating current switch –fuse combinations.
IEC 62271-200	-	Metal enclosed switchgear and control gear for rated voltage above 1kV and up to and including 52 kV
IEC 61869-1	-	Instrument transformer-general requirements
IEC 61869-2	-	Instrument transformers – additional requirements of Current Transformers
IEC 61869-3	-	Instrument transformers – additional requirements of Inductive voltage transformers
IEC 60051-1	-	Direct acting indicating analogue electrical measuring instruments and their accessories-Definitions and general requirements common to all parts.
IEC 60051-2	-	Direct acting indicating analogue electrical measuring instruments and their accessories-Special requirements for ammeters and voltmeters
IEC 60051-3	-	Direct acting indicating analogue electrical measuring instruments and their accessories-Special requirements for Watt meters and VAR meters
IEC 60051-4	-	Direct acting indicating analogue electrical measuring instruments and their accessories-Special requirements

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		for frequency meters
IEC 60051-8	-	Direct acting indicating analogue electrical measuring instruments and their accessories-Special requirements for accessories
IEC 60051-9	-	Direct acting indicating electrical measuring instruments and their accessories Recommended test method
IEC 60099-4	-	Surge arresters: Metal oxide surge arresters Without gaps for AC system
BS EN 13601	-	Copper and copper alloys: Copper rod, bar and wire for general electrical purposes

4. MATERIAL

4.1. HT SWITCHBOARD

4.1.1 Sheet Metal Work

The switchboard shall be fabricated with angle-iron framework, welded, grinded, finished and cladded with 12 SWG sheet steel or SWG thickness as recommended by the manufacturer in accordance with their type-tested protocol design. It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories.

Each cubicle shall be divided into four (04) compartments:

- Breaker Compartment
- Busbar Compartment
- H.T cable connection compartment
- Low voltage compartment to accommodate instruments

All instruments, relays, control and selector switches, indicating lamp, push buttons and trip levers shall be flush mounted and located at convenient heights on the front doors of switchgear in logical and clear manner. Means shall be provided to limit the opening angle of doors to about 100 degrees.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels shall be provided for fixing required type, size and number of 15 kV XLPE/SWA cable. Adequate number of eye bolts shall be provided to facilitate handling.

An earth bar of appropriate cross section to safely carry the fault current shall be provided on full length of H.T. switchboard and connected to the body of all sections of the switchboard. The external earth terminals shall be provided for main earth connection. The doors shall be grounded by flexible strap of copper braids.

The control cabling inside the switchboard shall be suitably numbered and harnessed by means of straps or cords. All indicating, selecting and control equipment shall be suitably arranged and clearly labeled with indelible labels, indicating the rating and designation of fuses, switches

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etc. The nameplates shall be provided on the front of panel for each circuit and component which is accessible from outside. The nameplates shall be of stainless steel with engraved equipment designation having minimum width of 5mm. Other labeling on the switchboard such as danger signs, voltage, and switchboard/panel etc., identification shall be of sufficient size to be legible.

On the front of each switch board cubicle a mimic diagram with the required circuit symbols shall be provided. The mimic diagram shall contain at least the following:

- 11 kV busbar
- 11 kV circuit breakers position indicators
- 11kV earthing switch with position indication
- Transformer Symbols
- Bus coupler symbol, if any.

The mimic bus should be of block plastic strip in accordance with the manufacturer's recommendations.

4.1.2 Bus Bars / Insulators

The bus bars shall be made of 99.99% pure high conductivity electrolytic tinned copper conductors suitably protected against corrosion, and shall be completely insulated by heat shrink coloured sleeves of specified voltage and mechanically braced to safely withstand the stresses due to short-time momentary current under the fault conditions. The phase identification of bus bars shall be red, yellow and blue. The clearances shall not be reduced on account of the bus bar insulation or the phase barriers.
The thickness of tinning on bus bar shall be adequate enough to ensure perfect protection against corrosion.

Contractor shall submit manufacturer verified busbar sizing calculations considering all applicable de rating factors for Engineer's review and approval.

The temperature rise of bus bars and their joints shall not exceed 40oC during testing for short circuit.

Accessibility of busbar must be made possible after removing of partitions. In this way, access to the busbar compartment should be "tool-based" according to IEC 62271-200.

Porcelain bush/epoxy resin type insulators shall support the Bus bars. The insulators shall be made of high quality porcelain material by the wet process. The entire insulator shall be smoothly glazed and shall be free from imperfections of all sorts. The electrical characteristics shall also be suitable for highly polluted / corrosive atmosphere. The cast resin insulators of equivalent characteristics can also be considered.

The bus bars and support insulators shall safely withstand the forces produced by rated short circuit current as mentioned in clause 2.1.

4.1.3 Circuit Breaker

The circuit breakers shall be type tested triple pole, with-draw-able type, with arc interruption in vacuum. The operating characteristics and

technical data shall be as given under Clause 2.1 of this section. The bidder/Contractor shall submit with his offer the type and details of equipment proposed.

The circuit breaker shall have trip free, direct acting and with both manually and motor operated drive mechanisms. For manual operation a handle shall be provided.

The motor spring operating mechanism shall be so designed to carry out the desired closing sequence using the stored energy in the closing spring supplied by the motor. The operating mechanism should incorporate springs capable of storing the energy required for desired switching sequence when the breaker has been closed. The closing spring is recharged automatic after closing.

The unit shall have rollout trucks and channels for horizontal withdrawal. Interlocking device shall be provided such that the breaker can be closed only when it is in fully plugged-in or fully withdrawn position, and withdrawal of circuit breaker is only possible in the open or isolated position. Safety shutters shall be provided which will automatically cover the live contact as the circuit breaker is withdrawn. Other interlocks as essentially required for safe and proper operation of circuit breaker shall be provided. The circuit breaker phases shall be separated by barriers of approved heat resisting, non-tracking insulating material.

Each circuit breaker shall have a device to register the number of closing operation.

The circuit breaker shall have automatic, mechanically operated `ON' and `OFF' position indications. The circuit breakers shall be provided with ON-OFF push buttons.

Luminous indications shall be provided on all incoming and outgoing panels, which shall include but not limited to following:

- Circuit Breaker TEST POSITION
- Circuit Breaker ON
- Circuit Breaker OFF
- Circuit Breaker TRIPPED
- Heater ON
- Buchholz Alarm
- Buchholz Trip
- Temperature Alarm
- Temperature Trip
- Earthing Switch ON
- Earthing Switch OFF

Additional indication lamps as shown on the drawings and/or as required by the Engineer shall also be provided.

Indicating lamps shall be LED type suitable for flush mounting, complete with base. They shall be suitable for operation on 110V AC and it shall have rosettes of suitable colours as approved by the Engineer.

Each Circuit Breaker shall be provided with at least three normally closed (NC) and three normally open (NO) potential free auxiliary contacts rated for 10 Amps, 230V AC as spares. Adequate provision shall be made for remote indication of the circuit breakers position/status.

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A test position shall also be provided to facilitate testing operation of circuit breaker manually and by protective relays. Test socket with plug shall be provided for testing the relays.

The circuit breaker shall be complete with necessary secondary wiring with ferrules to indicate the circuit. Protection shall also be provided for all control circuits.

4.1.4 Earthing Switches

A triple pole "Make-Proof" (Spring loaded) type earthing / grounding switch shall be provided for each incoming and outgoing cable earthing, complete with mechanism for interlocking it with the circuit breaker and the roll-out truck, and mechanical indication to show the position of grounding switch.

The earthing / grounding switch shall be type tested in accordance with the latest edition of IEC 62271-102. Contractor shall submit duly verified type test certificates for offered earthing switches from independent laboratories for following tests in accordance with the latest edition of IEC 62271-102 / 200:

- Verification of making & breaking Tests for Earthing Switch
- Short-time withstand current and peak withstand current tests
- Short-circuit making current test
- Operating and Mechanical Endurance Test

The earthing / grounding switch shall be suitable for earthing of equipment and shall be rated to safely carry the fault current due to inadvertent closing of supply circuit breaker and also for making duty on the fault.

Interlocking by means of "Blocking magnet" shall also be provided in the switchboard so that the supply circuit breakers at the Upstream Substation cannot be closed if the respective earthing switches in Substation are ON and to ensure interlocking of Earthing Switches in case of energization of main 11 kV cable. These switches shall be manually operated and be interlocked with the associated circuit breaker.

4.1.5 Instrument Transformers

The proposed 11kV Current Transformer & "11kV Potential Transformer" shall be type-tested. Contractor shall submit independent laboratories certificates in accordance with the latest edition of "IEC 61869-2" (for Current Transformer) & shall submit independent laboratories certificates in accordance with the latest edition of "IEC 61869-3" (for Potential Transformer).

All instrument transformers shall have separate secondaries for instruments/ metering and protection.

The current transformers shall have accuracy class 5P20 for protection and 0.5M5 for metering. The burden of instrument transformers shall be suitable for the load of protection and instrumentation circuits. The voltage transformers shall have accuracy class 1.0 for metering and protection.

The Contractor shall also submit burden calculation of Instrument transformers for the loads of protection and instrumentation circuits as

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specified above to the Engineer for review and approval.

4.1.5.1 Current Transformers

Each circuit breaker shall be provided with current transformers having following ratings and characteristics:

- Type	:	Cast resin
- Number	:	Three single phase units
- Burden	:	Suitable for load of protection and Instrumentation circuits.
- Accuracy	:	5P 20 for protection and 1.0 for measuring with security factor 5.
- Duty	:	For operating relays/meters and instruments.
- CT ratio	:	As shown on the drawings.
- No. of cores	:	1 or 2 as required and as shown on Bidding drawings.
- Rating and Insulation	:	As shown on drawings and/or specification in requirement as per clause 4.1.1
- Rated dynamic	:	2.55 times rated symmetrical short circuit current.

4.1.5.2 Potential Transformers

Potential transformers (PT) shall be provided as shown on the Bidding Drawings and having the following ratings and characteristics:

- Type	:	Cast resin
- Number	:	Three single phase units
- Burden	:	Suitable for load of protection and Instrumentation circuits.
- Accuracy	:	Class 1.0
- Duty	:	For operating relays/meters and instruments.

Potential Transformers shall be designed to have either two independent secondary windings of specified ratio for connection in star or open delta or with a single secondary windings as required and as shown on single line diagram.

- Voltage ratio : $\frac{11\,kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}} / \frac{110V}{3}$ for double secondary winding

: $\frac{11\,kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$ for single secondary winding

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- Rated voltage factor : 1.2 continuous and 1.5 for 30 seconds.

- Rating and insulation : As shown on drawings and as per requirements given specification in Clause 4.1.1

4.1.6 Protective relays

The protective relays shall be type tested. The over current and earth fault relay shall be in the form of single unit containing at least two over current elements for phases and for earth fault protection. The relay shall have draw-out feature for its active part from the enclosure. The front of the relay shall be covered with suitable transparent plastic material fastened to the enclosure with easily removable screws.

The relay shall be numerical static type. The relay shall have inverse definite minimum time characteristics with multiple choice of characteristic curves as per IEC 60255. Each element of relay must contain an instantaneous unit for short-circuit protection.

The relay shall be self-powered i.e. requiring no external auxiliary supply preferably be triple pole type and have continuous self-supervision. They shall be operated from the fault current supplied through secondary of current transformers and its contacts shall be capable of making and breaking max. rated trip coil currents. Auxiliary contacts shall be provided for A.C. series trip mechanism for indicating breaker trip.

Also suitable to have dual Auxiliary Supply110V DC from capacitor trip tripping Unit (Refer Clause 4.1.7) in each breaker/relays.

The circuit breakers shall be provided with inverse definite minimum time directional or non-directional over-current relays for phase and earth fault protection as shown on drawings and / or as needed per system operational requirement.

The relay shall be compatible with the utility's is 11kV network.
Operation indicators shall be provided for the phase and earth fault relays for the following:

- Relay Pickup
- Time delayed trip
- Instantaneous trip

The relays shall have the following common characteristics, unless otherwise specifically mentioned:

- Phase fault over current setting range

  Inverse : 50-200% of CT secondary rating

  Instantaneous : 200-800% of CT secondary rating. The instantaneous elements shall also have infinity setting to block their operation, if necessary

- Ground-fault : 20-80% of CT secondary rating Instantaneous element as for phase fault.

- Time setting range : 0-1 second

- Connection : 5 Amp secondary of CT

- Auxiliary Supply tripping : 110V DC from capacitor trip Unit (Refer Clause 4.1.7) in each breaker panel or CT powered Series Tripping (AC)

- Indications/Controls : 110V AC from secondary of P.T

- Heaters & audible alarm : 230V AC

- Auxiliary Contacts : Provision for remote indication and/or as required.

No separate payment shall be admissible for any alternate proposal to cater for the auxiliary power requirement of the proposed protection relays and the payment for the same deemed to have been included in the relevant BOQ item.

4.1.7 Capacitor Shunt Trip Unit

Each circuit breaker in the H.T. switchboard shall be provided with 110 volts DC trip coils, which will be supplied power through the capacitor trip units. The trip coils shall be fed through the relay contacts and the 'OFF' push buttons.

The capacitor trip unit will be fed from 110 AC volts secondary of potential transformer. The capacitor trip unit shall be suitable for performing two successive tripping operations carried out within five minutes. Every circuit breaker shall be provided with a separate capacitor trip unit.

4.1.8 Meters & Selector Switches

The meters to be provided on HT switchboard are shown on drawings and shall be as specified below:

4.1.8.1 Operating Hours and Switching Frequency Meters.

All incoming and outgoing 11 kV feeders shall be equipped with an operating hour counter and switching frequency meter. These shall operate through the auxiliary contacts of 11kV circuit breaker.

4.1.8.2 Ammeter and Voltmeter

The ammeter and voltmeter shall be moving iron spring controlled or digital having front dimensions of 96 x 96 mm. Voltmeters shall have measuring range of 0-15 kV and ammeters measuring range shall be as shown on the drawings. Ammeters and voltmeters shall conform to BSS accuracy class 1.5 and suitable for connection to the secondary of PTs and CTs installed on the switchboard.

4.1.8.3 Selector Switches

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Ammeter selector switch shall be R-Y-B-OFF and voltmeter selector switch RY-YB-BR-OFF. The selector switches shall be complete with front plat and operating lever.

4.1.8.4 kWh and kVArh Meters

Kilowatt-hour (kWh) and Reactive Kilovolt ampere-hour (kVArh) meters shall be suitable for 3 phase, 3-wire, 50 cycles balanced and unbalanced loads. The kWh meter shall also be provided with maximum demand indicator and built in switch for operation at an interval of 30 minutes. Such shall be approved from the local utility (KESC).

4.1.8.5 Alarm Indication

On occurrence of any fault in the system and subsequent tripping of Circuit Breaker / load break switch, audio alarm shall be provided on the HT Switchboard. Push buttons shall be provided on HT Panel for independent resetting of the audio alarm and fault indicating lamp. At least two potential free contacts rated 10 Amp AC or DC shall be available for remote connection.

4.1.9 Surge Protection

Surge Arresters shall be provided in H.T. switchboard, wherever required, as shown on drawing. The 11 kV surge arrester shall have the following characteristics:

- Voltage Class (highest system voltage): 12 kV rms
- Service (rated voltage) : 11 / sqrt 3 kV rms

This equipment will be tested in accordance with the relevant IEC Standard.

4.1.10 Tools

One complete set of tools for routine operation, setting and maintenance of HT switchboard including protective relays as recommended by manufacturer of each component shall be furnished within the price quoted for the HT Switchboard.

The tools shall be supplied in suitable box. Details of tools shall be furnished by the bidder with his offer in **Appendix - D** to Bill of quantities.

4.1.11 Insulation Mat

The insulation mat shall be placed in front of the HT switchboard all along the entire length. They shall be one meter wide and 6 mm thick and suitable for providing insulation for 15 kV working.

4.1.12 Danger Boards with Signs & Designation and Shock / First Aid Charts

As per requirements of Pakistan Electricity Rules/Electric Inspector, Danger Boards having signs and designation of the room shall be installed on the external door of each room of the Substation.

Shock/First Aid Charts shall be installed in H.T and L.T, Rooms of substation.

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4.1.13 Routine Tests

The following routine tests shall be performed on H.T. switchboard in accordance with the latest edition of IEC 62271-1 & 62271-200 as minimum unless required otherwise per relevant standard:

a) Di-electric test on main circuit
b) Tests on auxiliary and control circuits
c) Measurement of the resistance of the main circuit
d) Partial discharge measurement
e) Mechanical Operation Test
f) Tests of Auxiliary electrical devices
g) Tests after erection on site
h) Relay testing through primary injection test

4.2. WARRANTY

All proposed H.T Switchboards (complete sets including all equipment, devices, components, parts etc.) will include a warranty of at least 2 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

5. INSTALLATION (H.T SWITCHBOARDS)

The HT switchboard shall be installed at location shown on the drawing. The cable trenches shall be constructed as part of civil works. The Contractor shall co-ordinate with the manufacturer for civil works including foundation detail as per Ambient conditions referred in Clause 3 of technical specification, Section 8001 for providing any openings, holes, etc., in time to avoid any breakage/damage to completed works. In case such provisions in civil works for installation of electrical equipment are not made or made incorrect, the same shall be rectified by the Contractor at his own cost and to the satisfaction and approval of engineer. In this regard Contractor should submit shop drawing as per Manufacturer's recommendation regarding civil works for the Engineer review and approval.

The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material approved by the Engineer. All installation materials for physically erecting the switchboard, such as bolts, nuts, washers, supporting steel, etc. shall be provided and installed by the Contractor. The switchboard shall be installed upright and in level and shall be firmly and rigidly bolted on the floor and concrete supports. All wiring external from HT Switchboard to alarm indication control unit protection interlock circuits and for auxiliary power supply for heaters, etc., will be furnished and installed by the Contractor in consultation with the Engineer.

The switchboard shall be erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking of meters relays, etc., provided by the manufacturer for safe transport shall be released only after the switchboard is erected in position.

Necessary provision shall be made in the HT switchboard for incoming/outgoing cables, and installation of cable termination kits, keeping in view both cable and switchboard manufacturer's recommendations. The cable armour shall be connected to the earth

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system.

The switchboard body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The switchboard shall be tested and commissioned in the presence of the Engineer. The tests to be carried out shall be as recommended by the international standard to which the switchboard is manufactured and/or as recommended by manufacturer; but as a minimum the tests given in article "Testing" of General Specifications for Electrical Works, section 8001 of these Specifications shall be carried out.

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against each Bill of Quantities item as given below shall include design, supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Bidding Drawing related to the item.

6.2. HT Switchboard

6.2.1 Measurement:

Measurement shall be made for the complete job of HT Switchboard acceptably supplied and installed by the Contractor.

6.2.2 Payment:

Payment shall be made for the number of job measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the HT switchboard including all connections, installation materials, such as foundation bolts, supporting steel, nuts, washers etc. wiring for control and auxiliary circuits, tools, etc., complete with LT wiring from LT switchboard for power supply of heaters.

No separate payments shall be made for the under mentioned specified work related to the supply and installation of HT Switchboards. The cost thereof shall be deemed to have been included in the quoted rates of above work.

- Civil works for foundation

6.3. HT Insulation Mat

6.5.1 Measurement:

Measurement shall be made for the complete job of Insulating Mat acceptably supplied and installed by the Contractor.

6.5.2 Payment:

Payment shall be made for the number of job measured as provided above at the Contract unit price and shall constitute full compensation for supplying and installing and proper placing of insulation mat in front of complete HT Switchboard.

6.4 Danger Boards with Signs & Designation and Shock & First Aid Charts

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6.6.1 Measurement

Measurement shall be made for complete job of Danger Board with Signs & Designation and Shock / First Aid Charts acceptably supplied and installed by the Contractor as a complete job in accordance with the provisions of Pakistan Electricity Rules and requirements of Electric Inspector.

6.6.2 Payment

Payment shall be made for the number of jobs measured as provided above at the Contract unit price each and shall constitute full compensation for supplying and installing the danger boards with signs and designation and shock/first aid charts including all accessories screws, nuts, bolts, etc.

6.5. Spare Parts

6.7.1 Measurement

Measurement shall be made for the complete job of spare parts of HT switchboard/ Kiosk as per list in **Appendix – D** to the bill of quantities, acceptably supplied by the Contractor as a complete lot.

6.7.2 Payment

Payment shall be made for the complete job of spare parts as provided above, at the Contract Unit Price each and shall constitute full compensations for supplying, tagging, and packing of spare parts including wooden / steel storage boxes.

*** End of Section 8131 ***

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SECTION - 8132

LOW TENSION SWITCHBOARDS

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing, connecting, commissioning of all material and services of the complete LT Switchboards as specified herein and/or shown on the Bidding Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and position of the LT Switchboards/

The LT Switchboards shall also comply with the General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Bidding Documents.

2. GENERAL

The main LT switchboard shall be factory manufactured / assembled / routine tested either by an Original Equipment Manufacturer (OEM) itself based on its own verified reference design or shall be factory manufactured / assembled / routine tested by some other approved manufacturer / assembler based on the verified reference design of the OEM in accordance with the latest edition of IEC 61439. In later case, the manufacturer / assembler shall submit duly signed & stamped documents and drawings from the OEM along with its own valid letter of authorization from the OEM.

The main LT switchboard shall be manufactured and conform to Form-3b and shall meet the below criteria as stated in the latest edition of IEC 61439:

- Separation of busbars from all functional units
- Separation of all functional units from one another
- Separation of terminals for external conductors and external conductors from the functional units, but not from the terminals of other functional units
- Terminals and external conductors separated from Busbars.
- Separation may be achieved by means of partitions or barriers (metallic or suitable non-metallic material)

The LT Switchboards shall be of sheet steel fabricated, floor/wall mounting, cubicle type, totally enclosed, dust tight and vermin proof. It shall be complete in all respect with material and accessories, factory assembled, tested and finished all according to the specifications and to the normal requirements. All wiring and equipment for control, protection, indication, etc. required for the safe and intended operation of the systems as specified herein or shown on the drawings shall be furnished by the Contractor.

The LT Switch board shall have protection class (IP rating) of IP-42 unless specified otherwise by the Engineer.

The LT Switchboards with all components and accessories shall be suitable for front operation only and shall:

- be design verified assemblies as per the latest edition of IEC 61439.
- be suitable for addition of units, on either side.
- be suitable for extension of Busbar / interfacing with other L.T. Switchboard
- have a rated service short circuit breaking capacity (Ics) at 415 V AC conforming to IEC 60947-2 and / or as shown on the drawings

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- be provided with adequate clearance from live parts so that flashovers cannot be caused by switching, vermin, pests, etc.
- have all components rated for insulation class of 600-volt minimum.
- be designed for flush mounting of all instruments on the front side.
- have incoming and outgoing cable termination arrangement, terminal blocks, line-up terminals, etc.
- have all incoming and outgoing connections from the bottom or with appropriate provision for top entry as per site requirements.
- have the components mounted so as to facilitate ease of maintenance from the front.
- have wiring diagram in the pocket on the inside of each door of the panel.
- be suitable for 400 volts AC, 3 phase 4 wire, 50 Hz system.
- be labeled with stainless steel nameplate on the front side of door for each incoming and outgoing circuit.
- have doors grounded by flexible copper cable/strip.
- have arrangements for extension of panel in future.
- have common lamp test facility for all lamps.

3. DESIGN VERIFICATION

Contractor shall submit duly verified design verification test certificates and their comparison with a reference design as per the latest edition of IEC 61439 in respect of following for Engineer's review:

- Temperature Rise Limits
- Short Circuit Withstand Strength of Switchgear
- Short Circuit Withstand Strength of protective circuit

Contractor shall also submit a duly verified design verification test report for the switchboard assembly with design verification test certificates for the offered design of main LT Switchboard from reputed independent IEC accredited laboratories highlighting the following in accordance with the latest edition of IEC 61439 as minimum unless required otherwise as per relevant standard shall be submitted:

a) Rated operational voltage
b) Rated frequency
c) Rated current
d) Dielectric properties
e) Rated insulation voltage
f) Rated impulse withstand voltage
g) Short circuit withstand strength
h) Rated short time withstand current – 3 phase
i) Rated peak withstand current
j) Rated conditional short circuit -3 phase
k) Clearances
l) Creepage distances
m) Mechanical operation
n) Degree of protection

4. APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this Section:

IEC 61439	-	Low Voltage Switchgear and Control gear Assemblies (All Parts)
IEC 60947-3	-	Low Voltage Switchgear and Control Gear-Switches, Disconnector, Switch-disconnector and Fuse Combination Units.
IEC 60947-2	-	Low Voltage Switchgear and Control Gear-Circuit Breakers for Moulded Case Circuit Breakers (MCCBs) and Air Circuit Breakers (ACBs)
IEC 60831	-	Shunt Power Capacitors of self- heating type AC systems having a rated voltage upto and including 1000V
IEC 60073	-	Basic safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
IEC 61869-2	-	Instrument Transformers – Additional requirements for Current Transformers
IEC 61869-3-		Instrument Transformers – Additional requirements for Inductive Voltage Transformers
IEC 60051-1, 2, 3, 5 & 8	-	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC 60898-1	-	Electrical Accessories- Circuit breakers for over current protection for household and similar installations – Circuit breakers for AC operation
IEC 60051-2	-	Direct acting indicating analogue electrical measuring instruments and their accessories. Special requirements for ammeters and voltmeters
IEC 60871-1	-	Shunt Power Capacitors for AC power systems having a rated voltage above 1000V - General
IEC 60947-4-1	-	Low Voltage switchgear and control gear – Contactors and motor starters – Electromechanical contactors and motor starters.
BS EN 60529	-	Degrees of protection provided by enclosures (IP Code)
BS EN 13601	-	Copper and copper alloys: Copper rod, Busbar and wire for general electrical purposes.
IEC 60269	-	Low Voltage fuses
BS 88-2	-	Low Voltage Fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to K.
EN 50160	-	Voltage Characteristics of Public Distribution Systems
IEEE 519	-	Harmonic Control in Electric Power Systems

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5. MATERIAL

5.1. Sheet Metal Work

The Switchboards shall be fabricated, welded, grinded, finished with angle iron framework and cladded with 14 SWG MS sheet. It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories in accordance with the specified form of internal separation.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable glands respectively for unarmoured and armoured cables shall be provided. All holes, cutout shall be tool or jib manufactured and free from burrs and rough edges. An earth bar of appropriate cross section shall be provided and connected to the bodies of all sections of the switchboard. Two external earth terminals shall be provided for main earth connection to the body of switchboard. The doors shall be earthed by means of flexible copper strip. Means shall be provided to limit the opening angle of doors to about 100^0.

The cabling inside the switchboard shall be suitably numbered and harnessed by means of straps or cords. Colour sleeves shall be provided on each cable lugs, connected to the bus bars, circuit breakers or terminals etc. for phase identification. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, selecting and control equipment shall be suitably arranged and clearly labelled by means of flame proof material using indelible ink/marking indicating the rating of fuse, switches, etc. The nameplates provided on the front of panel shall be of flame-retardant material preferably stainless steel. Use of plastic or any inflammable material shall not be permitted for nameplates.

5.2. Components

The switchboards shall be provided with all components as specified or shown on the Drawings and as necessary for the satisfactory operation of the switchboard and of the electrical system. Typical specifications are given here under.

5.2.1 Bus Bars

The bus bars shall be made of 99.99% pure high conductivity electrolytic tinned copper and shall be completely insulated by heat shrink colored sleeves of specified voltage grade. And mechanically braced for the specified fault level according to relevant IEC standard. The phase identification of bus bars shall be by providing colours sleeves on bus bars ends and these shall be red, yellow and blue for phase and black for neutral. The earth bus bar shall be green. The thickness of tinning on bus bars shall be adequate enough to ensure perfect protection against corrosion besides ensuring specified rated ampacity.

The bus bars shall be triple pole, neutral & earth and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise of bus-bars, at rated current, shall not exceed 30^0C above the specified ambient temperature.

Neutral bus bar shall be of the same cross section as phase bus bars. Earth bus bar shall be of half cross-section area as phase bus bars.

Contractor shall submit manufacturer verified bus bar sizing calculations along with supporting documents considering all applicable de-rating factors for Engineer's review and approval.

5.2.2 Circuit Breakers

The circuit breaker shall be triple/four pole, current limiting type, manually operated or motor operated, spring charged type as shown on the drawings with front drive grip handle. ON-TRIP-OFF indication shall be provided on circuit breakers. The Circuit breakers shall have the following protections and setting range unless otherwise shown on the drawings:

- Adjustable three pole, manual reset thermal overload release of setting range 80 to 100% of rated current.

- Magnetic triple pole short circuit release having range according to manufacturer's standard range.

The incoming circuit breakers of main LT panel (normal and emergency) shall be either air circuit breakers or moulded case type, whereas outgoing circuit breakers of main LT panel shall be moulded case type, unless stated otherwise on the drawings. Wherever Air circuit breaker is specified on the drawing, these shall be 4-Pole, motorized, withdrawable type, having LSIG protection.

The incoming circuit breaker shall have two numbers normally open and two numbers normally closed auxiliary contacts rated for 2 Amp, 230 VAC. The incoming circuit breaker shall also have ON-TRIP-OFF indicating lamps. Where shown on the drawings indication lamps shall also be provided for outgoing circuit breakers. Generally, the circuit breaker shall have specified rupturing capacity without the use of back-up fuses. However, if required and / or as mentioned on the drawings, appropriately rated HRC fuses shall be provided as backup protection to ensure a faster tripping in case of abnormally higher fault currents. Auxiliary release and trip coils shall be provided for desired operation and/or interlockings as stated on the drawings and/or as needed per system operational requirement.

The motor operated, spring charged type circuit breakers shall be provided with anti-pumping circuit to prevent repeating cycle of TRIP reset and ON even if the close command is given while the circuit breaker has tripped due to fault.

Unless specified otherwise by the Engineer, the entire main LT Switchboard including all incoming and outgoing circuit breakers shall be "Withdrawable type" and these switchboards shall also comply with the following requirements:

- All circuit breakers and / or switch fuse units shall be as shown on the drawing. Where two or more feeders are contained in the same cubicle, they are to be separated by barriers of steel or fire resistant insulating material. If required, the metal surface of the cubicle shall be protected by fire resistant insulating material. Each panel shall combine in tier form all respective components with their incoming and outgoing power feeders.

- The draw out switching units shall be mounted on trucks or slide-in chassis having adequate guidance by greased sliding rails and/ or rollers. They shall be connected to the bus bars by means of a self-aligning plug and socket arrangement and

complete isolation of each circuit shall be attained by drawing out the switching unit.

- The main contacts shall have safety shutters, which will automatically cover the line contacts as the circuit breaker is withdrawn. The withdrawal of circuit breaker shall be accomplished by means of a crank, with as little effort as possible.

- The contact surfaces of the plugs and sockets shall be silver-plated. The contacts shall be of ample size and sufficiently strong to withstand maximum prevailing short circuits and carry continuously their normal rated currents without damage or overheating of any kind. Also, the control circuits shall be provided with plugs and sockets.

- The withdrawable units shall have clearly marked service, test and isolated (ready for complete withdrawal) positions. A mechanical interlock is to be provided to prevent withdrawal of the unit unless the power circuit has been interrupted. The unit shall, furthermore, positively be locked in the test position before it is manually released for complete withdrawal.

- All components required to make a fixed type circuit breaker withdrawable, such as, chassis, plugin plates, side plates etc, shall be duly supplied by the Contractor with all necessary details.

5.2.3 Switch - Fuse Units

The switch-fuse unit shall comprise a triple pole on load isolating switch with HRC fuses. The fuse shall be supplied complete with the fuse base and shall conform to BS-88 Class Q1 with a fusing factor of 1.5.

5.2.4 Digital Energy Analyzer with Power Quality analyzer

Digital Energy Analyzer shall be provided in L.T. switchboard, wherever required, as shown on drawing. The proposed digital energy analyzer shall be suitable for Power monitoring application, flush mounting, with front dimensions of 96 x 96 mm and shall be compatible for single and balanced and unbalanced three phase LV Systems.

The proposed digital energy analyzer shall have clear backlit LCD Display with built-in alarm / notification function, and shall comprise of at least following characteristics:

5.2.4.1 Power Quality Analysis:

- EN 50160 2010 compliance report
- IEEE 519 2014 compliance report
- IEC 61000-4-30 class S power quality measurement
- up to the 31st harmonic
- harmonic distortion
- waveform capture
- voltage sag and swell detection
- programmability (logic and math functions)
- Power quality monitoring

5.2.4.2 Supply Voltage

- 90...415 V AC 45...65 H
- 110...415 V DC +/- 10

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5.2.4.3 Type of Measurement:

- Voltage (L1-N; L2-N; L3-N; L1-L2, L2-L3; Avg. L-N, Avg. L-L)
- Currents (L1; L2; L3; total)
- Active power (L1; L2; L3; total, kWH)
- Reactive power (L1; L2; L3; total, kVARH)
- Apparent power (L1; L2; L3; total)
- Active & Reactive power per phase, rms
- Power Factor per phase, rms
- Voltage Interruption, Voltage Dips and Swells
- Min, Avg, and Max. values of above parameters
- Maximum demand (MDI) of Power and Current values
- Power factor (L1; L2; L3; total)
- Voltage (VL-L, VL-N) harmonics (up to 15-th order)
- Current harmonics (up to 15-th of L1, L2, L3)
- Total Harmonic Distortion (THD): Voltage and Current
- Voltage / Current Asymmetry
- Active energy counter
- Inductive energy counter
- Capacitive energy counter
- Apparent energy counter
- Frequency (Hz)

5.2.4.4 Measurement Accuracy

- Current +/- 0.1 %
- Voltage +/- 0.1 %
- Active energy +/- 0.2 %

5.2.4.5 Accuracy Class

- Class 0.2S (Active Energy)
- Class 0.2 (Active Power)
- Class 0.5S (Reactive Energy)
- Class 0.5 (Power Factor)
- Class 0.2 (Voltage)
- Class 0.2 (Current)

5.2.4.6 Communication Port Protocol

- Modbus TCP/IP

5.2.4.7 Data Recording:

- Min/max of instantaneous values
- Waveform logs
- Sequence of event recording
- Time stamping
- Alarm logs
- Trending/forecasting
- Sag and swell logs
- Harmonics logs
- GPS synchronisation
- Data logs
- Event logs

5.2.4.8 Cyber Security:

- Enable/disable communication ports
- Password protection

- Syslog protocol support
- Robust security logs
- Port hardening

All accessories required for the proper operation shall be supplied by the Contractor and cost for the same shall deemed to be included in the cost of relevant BOQ item for main LT Switchboard. No extra payment, whatsoever shall be admissible in this regard.

5.2.5 Three Phase Energy Meters (Kilowatt Hour Meters)

Three phase or Single phase energy meters of frequency 50 Hz and accuracy class of 1.0 with proper meter base, cover, frame, terminal block, terminal cover, auxiliary circuit etc. shall be provided for use with instrument transformers.

The construction of meter shall be suitable for its purpose in all respect and shall give reasonable assurance of permanence in all mechanical, electrical and magnetic adjustments. The construction shall be such that the meter is not prone to produce appreciable noise in use.

The meter shall have a dust proof case, which can be sealed in such a way that the mechanism of the meter is only accessible after breaking the seal. The case shall be made of metal or toughened glass of a sufficient strength to ensure adequate protection of the internal parts.

The direction of rotation shall be marked by a clearly visible indelible arrow.

Electronic meters with same accuracy class can also be provided.

5.2.6 Three Phase Digital Multimeter

The proposed three phase digital multimeter shall be flush mounting, with front dimensions of 96 x 96 mm and shall have accuracy class 1.0 according to relevant IEC standard and shall be suitable for connection to 5 Amps secondary of current transformers or directly through shunt as shown on drawings.

It shall be suitable for single and balanced and unbalanced three phase LV System, have Built-in Selector switch, with clear backlit LCD Display and shall ensure measurement of following parameters:

- Voltage (L1-N; L2-N; L3-N, L1-L2, L2-L3; average L-N, average L-L)
- Currents (L1; L2; L3; total)
- Frequency (Hz)

5.2.7 Current Transformers

Air-cooled, ring type current transformers shall be provided having transformation ratio as indicated on the drawings. The current transformers shall be of suitable burden having accuracy class 1.0 according to IEC 61869-2 or relevant standard. The current transformers shall have 5 amps secondary.

5.2.8 Selector Switches

Ammeter and voltmeter selector switches shall be complete with front plate and grip handle. R-Y-B and OFF position for ammeters and

RY-YB-BR-RN-YN-BN and OFF position for voltmeters shall be marked on the respective selector switches.

The selector switches for controls shall be rotary cam type, having required number of positions. It shall be provided complete with knob and front plate showing all positions as required.

5.2.9 Air Break Contactors

The contactors shall be air break, triple pole 400 VAC type and suitable for the type of duty (at least utilization Category AC3) to be performed and AC6b when used inside Power Factor Improvement plant to perform capacitor bank switching. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with single phase 230 VAC operating coil and minimum two spare normally open and one normally closed auxiliary contact. The number of working auxiliary contacts shall be provided according to the system requirements.

The Magnetic Contactors when used for Motor Starter circuit shall be type-2 coordinated with the backup protection. That is under short circuit conditions; the contactor and starter shall cause no danger to persons or installation and shall be suitable for further use.

5.2.10 Push Buttons

The push buttons shall be illuminated, momentary make/break contact type or latch type (push-on/push-off) as required and approved by the Engineer and suitable for flush mounting. The push button for ON and OFF switching shall be red and green respectively.

5.2.11 Impulse Relay

Impulse Relay shall be 1 or 2 pole, 250 V rated and be provided with latching mechanism.

5.2.12 HRC Fuses

HRC fuses shall be provided complete with fuse bases, fuse and trip indicator etc. The fuses shall have a fusing factor as specified for class Q1 in accordance with BS 88.

5.2.13 Indicating Lamps

Indicating lamps shall be LED type suitable for flush mounting, complete with base. They shall be suitable for operation on 230V AC and it shall have rosettes of suitable colours as approved by the Engineer.

5.2.14 Line up Terminals

Line up terminals wherever provided for control or power circuits shall be suitable for voltage and size of conductors as indicated on drawing.

The line-up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

5.2.15 Auxiliary Relays

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The auxiliary relays used for control purposes shall generally be provided with operating coil voltage rating 230 volts AC, 50 Hz. The auxiliary relays shall have appropriate number of pins/contacts as required for normal operation of the system. Use of different types and makes shall be avoided as much as possible.

5.2.16 Program Selector Switches

Program selector switches shall be rotary or cam type, 2-position, 2-pole and 3-position, 3-pole as required, complete with knob and front plate with position indication.

5.2.17 Uninterruptable Power Supply

An uninterruptable Power Supply (UPS) with an output of 230V, 50 Hz shall be provided by the Contractor as the power supply for controlling and interlocking along with the LT Switchboard. Capacity of the UPS shall be 150% of requirement for 10 minutes. The specifications of UPS shall be as per specification section 8180.

5.2.18 Active Harmonic Filter (AHF)

Active Harmonic Filter shall be installed to mitigate harmonic distortion in the electrical system. Harmonics are current or voltage components that are multiples of the fundamental frequency (usually 50 or 60 Hz). They can cause various problems, including equipment damage, increased energy consumption, and distorted waveforms. An AHF shall measure and generate harmonic currents that are equal in magnitude but opposite in phase to the harmonics produced by the load. These generated harmonics will cancel out the existing harmonics, improving the overall power quality

AHF shall be provide the following solutions:

1. Reactive Power Compensation
2. Harmonic Mitigation
3. Voltage Unbalance mitigation

The contractor shall submit compliance against IEEE519 for the above.

It shall be in modular arrangement of approximately 800A, each having 200A rating suitable for the system voltage of 415V. However, Contractor shall submit calculations for the selection of AHF modules during material submittal stage. The modules shall be enclosed in a mild steel housing of minimum 2mm(14SWG) thickness and an ingress protection of at least IP40.

Following are the technical requirements:

a. System Voltage:
   Voltage 240 – 415 VAC (±10%)

b. Harmonic filter:
   The harmonic filter shall be suitable for filtration of 2nd to 50th harmonics in the electrical system or as specified in IEEE 519.

c. Total Harmonic distortion current:
   The THDi shall be <5% or as specified in IEEE 519.

d. Response time:
   The response time shall be as specified in IEEE 519.

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e. Redundancy:
Each module has independent controller. If one module fails, the rest keep operating.

f. Communication Protocol:
Modbus TCP/IP

g. Cooling method:
Forced air by temperature-controlled fans and filters

h. Operating Temperature and Humidity:
5 to 40 °C, without derating. It shall operate at maximum ambient temperature 50 °C. AHF shall operate satisfactorily at the relative humidity specified in Specification section 8001.

i. Cable entry:
Cable entry shall be from top.

j. Noise level:
The noise level shall not be more than 68 dB at full load or as suitable for Hospital environment.

k. Current transformers:
Current transformers shall be installed at the network and load side with a minimum accuracy class of 1.0.

l. HRC fuse:
Appropriately rated HRC fuses shall be used for each module connection.

It shall be complete in all respects covering internal protections, cabling, copper work and termination point for connection from the power equipment.

5.2.19 Surge Protection

Surge Arresters shall be provided in L.T. switchboard, wherever required, as shown on drawing. The Contractor shall submit proper calculations for the Surge protection device (SPD) rating and the SPDs shall be adequately sized for 400 Volts and shall have the following characteristics:

- Voltage Class (highest system voltage): 440 V rms
- Service (rated voltage): 400 / 1.732 kV rms

This equipment will be tested in accordance with the relevant IEC Standard.

5.3. Warranty

All proposed L.T Switchboards (complete set including all equipment, devices, components, parts etc.) will include a warranty of at least 2 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment whatsoever, shall be admissible in this regard and for extended warranty, if any.

6. INSTALLATION

The LT Switchboards Boards shall be installed at location shown on the drawing or as advised by the Engineer. The concrete pedestal shall be constructed as per relevant specifications for civil works. The Contractor shall be responsible to ensure co-ordination with the civil works for providing any openings, holes, etc., to avoid any breakage to completed works. In case the provisions in civil works for installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own cost and to the satisfaction of Engineer.

The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.

All installation materials for physically erecting the switchboard such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The Switchboard and Automatic Transfer Switch (ATS) shall be installed upright and in level and shall be firmly and rigidly bolted to the floor and concrete supports.

The LT switchboard shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking of meter, relays, etc., provided by the manufacturer for safe transport shall be released only after the switchboard is erected in position. The incoming and outgoing cables shall be connected as recommended by cable manufacturer and providing color sleeve on the lugs at both ends of cables the cable armour shall be connected effectively to ground.

The control system components, devices, and wiring etc. shall be installed as per manufacturer's instructions and recommendations. After installation, the equipment shall be sequentially tested to confirm that the required switching is effective. The tests shall be carried out in the presence of the Engineer and to his entire satisfaction.

The requirement of the same shall be calculated by the contractor. The cost of UPS is deemed to be included in the cost of main LT Switchboard and no extra payment shall be made in this regard.

The switchboard body shall be connected to earth as per instructions given in section "Earthing" of these Specifications. The switchboard shall be tested and commissioned in the presence of the Engineer.

The LT Switchboards shall be tested before energizing as per instructions contained in article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

No separate payment for supplying, installing the control cables for the complete system and testing and commissioning of the entire system is admissible and is deemed to have been included in the BOQ rates for LT Switchboards Boards.

7. MEASUREMENT AND PAYMENT

7.1. General

The Contractor's bid amount against Bill of Quantities items as given below shall include design, manufacturing, fabrication, supply, installation, testing,

commissioning and completion for all works specified herein and as shown on the Tender Drawings related to the item.

7.2. LT Switchboards

7.2.1 Measurement

Measurement shall be made for the number of each LT Switchboards given in BOQ acceptably supplied and installed by the Contractor as a complete job.

7.2.2 Payment

Payment shall be made for the total number of each type of job measured, as provided above, at the Contract unit price each and shall constitute full compensation for design, manufacturing, fabricating, supplying, installing, connecting, interfacing, testing and commissioning of the LT Switchboards as per single line diagram shown on the drawing alongwith, Active Harmonic Filter with HRC fuses (including it design calculations, all controls / indications etc.) , adequately sized UPS, all erecting material such as foundations bolts, supporting steel channels, nuts, washers, cable glands etc., complete with foundation and all related Civil works.

No separate payments shall be made for the under mentioned specified work related to the supply and installation of LT Switchboards Boards. The cost thereof shall be deemed to have been included in the quoted rates of above work.

- Civil works for foundation

***** End of Section 8132 *****

SECTION - 8133

LOW TENSION DISTRIBUTION BOARDS

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing, and commissioning of all material and services of the complete Low Tension (LT) Distribution Boards as specified herein, shown on the Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact location and position of the each L.T. Distribution Board.

The Low Tension Distribution Board with accessories shall also comply with the General specifications for Electrical Works, section - 8001 and with other relevant provisions of the Contract Document.

2. GENERAL

The Low Tension Distribution Board (DB) shall be sheet steel fabricated suitable for surface/recessed mounting on wall or floor standing totally enclosed, dust tight and vermin proof. It shall be complete in all respects with material and accessories, factory assembled, tested and finished according to the Specifications and to the normal requirements. The indoor LT Distribution Boards shall have protection class (IP rating) of IP54 rated.

The Low Tension Distribution Board shall be front operation type and shall:

- have a rated service short circuit breaking capacity, Ics at 400V conforming to IEC 60947-2 unless stated otherwise on the drawings.
- be suitable for 400/230 volts, 3 phase, 4 wire, 50 Hz system.
- be provided with adequate clearance from live parts so that flashovers cannot be caused by switching, vermin, pests, etc.
- have incoming and outgoing cable termination arrangement, terminal blocks, line-up terminals, etc.
- be provided with steel nameplate on the front side of door and wiring diagram on inside of door.
- be designed for flush mounting of all instruments on the front side.
- have all incoming and outgoing connections from the bottom or with appropriate provision for top entry as per site requirements.
- have the components mounted so as to facilitate ease of maintenance from the front.
- have doors grounded by flexible copper cable/strip.
- have provision for remote signaling of all motor operating status.
- have wiring diagram in the pocket inside the door of Distribution Board

3. APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this Section:

IEC 61439 - Low Voltage Switchgear & Control gear Assemblies. (All pa

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IEC 60947-2	-	Low Voltage Switchgear and Control gear.
IEC 60073	-	Colours for indicator lights and push buttons.
IEC 60831	-	Power Capacitors.
BS 88	-	HRC Fuses.
IEC 60051-1, 2, 3, 5 & 8	-	Direct acting indicating analogue electrical measuring instruments and their accessories
BS EN 61869-2	-	Low voltage current transformers
IEC 60898-1	-	Electrical Accessories- Circuit breakers for over current protection for household and similar installations – Circuit breakers for AC operation
IEC 60051-2	-	Direct acting indicating analogue electrical measuring instruments and their accessories. Special requirements for ammeters and voltmeters
BS EN 60529	-	Degrees of protection provided by enclosures (IP Code)
BS EN 13601	-	Copper and copper alloys: Copper rod, Busbar and wire for general electrical purposes.
IEC 60269	-	Low Voltage fuses

4. MATERIAL

4.1. Sheet Metal Work

The Low Tension Distribution Board (DB) shall be fabricated with 16 SWG sheet steel recess / surface mounting as approved by the Engineer. All the components shall be installed on a common component mounting plate inside the enclosure and protected from the front with screwed sheet steel front plate. The enclosure shall be provided with rubber gasketting and a lockable hinged door with cam fastener.

The distribution board shall be supplied complete with all installation materials as recommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for accommodating the cables and conduits may be provided. The box shall be of the same material and finish as the DB. All holes, cutout etc. shall be tool and free from burrs and rough edges.

The cabling inside the DB shall be suitably harnessed by means of straps or cords. Colour sleeves shall be provided on each cable lugs connected to the bus bars, circuit breakers or terminals for phase identification. An earth bar shall be provided for connection of incoming and outgoing earth conductors. The earth bar shall be permanently connected to the body of DB at two points. Flexible copper strip shall be provided for earthing of the door of DB.

Circuit numbers/ designation on all circuits shall be conspicuously marked to facilitate connection and maintenance.

All metal work of the DB shall be cleaned down to bare shining metal phosphated and the surfaces chemically prepared for powder coating to ensure perfect protection against tropical, and highly humid atmosphere being compliant with the project's ambient conditions as specified in Clause 3.0 of specification section 8001. The color shade of the Distribution Board shall not be other that

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RAL 7032 or RAL 7035. The thickness of color powder / paint shall not be less than 120 microns.

4.2. Components

The Low Tension Distribution Boards (DB) shall be provided with components as specified, as shown on the Bidding Drawings and required for the satisfactory operation of the distribution board and of the electrical system.

The various components such as Direct - On - Line (DOL) Starters, Air Break Automatic Star-Delta Starters etc. not specified in this section and installed in LT Distribution Boards.

Typical component specifications are given below:

4.2.1 Bus Bars

The Bus bars shall be made of 99.9% pure high conductivity electrolytic tinned copper and shall be completely isolated and mechanically braced for the specified fault level. The identification of bus bars shall be by providing colors sleeves on bus bar ends and these shall be red, yellow and blue for phases and black for neutral. The earth bus bar shall be green. The thickness of tinning on bus bar shall be adequate enough to ensure perfect protection against corrosion besides ensuring specified rated ampacity.

The bus bars shall be for three phase, neutral and earth and shall be of appropriate size to meet the electrical and mechanical requirements of the system. The temperature rise shall not exceed 30°C at rated current.

Contractor shall submit manufacturer verified bus bar sizing calculations considering all applicable deviating factors for Engineers review and approval.

4.2.2 Moulded Case Circuit Breaker (MCCB) / Miniature Circuit breaker MCB)

The MCCBs shall be moulded case triple pole 440 Volts or single/double pole 250 Volts of current ratings as shown on the drawings. These shall have fixed magnetic short circuit and adjustable/fixed thermal overload protection.

Under voltage and shunt trip etc. shall also be provided when so required for safe operation and interlock.

The MCCBs shall be installed such that their switching levers are accessible through the front plate for operation.

The single and triple pole MCCBs shall have short circuit rupturing capacity suitable for the distribution system as approved by the Engineer or as shown on the drawings. The MCCBs shall be suitable for working on lighting and power circuits.

The miniature circuit breakers shall conform to IEC 60898 and shall have tripping characteristics as approved by the Engineer. MCB shall have positive Contact indication, marked on the toggle and front size of the MCB.

Both MCCB and MCB shall be provided with protection of terminals against accidental direct contact.

Generally, the circuit breaker shall have specified rupturing capacity

without the use of back-up fuses However, if required and / or as mentioned on the drawings, appropriately rated HRC fuses shall be provided as backup protection to ensure a faster tripping in case of abnormally higher fault currents. Auxiliary release and trip coils shall be provided for desired operation and/or interlockings as stated on the drawings and/or as needed per system operational requirement.

4.2.3 Three Phase Energy Meters (Kilowatt Hour Meters)

Three phase or Single phase energy meters of frequency 50 Hz and accuracy class of 1.0 with proper meter base, cover, frame, terminal block, terminal cover, auxiliary circuit etc. shall be provided for use with instrument transformers.
The construction of meter shall be suitable for its purpose in all respect and shall give reasonable assurance of permanence in all mechanical, electrical and magnetic adjustments. The construction shall be such that the meter is not prone to produce appreciable noise in use.

The meter shall have a dust proof case, which can be sealed in such a way that the mechanism of the meter is only accessible after breaking the seal. The case shall be made of metal or toughened glass of a sufficient strength to ensure adequate protection of the internal parts.

The direction of rotation shall be marked by a clearly visible indelible arrow.

Electronic meters with same accuracy class can also be provided.

The construction material of 3 phase wall mounted energy metering panel, wherever specified in drawings shall be as specified in Clause-4.1 of this specification section.

4.2.4 Ammeters and Voltmeters

All meters shall be flush mounting, analog type (moving iron, spring controlled) or digital type. The front dimensions shall be 96 x 96 mm for meters.

Digital meters can also be provided subject to submission of technical documents ensuring that these shall be suitable for operation under outdoor ambient temperature as specified under clause 3.0 of specification section "8001".

The meters shall be of accuracy class 1.5 according to latest edition of applicable IEC Standard. The ammeter shall be suitable for connection to 5 Amps secondary of current transformers or directly through shunt as shown on drawings. The ammeters and voltmeters shall have measuring range as indicated on the drawings.

Electronic meters with same accuracy class can also be provided subject to no additional cost.

4.2.5 Current Transformers

Air cooled, ring type current transformers shall be provided having transformation ratio as indicated on the drawings. The current transformers shall be of suitable burden having accuracy class 1.0 according to relevant IEC standards. The current transformers shall have 5 amps secondary.

4.2.6 Selector Switches

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The ammeter and voltmeter selector switches shall be complete with front plate, grip handle R-Y-B and OFF position for ammeters, and RY-YB-BR-RN-YN-BN and OFF position for voltmeters shall be marked on the respective selector switches.

4.2.7 Air Break Contactors / Impulse Relay

The contactors shall be air break, triple pole 415 VAC type and suitable for the type of duty (at least utilization Category AC3) to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contactor shall be provided with single phase 230 VAC operating coil and minimum one spare normally open and one normally closed auxiliary contact. The number of working auxiliary contacts shall be provided according to the system requirements.

Impulse Relay shall be 1 or 2 pole, 250 V rated and be provided with latching mechanism.

4.2.8 Push Buttons

The push buttons shall be illuminated, momentary make/break contact type or latch type (push-on/push-off) as required and approved by the Engineer and suitable for flush mounting on the door of panel and on remote area. The push button for ON and OFF switching shall be red and green respectively. They shall be provided as shown on the drawing.

The pushbuttons installed outside the distribution board shall be housed in mild steel enclosures of the same material and specifications as of the Distribution Board. These enclosures shall be finished flushed in the wall or mounted with the surface of the wall, as directed by the Engineer.

4.2.9 Indicating Lamps

Indicating lamps shall be LED type suitable for flush mounting, complete with base. They shall be suitable for operation on 230 VAC /110 AC or 60V DC/ 110V DC and it shall have rosettes of suitable colours as approved by the Engineer. These shall also be provided for R, Y, B phases on each distribution board.

4.2.10 Line up Terminals

Line up terminals wherever provided for control or power circuits shall be suitable for voltage and size of conductors as indicated on drawing.

The line-up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

4.2.11 Surge Protection

Surge Arresters shall be provided in LT Distribution Boards, wherever required, as shown on drawing. The Contractor shall submit proper calculations for the Surge protection device (SPD) rating and the SPDs shall be adequately sized for 400/ 230 Volts Volts and shall have the following characteristics:

- Voltage Class (highest system voltage): 440/230 V rms

This equipment will be tested in accordance with the relevant IEC Standard.

4.3. Warranty

All proposed L.T Distribution boards (complete set including all equipment, devices, components, parts etc.) will include a warranty of at least 2 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

5. INSTALLATION

The location of Low Tension distribution boards (DB) are shown diagrammatically on the drawings. The actual location shall be determined at site, keeping in view the site conditions and in co-ordination with other equipment, as approved by the Engineer.

Low tension distribution board for recessed mounting in wall shall be installed such that the door shall finish flush with the surface of wall. The recess mounted distribution board shall be installed before the plastering of walls. The DB shall be protected to avoid any damage due to the civil work. Any cuttings, dismantling of the existing wall required for fixing the DB shall be coordinated at site with the approval of Engineer. Any damage done to civil structure shall be made good by the Contractor. The outdoor distribution board shall be installed on pedestal on location as directed by the Engineer.

All loose parts dispatched separately with the DB shall be installed as per manufacturer instructions and all adjustments or setting shall be made as required. All screws, nuts and bolts used for fixing the distribution board shall be galvanized.

The distribution boards installation shall include connecting all incoming and outgoing cables. The cable entry in the boards shall be provided from top or bottom as required and/or as approved by the Engineer.

The distribution boards shall be tested as per instructions contained in article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against Bill of Quantities item as given below shall include design, manufacturing, fabrication, supply, installation, testing, commissioning and completion for all works specified herein and as shown on the Tender Drawings related to the item.

6.2. LT Distribution Boards

6.2.1 Measurement

Measurement shall be made for the number of each LT distribution board acceptably supplied and installed by the Contractor as a complete job.

6.2.2 Payment:

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Payment shall be made for the number of jobs measured, as provided above, at the Contract unit price each and shall constitute full compensation for design, manufacturing, fabricating, supplying, installing, connecting, testing and commissioning of the LT distribution boards including fixing arrangement, adapter box and other accessories for complete installation.

No separate payments shall be made for the under mentioned specified work related to the supply and installation of LT Distribution Boards. The cost thereof shall be deemed to have been included in the quoted rates of above work.

- Civil works for foundation

***** End of Section 8133 *****

SECTION - 8134

LT BUS TIE DUCTS/ BUS BAR TRUNKING

1. SCOPE OF WORK

The work under this Section consists of supplying, installing, and commissioning of all material and services of the LT Bus Tie Ducts/Bus Bar Trunking and accessories as specified herein, shown on the Bidding Drawings and given in the Bill of Quantities.

The contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and position of the LT Bus Tie Ducts/Bus Bar Trunking. Final field measurements shall be made by the Contractor prior to release of the LT Bus Tie Ducts/Bus Bar Trunking for fabrication by the manufacturer.

The LT Bus Tie Ducts/Bus Bar Trunking shall also comply with the General Specifications for Electrical Works Sec. 8001 and with other relevant provisions of the Bidding Documents.

2. GENERAL

The LT Bus Tie Ducts/Bus Bar Trunking shall be factory manufactured / assembled / routine tested either by an Original Equipment Manufacturer (OEM) itself based on its own verified reference design in accordance with the latest edition of IEC 61439-6.

The locations of the LT Bus Tie Ducts/Bus Bar Trunking are tentatively shown on the drawings. The Contractor shall discuss the electrical layout with the Engineer and coordinate at Site with other services for exact locations and positions of LT Bus Tie Ducts/Bus Bar Trunking.

The Contractor shall be responsible for proper functioning of LT Bus Tie Ducts/Bus Bar Trunking after installation and commissioning. After installation, the contractor shall be responsible to provide high performance epoxy paint on the LT Bus Tie Ducts/Bus Bar Trunking, plug-in tap off boxes and all accessories.

External fire barriers shall be provided for Bus-bar trunking, and shall also be positioned when it passes through fire insulating ceiling and walls. These fire barriers shall be effective in the space between the trunking and the protective sleeve of the ceiling.

Bus-bar trunking system shall have protection against mechanical damage, dust accumulation and weather proof to IP-67 degree of protection for outdoors and IP-55 rated for indoor application.

The structural design considerations, in accordance with the wind and seismic loads given in the relevant sections, shall be taken into account for the proposed components of the LT Bus Tie Duct / Bus Bar Trunking and the calculations / analysis (manufacturer verified) shall be submitted to the Engineer for review and approval prior to commencement of works at site.

3. DESIGN VERIFICATION / TYPE TEST

Contractor shall submit duly verified design verification test certificates and their comparison with a reference design as per the latest edition of IEC 61439-6 in respect of following for Engineer's review:

- Temperature Rise Limits
- Short Circuit Withstand Strength
- Short Circuit Withstand Strength of protective circuit

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Contractor shall also submit a duly verified design verification test report for the LT Bus Tie Ducts/Bus Bar Trunking with design verification test certificates for the offered design of main LT Switchboard from reputed independent IEC accredited laboratories highlighting the following in accordance with the latest edition of IEC 61439-6 as minimum unless required otherwise as per relevant standard shall be submitted:

a) Degree of protection of enclosure
b) Clearances
c) Creepage distances
d) Electromagnetic Compatibility (EMC)
e) Mechanical operation
f) Resistance to flame propagation
g) Fire Resistance in building penetration
h) Rated operational voltage
i) Rated frequency
j) Rated current
k) Dielectric properties
l) Rated insulation voltage
m) Rated impulse withstand voltage
n) Short circuit withstand strength
o) Rated short time withstand current – 3 phase
p) Rated peak withstand current
q) Rated conditional short circuit -3 phase
r) Mechanical operation

4. APPLICATION STANDARDS / CODES

The latest edition of following standards and codes shall be applicable for the materials specified within the scope of this section:

IEC 61439-1	-	Low Voltage Switchgear & Control gear Assemblies (General)
IEC 61439-6	-	Low Voltage Switchgear & Control gear Assemblies – Busbar trunking systems (busways)
BS EN 13601	-	Copper and copper alloys: Copper rods, bar and wire for general electrical purposes
BS 7671	-	IEE Wiring Regulations for Electrical Installations
IEC 60947-2	-	Low Voltage Switchgear and Control gear – Circuit breakers

5. MATERIAL

5.1. LT Bus Tie Duct / Bus Bar Trunking

The Contractor shall supply and install LT Bus Tie Ducts/Bus Bar Trunking as shown in Drawings and specified in Bill of Quantities and/or as required by the Engineer.

The Contractor shall supply the LT Bus Tie Ducts/Bus Bar Trunking, complete in all respects including supporting and hanging arrangement. The Contractor shall provide all installation materials as required.

The LT Bus Tie Ducts/Bus Bar Trunking shall be [illegible]phase, 4-bar/ 4.5 bar, unless

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required/ approved otherwise with full capacity neutral and earth bar and shall have conductors of rectangular 99.9% pure high conductivity aluminum of cross sections suitable for continuous current rating shown in the Bill of Quantities and Drawings and/or as required by the Engineer. The bus-bars of LT Bus Tie Ducts/Bus Bar Trunking shall be braced and supported to withstand the perspective short circuit current (in kA) as stated on the drawings, unless required otherwise, for a safe and satisfactory operation.

The housing of LT Bus Tie Ducts/Bus Bar Trunking shall be made of at least 14 SWG sheet steel. The sheet steel shall be derusted, degreased and painted with heat resistant paint over base coat of anti-rust paint to ensure adequate protection against environmental effects of highly corrosive environment. It shall be totally enclosed in an earthed trunking/duct. The enclosure shall be boltless. The system shall be of sandwich type construction without any air gap between bus-bars except at plug-in openings. The complete system shall comply with the requirements of BS EN 61439-6. The cost of such measures shall be deemed to have been included in the relevant BOQ item and no extra payment shall be admissible in this regard.

The LT bus tie duct/ bus bar trunking end terminated at LT Switchboard/ Synchronization Panels/ ATS AMF panels shall be coordinated with the flanged opening to be provided in the main LT Switchboard/ Synchronization Panels/ ATS AMF panels along with flexible aluminum connections to safely withstand the electrodynamic stresses.

Flexible flanges of the same current capacity as shall be used for termination at Transformers/ Generators/LT Switchboards/ HT Switchboards/ Synchronization Panel /ATS AMF Panel.

The LT Bus Tie Ducts/Bus Bar Trunking shall be provided with all supporting steel, hardware etc. for hanging the bus ducts from RCC ceiling/wall steel structure. The outdoor supporting structure of the Bus bar Trunking/ Bus Tie duct from substation (Transformer room & generator canopies) to the LT room shall be adequately protected against environmental conditions, it shall be included in the offer and no extra payment shall be permissible in this regard. All organic materials shall be treated for tropical atmosphere providing protection against highly humid and corrosive hot climatic conditions.

It shall be possible to remove any joint connection assembly to allow electrical isolating or physical removal of a Bus-bar trunking section without disturbing adjacent Bus-bar trunking sections.

All plug-in openings shall be covered by hinged doors, which cover the openings when not in use. The hinged door shall have padlocking facility to prevent opening by unauthorized persons. All openings shall be usable simultaneously.

All contacts on joints and plug-in openings should be bimetallic (Aluminium/Copper) or silver plating copper to avoid electrochemical corrosion and minimize the contact resistance.

On straight lengths, as specified by the manufacturer, and at every building expansion joints suitable flexible aluminium expansion connections shall be provided.

5.2. Reducer Boxes

The reducer box with ACB shall be provided at locations where current rating of bus-bar trunking is being reduced to economize the installation. The ACB shall be rated to protect the up-coming down stream bus-bar trunking of reduced current rating. The dimensions of the reducer box shall match with larger bus-bar

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trunking at one side and smaller bus-bar trunking on the other side, while maintaining the continuity and specified IP degree of protection of the trunking.

The MCCB shall have current rating as indicated on the drawings with service breaking capacity Ics of RMS value at 415 VAC equal to or higher than the perspective fault level of installation.

5.3. Plug-In Units / Tap-Off Boxes

The plug-in units/Tap-off Boxes shall incorporate MCCB/MCB having service breaking capacity Ics of RMS value at 415 VAC equal to or higher than the perspective fault level of installation.

The plug-in units / tap-off boxes shall be interchangeable and suitable for plugging in all sizes of LT Bus Tie Ducts/Bus Bar Trunking provided on site. The plug-in units, which cannot be operated directly from the floor, shall be equipped with suitable means for hook-stick operation.

Plug-in units / tap-off boxes shall be mechanically interlocked with the Bus tie duct to prevent installation or removal of plug-in units while the switch is in the ON position. The plug-in enclosure shall make positive earth connection with the ground bus before the jaws make contact with the phase bars.

5.4. Warranty

All proposed LT Bus Tie Ducts/Bus Bar Trunking (complete set including all equipment, devices, components, parts etc.) will include a warranty of at least 2 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

6. INSTALLATION

The LT Bus Tie Ducts/Bus Bar Trunking shall be installed at location(s) shown on the drawings. The Contractor shall ensure coordination with the Civil/Steel Structure Works for providing any openings, holes, etc. to avoid any breakage to completed works. In case the provisions in Civil/ Steel Structure works for installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own risk and cost and to the satisfaction of Engineer.

LT Bus Tie Ducts/Bus Bar Trunking shall be preferably installed in such a way that plugs are front mounted to permit practical use of all plug-in openings.

All installation materials for physically erecting the LT Bus Tie Ducts/Bus Bar Trunking shall be provided and installed by the Contractor. Complete site installation including alignments, joints, meggering etc. must be certified by the manufacturer's representative and signed off by Contractor and Vendor prior to offering the installation for commissioning.

The Bus-bar trunking system shall be supported throughout the entire length as per manufacturer's requirements to withstand its own weight and abnormal forces created on short circuit conditions/seismic conditions. However, the spacing between hangers/supports of bus-bar trunking shall not exceed 10 feet for horizontal runs and 13 feet for vertical runs.

Spring type hangers shall be used for fixing of Bus-bar trunkings when they run

vertically. Purpose made fittings, supports and accessories should be used throughout the installation.

Fire barriers, when installed shall prevent fire, smoke and hot gasses passing into the next story and according to prevailing regulations.

Bus-bar trunking should be covered with plastic envelope until building is clean and the Bus-bars are ready to be tested and energized.

The LT Bus Tie Ducts/Bus Bar Trunking shall be connected to earth as per instructions given in Section – 8240 "Earthing" of these Specifications.

The LT Bus Tie Ducts/Bus Bar Trunking shall be tested and commissioned in the presence of the Engineer. The Bus Ducts shall be tested before energizing as per instructions contained in article "Testing" of General Specifications for Electrical Works, Section-8001 of these Specifications.

7. MEASUREMENT AND PAYMENT

7.1. General

The Contractor's bid amount against Bill of Quantities item as given below shall include design, fabrication, supply, installation, testing, commissioning and completion for all works specified herein and as shown on the Bidding Drawings related to the item.

7.2. LT Bus Tie duct / Bus Bar Trunking

7.2.1 Measurement

Measurement shall be made of the total running feet of each LT Bus Tie Ducts/Bus Bar Trunking, including support structure as shown on drawing and given in BOQ acceptably supplied and installed by the Contractor as a complete job.

7.2.2 Payment:

Payment shall be made for the total running feet, as provided above, at the Contract unit price each and shall constitute full compensation for design, fabricating, supplying, installing, connecting, terminations, testing and commissioning of the LT Bus Tie Ducts/Bus Bar Trunking including all accessories such as flexible tinned copper connections, flanged end, necessary offsets, supports, hangers/ spring hangers, rawal bolts, nuts, bolts, washers, etc. complete in all respects.

7.3. Plug-in Units/Tap-off Boxes/ Reducer Boxes

7.3.1 Measurement

Measurement shall be made for each plug-in units/tap-off boxes/ reducer boxes acceptably supplied and installed by the Contractor as complete unit.

7.3.2 Payment

Payment shall be made for the number of units measured as provided above at the contract unit price each and constitute full compensation for design, fabricating, supplying, installing, connecting, terminations, testing and commissioning of th[illegible] Units/Tap-off Boxes.

***** End of Section – 8134 *****

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SECTION - 8150

LIGHT FIXTURES

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and accessories of the complete Light fixtures as specified herein and/or shown on the Tender drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact locations and positions of the light fixtures. Also submit False ceiling Layout depicting locations of fixtures in coordination with equipment i.e. HVAC, telecom etc.

The lighting fixtures with accessories shall also comply with the General Specifications for Electrical Works, Section-8001 and with other relevant provisions of the Tender Document.

2. GENERAL

The description of light fixtures is given in the bill of quantities, and stated on the drawings, and all relevant material is described in this Section.

The determination of quality and quantity will be established on 3rd party laboratory based certified photo-metric data covering the coefficient of utilisation, light distribution curves, construction material, shape, finish, operation, etc. The Contractor shall submit the certified photometric data and type test certificates for each proposed /offered light fixture for the Engineer's review and approval. The type test certificates must comply with the requirement laid down in the relevant standard.

The Contractor shall submit at least one sample of each and every light fixture specified and obtain approval of the Engineer before purchasing. The light fixture, for which the material sample is not submitted, shall be liable to rejection. The quality and finishes of the light fixtures shall be as required and specified in the relevant section of this specification. The accessories such LED drivers, LED Chips, LED optics etc., for all type of light fixtures, shall be of approved manufacturer. Approved equivalent against those specified will be accepted if the specified one is/will not be available. For any substitution the Engineer's approval is necessary. However, if any approved equivalent light fixture has any additional features including lumen output then no extra payment shall be admissible.

Light fixtures offered by the authorized local distributor / supplier shall only be considered for review subject to submission of following documents by the Contractor:

- Authorization / conformance certificate from the Original Equipment Manufacturer (OEM) in favor of the respective authorized local distributor / supplier for the supply and distribution of light fixtures.
- Detailed company profile of the Original Equipment Manufacturer (OEM) comprising information regarding Country of origin, reference list of similar works done / products installed by the OEM indicating the name of customer, description and quantity of product, year of supply etc.

All fixtures shall be finished in standard colour schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

All proposed luminaires/Light fixtures and the associated drivers/Control gears will include a warranty of at least 3 years from his proposed Original Equipment Manufacturer (OEM). All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for

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ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

3. APPLICABLE STANDARDS/CODES

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this section:

IEC 60598-1	-	General requirements and tests
IEC 60598-2-1	-	Particular requirement- Fixed general purpose luminaire
IEC 60598-2-2	-	Particular requirement- Recessed luminaries
IEC 60598-2-3	-	Particular requirement- Road and Street lighting
IEC 60598-2-5	-	Particular requirement – Flood Lights
IEC 62471	-	Photo biological Safety of lamps and lamps system
IEC 62031	-	LED modules for general lighting – Safety specifications
IEC 62262	-	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
BS EN 55015	-	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 61547	-	Equipment for general lighting purposes/ - EMC immunity requirements.
BS EN 61000-3-2	-	Electromagnetic compatibility (EMC) - Limits for harmonic currents emissions.
BS EN 61000-3-3	-	Electromagnetic compatibility (EMC) - Limits for voltage fluctuation and flicker in public LV systems.
BS EN 62493	-	Assessment of lighting equipment related human exposure to electromagnetic fields
LM79 / LM80 /LM82	-	Test Reports for the offered luminaires
BS 5266	-	Emergency lighting
ISO 7010	-	Signs for the purposes of accident prevention, Fire protection, health hazard information and Emergency evacuation.

The LED driver shall fully conform to following standards:

BS-EN 61347-1	-	Lamp control gear - General and safety requirements.
BS-EN 61347-2-11/13	-	Lamp control gear – Part-2-11 / Part 2-13 Particular requirements

BS EN 62384	-	DC or AC supplied electronic control gear for LED modules performance requirements
ISO 14644-1	-	Cleanrooms and associated controlled environments
ICAO	-	International Civil Aviation Organisation Standards and Recommended Practices: Aerodromes- Annex 14- Volume 1 (Latest Edition)

4. MATERIAL

4.1. LED Weather-proof Batten Light Fixture

The Contractor shall furnish and install the complete LED weatherproof batten luminaire of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, dimensions, minimum luminous flux and minimum luminous efficacy, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 4000K. Colour rendering index (CRI) shall be greater than 80. The LED shall have colour consistency preferably within 3 SDCM (standard deviation of colour matching).

The system should be designed in a way that it ensures higher uniformity along with a smooth light of higher colour consistency & system efficiency.

The LED luminaire shall be designed for lumen maintenance of L70B50 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of upto +45 degree Celsius.

The housing and optic shall be made of Polycarbonate material. Optical cover / lens shall be made of Polycarbonate material with Opal finish. The reflector shall be steel and fixation material of the luminaire shall be made of stainless-steel material with required beam symmetry. The product shall be suitable for hard-working applications / environments and shall be adequately protected against water and dust ingress.

Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be integrated within the luminaire and must be adequately protected against heating effect. The internal wiring of LED batten light fixtures shall be done with heat resistant wires at the manufacturer's factory. The internal wiring shall be clipped properly and heat resistant sleeves be provided on cables passing near driver. Connectors suitable for connecting 2.5 sq.mm cable conductors shall be provided for supply connections. An earth terminal for connection to 2.5-sq.mm cable conductor shall be provided.

The luminaire shall have provision of surface, wall mounting as well as suspended arrangement as specified on the drawings or in BOQ and as approved by the Engineer. All installation accessories including mounting clips etc. shall be provided as per installation requirement at site.

The light fixture shall be designed to comply the IK08 category's impact requirement unless required otherwise.

4.2. LED Wall/Bulkhead/ Surface mounted Downlight Fixture

The Contractor shall furnish and install the complete LED wall / bulkhead/ surface mounted downlight of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, shape, dimension, minimum luminous flux, and minimum luminous efficacy, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have color temperature of 3000K, with colour rendering index (CRI) less than or equal to 80. The LED shall have colour consistency preferably within 3 SDCM (standard deviation of colour matching).

The LED luminaire shall have a minimum luminous flux of 6800 and a minimum luminous efficacy of 135. The LED luminaire shall be designed for lumen maintenance of L80B50 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of upto +40 degree Celsius.

The housing of the luminaire shall be made of polycarbonate material with PMMA reflector. The cover /diffuser shall be polycarbonate with UV resistance and suitable for outdoor operation. The light fixture shall be IP 65 rated.

Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be integrated within the luminaire and must be adequately protected against heating effect.

The luminaire shall have provision of surface or wall mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including mounting clips etc. shall be provided as per installation requirement at site.

The light fixture shall be designed to comply the IK10 category's impact requirement as a minimum unless required otherwise.

4.3. Flood Light Fixture (For Façade lighting)

The Contractor shall furnish and install the complete LED flood Light Fixture of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of Light fixture including its IP degree of protection, beam symmetry, minimum luminous flux and minimum luminous efficacy, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 3000K or as may be required to suite the building's façade illumination requirement by the Engineer during detailed review stage, with colour rendering index (CRI) of greater than 80. The LED shall have colour consistency preferably within 4 SDCM (standard deviation of colour matching).

The system should be designed in a way that it ensures higher uniformity along with a smooth light of higher colour consistency & system efficiency.

The LED luminaire shall have a minimum luminous flux of 1880 and a minimum luminous efficacy of 80. The light fixture shall be designed for lumen maintenance of L70 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of up to +50 degree Celsius at operating and startup and +70 degree Celsius at storage.

The housing will be rectangular of extruded aluminum with die-cast aluminum end caps and electrostatically applied polyester powder coating, anti-aging and anti-UV high optical efficiency PMMA lenses, silicon gasket, clear tempered glass cover. The luminary shall have adjustable tilting angle ±90degree, 10x10 degree light distribution beam angle.

The luminary will include integrated heat sink and optical system. The luminary shall have cold rolled steel bracket for mounting.

The heat sink shall be designed to create better air-flow for better heat transfer. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be integrated within the luminaire and must be adequately protected against heating effect.

The luminaire shall have provision of surface / floor mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including mounting supports etc. shall be provided as per installation requirement at site.

The light fixture shall be designed to comply the IK06 category's impact requirement unless required otherwise.

4.4. Corrosion Resistant LED Flood Light Fixture

The Contractor shall furnish and install the complete Corrosion Resistant LED flood Light Fixture of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

The Contractor shall submit "Natural Salt Spray Test Report" for the proposed Flood light fixture for Engineer's review to ensure its application being suitable for harsh outdoor environment. The flood light fixture, for which the required "Natural Salt Spray Test Report" is not submitted, shall be liable to rejection.

For the description of Light fixture including its IP degree of protection, beam symmetry, salt spray testing hours, minimum luminous flux and minimum luminous efficacy, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 4000K, with colour rendering index (CRI) of greater than 80. The LED shall have colour consistency preferably within 5 SDCM (standard deviation of colour matching).

The system should be designed in a way that it ensures higher uniformity along with a smooth light of higher colour consistency & system efficiency.

The LED luminaire shall be designed for lumen maintenance of L70B50 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of upto +50 degree Celsius.

The housing will include optical system, LED light source, integrated heat sink, SPD and driver. It shall be made of non-corrosive high quality aluminium die cast material with polycarbonate optical cover and lens made of polycarbonate material. It shall be salt spray tested as required with symmetrical medium beam light distribution optics, along with 15 kV built in surge protection.

The heat sink shall be designed to create better air-flow for better heat transfer. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be

integrated within the luminaire and must be adequately protected against heating effect.

The luminaire shall have U-shaped adjustable bracket arrangements made of high quality Q235 grade steel which is suitable for mounting either on lighting masts / columns as well as from the wall, as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including mounting clips, steel bracket supports etc. shall be provided as per installation requirement at site.

The light fixture shall be designed to comply the IK08 category's impact requirement unless required otherwise.

4.5. LED In ground Light Fixtures (For Façade lighting)

The Contractor shall furnish and install the complete LED in ground type light of proper rating as specified and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, lifetime burning hours, minimum luminous flux, and minimum luminous efficacy the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 3000K, with colour rendering index (CRI) of greater than 70. The LED shall have colour consistency preferably within 5 SDCM (standard deviation of colour matching).

The system should be designed for facade lighting & possess uniformity to have a smooth and vivid warm white light of high colour consistency & high system efficiency.

The LED luminaire shall be designed for lumen maintenance of L70 or 70% at the end of useful life. The luminaire shall be suitable for ambient temperature range of between -40 to +50 degrees Celsius.

The housing shall be made of aluminium, brushed stainless steel ring frame, tempered glass cover and PMMA reflector. The light fixture shall have built-in driver potting and 2kV surge protection.

The housing will include integrated heat sink and optical system. The heat sink will be designed in such way to create better air- flow for better heat transfer. The fixed output LED driver shall be integrated within the luminaire.

The housing shall consist of a connector for connection to the power supply and earthing. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided. The fixed output LED driver shall be integrated within the luminaire.

The luminaire shall have provision of in ground mounting as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories and work shall be provided as per installation requirement at site and as recommended by the manufacturer.

The light fixture shall be designed to comply with IK10 category's mechanical impact protection unless required otherwise.

4.6. LED Emergency / EXIT Light Fixture

The Contractor shall furnish and install the complete LED Emergency/ Exit light fixture of proper rating as shown on the drawings, specified in Bill of Quantities

and/or as required by the Engineer.

For the description of LED Emergency/Exit light, the "Legend & Light Fixture Schedule" drawing shall be referred.

The emergency light fixture shall be composed of high intensity LEDs, non-maintained type with self-contained, NI-CD battery providing a backup of at least 3.0 hours if not mentioned otherwise. The body of luminaire shall be made of polycarbonate material with clear diffuser, with upper/lower gallery of polycarbonate and ABS, clear lens of polycarbonate.

The exit light fixture shall be composed of high intensity LEDs, maintained type with self-contained, Ni-mH or NiCD battery providing a backup of at least 3.0 hours if not mentioned otherwise. The body of luminaire shall be made of polycarbonate material with polycarbonate bezel and polycarbonate legend. High performance LED self-contained emergency exit sign luminaire shall be with LED strip and 30/40 meter viewing distance, plug in removable legend configurable for suspended, surface and recessed mounting,

The detail of manufacturer recommended mounting distances with respect to mounting heights to obtain lux level as per BS 5266 shall be submitted with the material submittal.

The luminaire shall have provision of suspended or wall mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer.

All installation accessories including mounting clips, suspension chains etc. shall be provided as per installation requirement at site.

4.7. LED Panel Light Fixture

The Contractor shall furnish and install LED Panel of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, dimensions, minimum luminous flux, minimum luminous efficacy, UGR and CRI, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 4000K. Colour rendering index (CRI) shall be greater than or equal to 80 or 90 as specified on drawings and BOQ. The LED shall have colour consistency preferably less than or equal to 4 or 3 SDCM (standard deviation of colour matching).

The system should be designed for office lighting & possess higher uniformity to have a smooth white light of high colour consistency & high system efficiency.

The LED luminaire shall be designed for lumen maintenance of 70% or L70B50 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of up to +40 degree Celsius.

The housing will be made of aluminium material, painted white or as directed by the Engineer. Optic material and optical cover / lens shall be of polystyrene/ prismatic material with anti-glare finish that are aesthetically acceptable for the office environment. The fixation material shall be of stainless steel.

The housing will include integrated heat sink and optical system. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be integrated within

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the luminaire and must be adequately protected against heating effect.

The luminaire shall have provision of recessed, surface or suspended mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including mounting clips, suspension chains etc. shall be provided as per installation requirement at site.

4.8. LED Recessed Down Light Fixtures

The Contractor shall furnish and install the recessed LED down light luminaires of proper ratings as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, dimensions, minimum luminous flux, minimum luminous efficacy, UGR and CRI, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 4000K. Colour rendering index (CRI) shall be greater than 80 or 90 as specified on drawings and BOQ. The LED shall have colour consistency equal to or less than 5 SDCM (standard deviation of colour matching).

The LED luminaire shall be designed for lumen maintenance of L80B50 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of +40°C.

The down lighter must be provided with a polycarbonate housing with suitable reflector having high haze and light transmission for uniform light output and required beam angle. It shall made of die cast aluminium housing with high reflectance white painted polycarbonate front element for IP-20 rated luminaire whereas for IP-54 rated luminaire, it shall be made of high purity aluminium with high-gloss high reflectance coated reflector along with tempered glass on the front cover.

The housing will include integrated die casting heat sink and optical system. The heat sink will be designed in such way that it creates a better air-flow for better heat transfer. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be integrated within the luminaire and must be adequately protected against heating effect.

The luminaire shall have provision of recessed mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including spring fasteners etc. shall be provided as per installation requirement at site.

4.9. LED Recessed Cleanroom Panel Light Fixture

The Contractor shall furnish and install LED Cleanroom Panel light of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, dimensions, minimum luminous flux, minimum luminous efficacy, UGR and CRI, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall have colour temperature of 6500K. Colour rendering index (CRI) shall be greater than or equal to 80 as specified on drawings and BOQ. The LED shall have colour consistency preferably less than or equal to 5 SDCM

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(standard deviation of colour matching).

The system should be designed for O.T, Xray and cardiac procedure room lighting & possess higher uniformity to have a smooth white light of high colour consistency & high system efficiency.

The light shall be ISO 14644-1 compliant, complying with ISO class 6 to 8.

The LED luminaire shall be designed for lumen maintenance of 70% or L70B50 at the end of useful life. The complete luminaire shall have a useful life of at least 50,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of up to +35 degree Celsius.

The housing will be made of sturdy cold rolled sheet steel material. Optic material and optical cover / lens shall be of polycarbonate material with anti-glare finish that are aesthetically acceptable for the hospital environment, being UGR 19 compliant. The fixation material shall be of stainless steel.

The light fixture shall be designed to comply with ingress protection of IP40 rear and IP65 for front unless required otherwise.

The housing will include integrated heat sink and optical system. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be integrated within the luminaire and must be adequately protected against heating effect.

The luminaire shall have provision of recessed mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including spring fasteners etc. shall be provided as per installation requirement at site.

4.10. LED Obstruction Light Fixture

The Contractor shall furnish and install LED Obstruction light of proper rating as shown on the drawings, specified in Bill of Quantities and/or as required by the Engineer.

For the description of luminaire including its IP degree of protection, dimensions, minimum luminous flux and minimum luminous efficacy, the "Legend & Light Fixture Schedule" drawing shall be referred.

The luminaire shall be Type B as per ICAO with surge protection device integrated.

The light shall be ICAO Annex 14- Volume 1 compliant.

The LED luminaire shall be designed for lumen maintenance of 70% or L70B50 at the end of useful life. The complete luminaire shall have a useful life of at least 100,000 burning hours. The luminaire shall be suitable for operating at an ambient temperature of up to +70 degree Celsius.

The housing will be made of yellow powder painted high pressure die-cast aluminium material. It shall have UV protected clear glass cover with stainless steel support. The light shall have a horizontal radiation coverage of 360 degree and a vertical radiation coverage of 50 degree or as per ICAO and approved by the Engineer
The light fixture shall be designed to comply with ingress protection of IP65 unless required otherwise.

Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided to suit the installation requirement. The fixed output LED driver shall be

integrated within the luminaire and must be adequately protected against heating effect.

The luminaire shall be mounted at 23 feet high mast or as per the instructions of the Engineer.

The luminaire shall have provision of pole/mast mounting arrangement as specified on the drawings or in BOQ and/or as required/approved by the Engineer. All installation accessories including mounting clips etc. shall be provided as per installation requirement at site.

5. INSTALLATION

5.1. General

The mounting heights of light fixtures are indicated on the drawings, and positions of fixtures are according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position.

The wiring between ceiling rose or terminal box and the fixture shall be carried out with 3-core 1.0 sq.mm and 1.5-sq.mm flexible copper conductor PVC/PVC cable respectively for circuits protected by 10 amps and 15/20 amps MCBs. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Covers, shades, reflectors, diffusers, etc., must be in a clear condition after installation. All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fixture.

5.2. Surface / Wall Mounted Light fixtures (LED Weather-proof Batten / Wall Bulkhead / Surface Down-lights)

Light fixtures on the surface of ceiling/ wall shall be installed with the back of the body flush with the ceiling / wall surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light fixture to the ceiling. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box.

5.3. Recessed Mounted Light Fixtures (LED Panel / Recessed Down Light Fixture / Recessed Cleanroom Light)

For the installation of recessed type light fixtures on false ceiling, the installation method/detail shall be coordinated with ceiling design and submitted for approval of Engineer. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling.

5.4. LED Emergency/ Exit Light Fixture

LED Emergency/ Exit light fixtures shall be installed on the surface of ceiling or wall by means of nylon plugs and galvanized steel screws, such that their back finish flush with the surface for exposed conduits and flush with outlet box for concealed conduit system. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box.

5.5. LED Flood Light Fixture (Corrosion Resistant Flood Light / Flood light for Façade)

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The LED flood light fixture shall be installed on the lighting poles or mounted on roof/ columns as shown on drawing and as per manufacturer's installation instructions. LED flood light fixture installed on Hot Dipped Galvanized, Mild Steel, poles and arm as specified in B.O.Q, and "Electrical detail" drawing, Engineer's or manufacturer recommendation shall be followed. Flood lights mounted on roof shall be mounted of corrosion resistant brackets.

The lighting fixture shall be properly levelled and the luminaire shall be adjusted to the appropriate position and all screws, bolts checked for tightness, etc. The light fixture shall be connected to the supply and earth at the proper terminals in the fixture.

5.6. LED In ground Light Fixture

Light fixtures shall be installed with the back of the body/ plastic housing buried in a hole. The ground shall be prepared by making an appropriate size cut out for the luminary in ground, stones/ gravel shall be laid at the bottom with sand on top and concrete shall be filled in the voids and on the outside for proper rigidity/ placement. The cut-out/ hole shall be provided with water drains to avoid immersing the luminaries in water and wired in accordance with the latest IEE electrical regulations or the national requirements. The incoming power supply cable shall be connected to the light fixture and each wire shall be ensured waterproof. The light fixture shall be adjusted at site at an appropriate location as approved by the Engineer after which the position shall be fixed/ locked.

5.7. LED Obstruction lighting

For the installation of LED Obstruction Lighting on pole/ mast, the mounting pole used to support the luminaire shall either be a circular insulating fiberglass tube or aluminium mast. The mounting pole and supports shall be securely fixed with brackets and guy wires where required as indicated on drawing and indicated by the manufacturer. submitted for approval of the Engineer. Also, the light fixture's placement shall be finalized in accordance with the highest point on the specified location to exactly comply with the international standards.

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or shown on the Bidding Drawings related to the item.

6.2. LED Weather-proof Batten Light / LED Wall/Bulkhead Light / Corrosion Resistant LED Flood Light / LED Flood Light for Façade / LED Emergency Light / LED Exit Light / LED Panel Light / LED Surface Down Light / LED Recessed Down Light / LED Recessed Cleanroom Light / LED Obstruction Light

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or shown on the Bidding Drawings related to the item.

6.2.1 Measurement

Measurement shall be made for each type of light fixture including all accessories acceptably supplied and installed by the Contractor as complete unit.

6.2.2 Payment:

Payment shall be made for the number of units measured as provided above at the contract unit price each and constitute full compensation for supplying, installing, connecting, testing and completion of LED Weather-proof Batten Light / LED Wall/ Bulkhead Light / Corrosion Resistant LED Flood Light / LED Flood Light for Façade / LED Emergency Light / LED Exit Light / LED Panel Light / LED Surface Down Light / LED Recessed Down Light / LED Recessed Cleanroom Light / LED Obstruction Light Fixture including all accessories such as LED drivers, LED Chips, LED optics, connecting cables & connectors, suspension rods and pendent arrangement, GI pipe bracket, Poles/masts, ceiling supports, internal wiring, nuts, bolts, screws, etc., as required and complete in all respects.

***** End of Section – 8150 *****

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SECTION – 8180

UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of Uninterruptible power supply (UPS) system including all material and accessories as specified herein and/or shown on the drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact locations and positions of the (UPS) system.

The (UPS) system with accessories shall also comply with the General Specifications for Electrical Works Section - 8001 and with other relevant provisions of the Contract Document.

2. GENERAL

The (UPS) system as described in this section shall comply with other sections of these specifications as applicable. The Contractor shall ensure that (UPS) system be supplied/fabricated from reputable manufacturers who have already supplied/fabricated similar items.

All proposed UPSs shall include a warranty of at least 2 years from the proposed OEM. All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. No additional payment, whatsoever, shall be admissible in this regard and for extended warranty, if any.

3. APPLICABLE STANDARDS/CODES

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this section:

EN 50091	-	Uninterruptible Power Supplies (UPS)
BS EN 62040	-	Uninterruptible Power System (UPS)
IEC/EN 62040-1 IEC/EN 60950	-	Construction and Safety
IEC 60947-2	-	Low Voltage Switch Gear and Control Gear. IEC 60947 Low Voltage Switch Gear and Control Gear.
BS EN ISO 1461	-	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
BS EN 15630	-	Safety requirements for electric fans and regulators.
BS EN 50085	-	Cable trunking and cable ducting systems for electrical installations.
BS EN 61537	-	Cable management. Cable tray systems and cable ladder systems
ISO-12944-2	-	Corrosion Protection of Steel Structures by Protective Paint Systems

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4. MATERIAL

The double conversion On-line uninterruptible power supply system shall be designed to supply uninterrupted, conditioned and clean electrical power to the electrical systems.

The system shall consist of complete UPS units, each comprising a rectifier, charger and inverter, a bypass unit with a static bypass switch, a maintenance bypass switch and battery panel.

The UPS system shall supply continuous, On-line electrical power via double conversion process within specified tolerance limits to the connected load, upon failure or deterioration of the normal mains supply, ensuring uninterrupted clean electrical power to the load in accordance with the specified battery autonomy.

The UPS shall withstand external environmental conditions specified in Specification section 8001 clause 3.0 without operational degradation, any necessary requirements shall be taken in account by the Contractor.

4.1 UPS System Operation

The UPS system shall operate in the following modes:

4.1.1 Normal Operation

The rectifier / charger shall draw AC power from the mains and supply DC power to the inverter while simultaneously float charging the battery. The inverter shall supply clean uninterrupted AC power to the load.

4.1.2 Emergency Operation

On failure or deterioration of the mains supply beyond specified tolerances, the inverter shall continue to supply the load from battery source without interruption or disturbance.

4.1.3 Battery Recharge

When mains power is restored, the rectifier/charger shall again supply power to the inverters without interruption or disturbance to the load, at the same time recharge the battery.

4.1.4 Automatic Bypass Operation

The UPS unit shall include automatically operated static bypass system. In the event of overloads exceeding system capabilities or inverter shut down for maintenance or due to internal faults, the static bypass transfer switch shall instantaneously transfer the load to the bypass source without interruption.

4.1.5 Manual Bypass Operation

The UPS shall include a manually operated mechanical bypass system for maintenance purposes. The system shall be designed to isolate the inverter and the static switch while maintaining load power via the bypass source. Transfer to the maintenance bypass shall take place without interruption to the load. An isolating device shall also be provided to isolate the rectifier / charger from the mains power supply.

4.1.6 Operation Without Batteries

It shall be possible to isolate the battery from the rectifier/ charger and the inverter by means of a circuit breaker for maintenance purposes.

In such a case the UPS shall continue to supply the load except in the events of mains power outage.

4.2 Electrical Characteristics

4.2.1 Input Power (Three Phase)

The Three UPS shall be designed to receive power from the mains having the following characteristics:

Voltage	=	380/400/415 volts AC ± 10%
Wiring	=	3 phase, 4 wire + earth
Frequency	=	50 Hz ± 5%
Power Factor	=	0.8

4.2.2 Input Power (Single Phase)

The Single phase UPS shall be designed to receive power from the mains having the following characteristics:

Voltage	=	220/230/240 volts AC + 10%/ - 15%
Wiring	=	1 phase, 2 wire + earth
Frequency	=	50 Hz + 5%
Power Factor	=	0 8

4.2.3 Rectifier / Charger

Rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair for the module shall be no more than 30 minutes in order to return the UPS to normal mode.

The rectifier/charger module shall be capable of drawing power from the utility with main / incoming supply power factor of 0.8.

i) Starting Currents

In order to limit inrush currents on starting a "soft start" power walk-in circuit shall be provided in the rectifier / charger input. The soft start shall be accomplished in 10 seconds.

ii) Charging Current

The charging current shall be automatically limited by an electronic device to the maximum value as specified by the battery manufacturer. A device shall also limit the power drawn by the rectifier/charger to the rated KVA.

iii) Charging Voltage

The DC voltage shall be set in to the charge/ floating value specified by the battery manufacturer.

DC output voltage fluctuations shall be regulated to less than 1% irrespective of load and mains supply voltage variations.

iv) Input Filter

The rectifier / charger shall be equipped with a filter limiting the DC ripple voltage to a value less than 1% of the DC voltage.

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v) Surge-Arrester

A surge-arrester of adequate capacity shall be fitted at the power input. The surge arrester must be able to protect the UPS and all downstream equipment under all modes of operation.

4.2.4 Battery Panel

The batteries shall be lead acid type, maintenance-free, housed in matching enclosures. The battery size shall be adequate to supply power to the inverter for specified time in the event of an outage on the normal mains supply, with the UPS system operating at rated load and power factor. Battery ratings shall be based on an operating temperature range up to 40°C. A circuit breaker shall be provided in the battery circuit. All connection cables shall be provided for battery panel.

The Contractor shall also submit design calculations for battery sizing for Engineer's review and approval.

4.2.5 Inverter

The inverter shall be of adequate size to ensure that the UPS system can supply rated load at least at 0.9 p.f., as per the following requirements:

i) Voltage Characteristics

a) Rated voltage = 380/400/415V (pre-set on commissioning) 3 phase + neutral.

b) Steady state voltage regulation = $\pm$ 1% for a load between 0 and 100% of full rated value irrespective of normal mains supply and DC voltage levels (within the limits specified above).

c) Transient voltage regulation = $\pm$ 5% of rated voltage for a 100% load step change. The voltage shall return to within steady state tolerances in less than 10 milliseconds.

d) Voltage distortion with linear load <1% for lower kVA ratings and <2% for kVA higher ratings or in accordance with the latest edition of IEC 62040-3.

e) Voltage distortion with 100% non-linear load <3% phase to phase & < 5% phase to neutral or in accordance with the latest edition of IEC 62040-3.

f) Voltage phase shift with 100% unbalanced load = 120°$\pm$ 1°

g) Output filter: the inverter shall be provided with an output filter to limit single harmonic distortion to 3% and total harmonic distortion to less than 5% irrespective of load and normal mains supply (within the limits specified above).

ii) Frequency Characteristics

a) Rated frequency = 50 Hz

b) The output frequency of the inverter shall be synchronised to that of the bypass power supply within the limits of $\pm$ 0.5 Hz.

c) For mains frequency variations exceeding the above limits,

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the inverter shall switch over to a free-running mode, with regulation providing an output frequency to within ± 0.1% of the rated value.

iii) Overload Capacity

The UPS shall be able to at least supply 110% load for 10 minutes, and 125% load for 1 minute on 3- phase & 1-phase or more as per Manufacturer's recommendations

The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module. Mean time to repair for the module shall be no more than 30 minutes in order to return the UPS to normal mode.

4.2.6 Static Bypass

The UPS system shall be provided with static bypass switch to initiate instantaneous load transfer from the inverter to the mains power supply and vice-versa without interruption.

The static bypass shall be completely independent of other components. It shall provide the load with uninterruptible supply in the following situations:

- Overloading of inverter
- Inverter fault
- Short circuit in load
- During manual switchover from inverter to bypass operation.

Synchronised transfer to bypass shall take place in zero millisecond. Unsynchronised transfer to bypass shall take place in 20 millisecond.

4.3 Mechanical Features

The UPS enclosure shall be of sheet steel construction, protected against corrosion, de-rusted, degreased, phosphated and powder coated or equivalent.

The enclosure shall be space saving modular, rigid framework construction with easily removable panels. The front or rear panel shall be detachable and shall have a safety lock. Access to components shall be from the front or from above via removable cover. The enclosure shall have height adjustable feet to ensure stable installation and levelling facilities. Each UPS system unit shall be housed in an integral enclosure. The battery shall be housed in a separate enclosure. Connection terminals shall be provided. Bus bars shall be made of electrolytic copper. Cable entry shall be from bottom/ rear. Ventilation fans with low noise generation shall be provided. Standby fans shall be provided and annunciation for fan failure shall be included.

The maximum sound level of the UPS shall be 56 dB (A) at one meter. All live parts shall be adequately insulated/shielded.

4.4 Controls, Indications, Protection

The Control and Indicator Panel shall be mounted on the front side. It shall provide information to the operator to monitor the status and facilitate operation of the UPS system.

4.4.1 Controls

The following main controls shall be provided:

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i) Switching from UPS operation to BYPASS operation.
ii) Rectifier / Charger ON/OFF
iii) Inverter ON/OFF
iv) Self-test
v) Remote control and monitoring facility on remote control unit or PC.

4.4.2 Indications / Alarms

The following indications/alarms shall be provided:

i) Status of mains supply.
ii) Status of battery.
iii) Rectifier / Charger ON.
iv) Load on inverter.
v) Load on bypass.
vi) Charger fault.
vii) Inverter overheating.
viii) Fan fault.
ix) Battery overloading/ autonomy.
x) Bypass defect.
xi) Overload.

4.4.3 Protection

The UPS shall include protection against the following:

i) Input over voltage.
ii) Load short circuits.
iii) Over temperature.
iv) Emergency stop in event of fire on receiving signal from building fire alarm control panel.
v) DC voltage low

4.4.4 Metering

The following measurements shall be indicated:

i) Mains input voltage.
ii) Rectifier / charger current.
iii) Battery voltage.
iv) Battery current (Normal / Charge).
v) Inverter output voltage.
vi) Inverter output frequency.
vii) Inverter output current.

5. INSTALLATION

5.1 General

The mounting heights, depths and other dimensions of all Uninterruptible Power Supply (UPS) system are stated on the relevant drawings or in general notes. In case of any discrepancy, the instructions of the Engineer shall be obtained before fixing the item.

5.2 Uninterruptible Power Supply (UPS) System

UPS installation shall be carried out by the Contractor in accordance with the recommendations/instructions of the manufacturer. The installation work shall be carried out under the supervision of Contractor's trained engineer to the

satisfaction of the Engineer. Installation work shall include all earthing to the UPS system from the existing distribution boards as per requirements and all power and control cable, conduit, trunking etc. shall be provided by the Contractor. The work shall include all cable terminations and labelling. The work shall also include angle iron supports at the base for UPS and stabilizer.

6. MEASUREMENT AND PAYMENT

6.1 General

The agreed Contract Price shall include supply, installation, testing, commissioning and completion for all work specified in these specification, as shown on any relevant Drawings and given in the Bill of Quantities related to the item.

6.2 Measurement:

Measurement shall be made for the total number of each type of Uninterruptible Power Supply (UPS) System with all accessories acceptably supplied and installed by the Contractor as complete unit.

6.3 Payment:

Payment shall be made for the total number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, and completion of Uninterruptible Power Supply (UPS) System complete with all installation material and accessories.

*** End of Section 8180 ***

SECTION - 8211

HIGH TENSION CABLE

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of High Tension (HT) cable and accessories as specified herein or as stated on the Tender Drawings and in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the H.T. cables.

The HT cable with accessories shall also comply with the General Specifications for Electrical Works Section-8001 and with other relevant provisions of the Bidding Documents.

2. GENERAL

The 15kV cable shall be three core, copper conductor, cross-linked polyethylene (XLPE) insulated, shielded, armored or unarmored as per requirements and overall sheathed. It shall be suitable for indoor and outdoor use in the transmission and distribution of electrical energy.

The cables shall be capable of operating continuously at a conductor temperature of not less than 90°C and shall be suitable for 8.7/15 kV, 50 Hz in three phase grounded system in accordance with relevant IEC standard.

The cable shall be treated for vermin proofing and be protected against rodents during storage, laying and all protective pipes/ sleeves shall be plugged to attain the same after installation.

3. APPLICABLE STANDARD/CODES

The following standards and codes shall be applicable for the materials within the scope of this Section:

IEC 60502	-	Power cables with extruded insulation and their accessories for rated voltages from 1 kV upto 30 kV
IEC 540	-	Test methods for insulation and sheaths of electric cables and
IEC 60885-2, 3	-	Electrical test methods for electric cables
IEC 60228	-	Conductors of insulated cables
IEC 60332-1-2	-	Tests on electric and cables optical fiber under fire conditions - Tests on a single vertical insulated wire or cable
IEC 60332-3	-	Tests on electric cables under fire conditions - Tests on bunched wire or cable
IEC 60227	-	For core identification by colours
IEC 60446	-	Basic and safety principles for man-made machine interface, making and identification – Identification of conductors by colours or numerals

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BS EN 50266 - Common test method for cables under fires conditions

4. MATERIAL

4.1 15kV Cable

4.1.1 Material Parameters

The cable shall meet the following specifications:

Nominal/System Voltage	-	11 kV
Frequency	-	50 Hz
System	-	3 phase with solidly grounded, star point of transformers.
Conductor Size	-	Sq.mm. As given in BOQ,
Number of Cores	-	3
Rated Voltage	-	15/8.76 kV phase to phase/ phase to ground
Continuous operating temperature of conductor	-	90°C
Conductor material	-	Stranded Copper
Insulation (XLPE)	-	Cross-linked polyethylene
Shielding	-	Copper tape
Jacket	-	PVC
Armoring	-	Galvanized steel wire
Over sheathing	-	Triple Extruded PVC
Phase identification	-	Red, Yellow, Blue

4.1.2 Conductor

The conductors shall be of high conductivity electrolytic copper, stranded in accordance with the IEC60228 standard.

4.1.3 Insulation

The insulation shall be cross-linked polyethylene triple extruded over the conductor. The insulation shall be laid ensuring the avoidance of any gap/air pockets between the conductor and insulation. The insulation shall be colour coded red, yellow and blue for phase identification. The nominal thickness of crosslinked polyethene (XLPE) insulation shall be at least 4.5mm in accordance with the IEC 60502.

The insulation shall be easy to strip from individual conductors and to separate for jointing/termination purposes.

4.1.4 Screening

All cables shall have a metallic layers surrounding the cores individually and or collectively.

Screening of individual cores in single or three core cables shall consist of a conductor screen and an insulation screen.

4.1.4.1 Conductor Screen

The conductor screen shall be non-metallic and shall consist of an extruded semi-conducting compound, which may be applied on top of a semi conducting tape. The extruded semiconducting compound shall be firmly bounded to the insulation.

4.1.4.2 Insulation Screen

The insulation screen shall consist of a non-metallic semi conducting layer in combination with metallic layer.

The metallic layer shall be extruded directly upon the insulation of each core and consist of either bounded or strippable semi-conducting compound.

A layer of semi-conducting tape or compound may than be applied over the core assembly. The metallic layer shall be applied over either the individual core or the core assembly collectively.

4.1.5 Shielding

Each core shall be shielded by a layer of semi-conducting material applied directly over the insulation. The semi-conducting insulation shall be covered by a bare copper tape applied with suitable overlapping.

Phase identification tape of red, yellow and blue colours shall be wrapped over the copper shield.

4.1.6 Assembly

The three insulated conductors shall be assembled with PVC or any non-hydroscopic filler and bounded with tape. The tape binder shall then be covered with extruded PVC jacket. The PVC jacket shall be padded with a suitable material before application of armor.

4.1.7 Armor

Armoring shall be provided with single layer of galvanized steel wire to provide cable protection and also act as a low resistance earth return path. The armoring shall be covered with binder tape. The armor shall be of appropriate size to carry the system fault current.

4.1.8 Oversheath

The entire cable assembly shall be covered with a PVC jacket of thickness not less than 2.5 mm. The colour of the jacket shall be black.

Embossed marking on the oversheath at 3 meters intervals shall give the following information:

- Name of Manufacturer
- Year of Manufacture
- Size of cable in sq.mm.
- Voltage grade
- Type of cable i.e. Cu./XLPE/SWA/PVC

4.2 Factory Tests

Physical and electrical acceptance tests in accordance with applicable standard shall be carried out at the manufacturer works in the presence of Engineer and Employer. Three copies of test reports will be furnished to the Engineer, which shall include brief description of tests, test records and results.

4.3 Straight-Through Cable Joint

The straight through Cable joint shall be provided with all material and accessories as required for making proper joint in accordance with the manufacturer's recommendation. Also, no separate payment shall be admissible in this regard and the cost of straight through joint is deemed to have been included in the BoQ item rate of H.T Cable.

4.4 Joint Boxes

The joint-boxes for the cable shall be cable manufacturer's recommended boxes for indoor or outdoor installation in accordance with the system requirements, and approved by the Engineer.

The joint boxes for 15 kV cable shall be horizontal, straight through, split type. Where installed underground, these shall be suitably protected against corrosion and ingress of moisture. At least two venting holes with plugs shall be provided for compound resin filling and inspection. Ground straps shall be furnished on the inside of joint box for ground continuity of the cable armor.

No separate payment shall be admissible in this regard and the cost of Joint Boxes is deemed to have been included in the BoQ item rate of H.T Cable.

4.5 Termination Kits

Termination kits shall be indoor/outdoor type as recommended by cable manufacturer and approved by Engineer. The termination kits shall be complete with all materials and meet all the requirements of IEC publication 60060, 60230 & 60270.

Termination kits shall be hot or cold shrink type suitable for the approved 15 kV HT cable and the ambient conditions described in Section – 8001. The termination kits shall provide reliable water proofing, mechanical and electrical protection after installation. The material and components of termination kits shall perform satisfactorily without distress under normal conditions, cyclic loading and fault conditions.

4.6 Cable Accessories

All cable accessories shall be provided for the complete cabling system without any additional cost unless specifically mentioned in BOQ. These shall include but not limited to the items such as saddles, clamps, fixing channels, connectors, clips, lugs, tapes, solder, identification tags, bushes, glands etc.

4.7 Cable Reels

The cable shall be supplied in non-returnable, mechanically strong, sea/rail/road worthy, wooden or metallic cable drums, protected against weather. The cable drum should bear the markings for cable type, cable size, voltage grade, year of manufacture, name of manufacturer, direction of unreeling, and any other additional marking normally provided by the manufacturer. Cable ends on cable reels shall be protected by means of suitable seal.

4.8 Cable Markers

Above ground cable markers made of Grade-25 reinforced concrete shall be erected at a maximum interval of 100 meters along the straight trench, at each bend and joint box for indicating the presence of underground cables. Where the trench changes its direction two number of markers shall be installed one in each direction to indicate the two directions of the trench. At the joint box, additionally a symbol shall be engraved just beneath the letters MV or LV to indicate the presence of the joint box.

The cable markers shall be finished in grey paint. The letters and symbols for indication shall be engraved in concrete on both sides. Letters shall be MV or LV for medium voltage or low voltage cable. The colour of the engraved letters and symbol shall be red. The dimensions of the markers shall be as shown on the drawing and shall be installed on the ground.

5. INSTALLATION

5.1 General

All installation material, labor, tools and accessories for cable installation shall be furnished by the Contractor. The cable and accessories shall be installed as described in these Specifications, drawings and in accordance with manufacturer's instructions.

Necessary precautions for safety of cables shall be taken during the laying of cables to avoid scratches/ cuts to the cable surface. Pulling force on cable at all times shall remain well within the manufacturer's recommended limits.

The exact cut lengths for cable shall be confirmed by the Contractor by actual measurements at site prior to the commencement of manufacturing. The cable lengths where shown on the drawing are tentative and only for general guidance. The Contractor shall be solely responsible for furnishing correct lengths of cable to avoid joints in cable length except where necessary, after obtaining approval of the Engineer. No separate payment for such joints shall be admissible.

Prior to installation of jointing and termination kits, the cable lengths shall be checked and tested to ensure that the cables are in sound condition, and no damage has been done during handling and installation. After the H.T. cable and jointing/termination kits are installed, it shall again be tested prior to commissioning and in accordance with recommendations of standard to which the cable is manufactured.

If existing services / culverts / drain etc. are present, MV Cables shall be laid using thrust boring or the support as approved by the Engineer. No separate payment shall be made and its cost is deemed to be included in the respective BOQ item.

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5.2 Underground Cables

The cables to be installed directly underground shall be laid in trenches in single tiers. Unless shown specifically on the drawing the depth of cable below finished ground level shall be 900 mm minimum measured from the top of the largest cable to the general ground level. The burial depth may be increased as required due to site conditions or when crossing other service pipes and roads. Burial depth less than 900mm and more than 1500mm shall require Engineer's approval.

When cables cross road, paved area, runway, taxiway other services or other cables, they shall be laid in protective pipes of required size as shown on the drawings. If existing services / culverts / drain etc. are present, Cables shall be laid using thrust boring or the support as approved by the Engineer. No payment shall be made and its cost is deemed to be included in the respective BOQ item. Cables entering the buildings shall also be laid in protective pipes. All the protective pipe ends, after installation of cables, shall be plugged water tight by means of sealant as approved by the Engineer. A minimum clearance of 250mm vertically and 500mm horizontally shall be maintained between cables and other services.

The cable trench shall be excavated as per route and location shown on the drawings. Before laying of cables in the trench, the bed of the trench shall be leveled and filled with a 100mm thick layer of fine sand (1.3mm diameter maximum particles size). The sand layer shall be leveled and the cables placed thereon. The cables shall be covered with a layer of fine sand 100mm thick measured above the top of the cable. Cable protective bricks shall be placed over the sand cover which shall be of class-C cement concrete, minimum 50mm thick and 300mm (W) X 300mm (L) dimensions. Good quality bricks of proper strength and shape, well-formed can also be used for the purpose of protection. The bricks shall be placed over the sand layer and end-to-end to cover the entire length and breadth of the cable trench. After the concrete bricks are placed, the remainder of the trench shall be backfilled with earth in layer of loose thickness of 200mm. Each layer shall be thoroughly tamped and compacted. Backfill/ earth fill shall be compacted to 95% for traffic / paved area and 90% for non-traffic area of the maximum density of soil / sand when checked as per ASTM D 1557.

A PVC warning tape shall be provided at 300 mm below normal ground level covering the entire length and breadth of the trench. The warning tape shall be yellow in colour with markings of danger and voltage of the cables printed in black.

Cable identification tags of water resistant material with indelible marking shall be fixed to cables with ties at a maximum of 20 meters interval along the cable length for identification of cable and circuit. The earth continuity conductor / counterpoise conductor shall be laid in the trench with the cable. The Contractor shall submit to the Engineer for approval, schedule of cable markers showing location of marker and instructions on each.

Sufficient slack shall be left in cables for which purpose the cut lengths of cables shall allow about 3% more in the measured lengths between terminations. At underground joint box, ample slack shall be left to prevent straining of cable joints due to settlement of the cable trench.

The cut lengths of cables wherever stated are only as a guide. The Contractor shall measure lengths between terminations of each circuit and if the discrepancy between measured lengths at site and where given on the drawing differ by more than 5%, the Contractor shall report to Engineer and act as directed. Cables, whether installed underground, or in cement concrete trenches, shall not be bent to a radius less than that recommended by the cable manufacturers.

5.3 Cable Marker

The cable marker shall be installed on finally compacted trench at mentioned distances.

Above ground, cable markers shall be erected at a 100 meter interval along the straight trench, and at each bend and joint box for indication of presence of underground cable. For more than one meter wide trenches, cable markers shall be provided at both edges of the trench. The cable marker shall bear the necessary instructions indicated in approved colours.

The Contractor shall submit to the Engineer for approval, schedule of cable markers showing location of marker and instructions on each marker.

5.4 Cables on Surface of Concrete Trenches / Cable Ladder

All cables for installation on surface of Concrete Trench/Cable shall be fixed by means of suitable clamps. The distance between each cable clamp shall be such so as to support the entire weight of the cable and that distance between the cable & surface and also the vertical clearance between two adjacent cables at any point is 100mm minimum. Common mounting channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

Cables shall be laid on cable ladders wherever marked in the drawing. All cables shall be properly fixed with cable ladders by means of suitable saddles or other approved means. A minimum distance between cables equal to the diameter of the cable shall be maintained between cables.

6. MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each item of Bill of Quantities as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Bidding Drawings related to the item.

6.2 H.T. Cable

6.2.1 Measurement:

Measurement shall be made of the total running feet of H.T. cables including straight through joint kits and Joint Boxes acceptably supplied and installed by the Contractor and which has satisfactorily passed all the required tests prior to and after installation. If existing services / culverts / drain etc. are present, MV Cables shall be laid using thrust boring or the support as approved by the Engineer. No separate payment shall be made in this regard and its cost is deemed to be included in the respective BoQ Item.

6.2.2 Payment:

Payment shall be made for the total running feet of the H.T. cables including straight through joint kits and Joint Boxes as provided above at the Contract unit price and shall constitute full compensation for supply, installing, connecting, testing and commissioning of the H.T. cables including straight through joint kits, Joint Boxes, cable identification tags, ties, colour sleeves, cable glands, lugs, and all accessories complete with plugging of protective pipes/ sleeves ends for water tightening. If existing

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services / culverts / drain etc. are present, MV Cables shall be laid using thrust boring or the support as approved by the Engineer. No payment shall be made and its cost is deemed to be included in the respective BoQ Item.

6.3 H.T Termination Kit

6.3.1 Measurement:

Measurement shall be made for each type of H.T termination kit acceptably supplied and installed by the Contractor as a complete unit.

6.3.2 Payment:

Payment shall be made for the number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of H.T. termination kit including all installation accessories, support for joint as required etc.

6.4 Excavation/Backfilling of Cable Trenches

6.4.1 Measurement:

Measurement shall be made for the total cubic feet of excavation work of cable trenches acceptably completed by the Contractor according to specification and/or as shown on drawing, complete with backfilling.

6.4.2 Payment:

Payment shall be made for the total cubic feet of excavation of cable trenches measured as stated above at contract unit price and constitute full compensation for all the works related to the item.

No separate payment shall be made for the under mentioned specified work related to the excavation of cable trench. The cost thereof shall be deemed to have been included in quoted unit rates of the excavation for cable trenches:

- Dewatering during excavation and backfilling.
- Providing and filling of fine sand in trenches.
- Compacted backfilling of trenches with specified material and disposal of surplus and rejected material.
- Providing and laying of 300mm x 300mm x 50mm thick concrete (grade-20) protective tiles in trenches.
- Providing and laying of PVC warning tape.

6.5 Cable Marker

6.5.1 Measurement:

Measurement shall be made for the total number of cable marker acceptably supplied and installed by the Contractor as a complete unit.

6.5.2 Payment:

Payment shall be made for the total number of cable marker as provided above at the contract unit price and shall constitute full compensation for

supplying & installing reinforced concrete cable markers, excavation, backfilling, concrete curing, and painting etc.

***** End of Section – 8211 *****

SECTION - 8212

LOW TENSION CABLES

1 SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of low tension (LT) cables and the accessories as specified herein or as shown on the Tender Drawings and in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and position of the L.T. cables.

The LT cables with accessories shall also comply with the General Specifications for Electrical Works, Section-8001 and with other relevant provisions of the Tender Document.

2 GENERAL

- All multi-core and single core PVC insulated and sheathed cables for light circuits, socket outlets and circuits operating up to 250 volts shall be 300/ 500 volts grade.
- All single core PVC insulated, non-sheathed cables shall be of 450/ 750-volt grade.
- Power cables for main feeders, main to sub main feeders, power equipment, etc., armoured or unarmoured shall be of 600/ 1000 volt grade.
- Armouring of multi-core/ single core cables shall be done with appropriate size galvanized steel/aluminium wire as per relevant codes.

The conductors shall be stranded high conductivity, soft annealed copper. Conductors of single core cables shall be circular, whereas of multi-core cables may be circular or shaped according to standard practices and codes. The PVC insulation, bedding and overall sheath shall be of extruded PVC compound having good flexibility, resistance to ageing and ability to withstand deformation at high temperatures. Non-hygroscopic filler shall be provided in multicore cable to fill empty gaps between the cores to make the cable a smooth round finish. In all shaped cables a non-hygroscopic high strength binding tape shall be provided on the core assembly. All cables shall be treated for vermin proofing and be protected against rodents during storage, laying and all protective pipe/sleeves shall be plugged to attain the same after installation.

Embossed marking on the oversheath at 3 meters intervals shall give the following information:

- Name of Manufacturer
- Year of Manufacture
- No. of cores and size of cable in sq.mm.
- Voltage grade
- Type of cable i.e., Cu./PVC/SWA/PVC

3 APPLICABLE STANDARDS/CODES

The latest editions of the following standards and codes shall be applicable for the materials specified within the scope of this section:

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BS 6004	-	Electric cables PVC insulated, non armoured cables for voltages upto and including 450/750 volts for electric power, lighting and internal wiring
BS 6346	-	Electric cables PVC insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 7846	-	Electric cables 600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire
BS 7889	-	Electric cables. Thermosetting insulated, unarmoured cables for a voltage of 600/1000 V, for fixed installations
IEC 60227	-	Polyvinyl chloride insulated cables of rated voltages upto and including 450/750V
IEC 60332	-	Tests on electric and optical fibre cables under fire conditions
BS 6746	-	PVC insulation and sheath for electric cables
BS EN 60228	-	Conductors of insulated cables
BS EN 50525	-	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V
BS EN 61386	-	Conduit systems for cable management
BS EN 50618	-	Electric cables for photovoltaic systems

4 MATERIAL

4.1 General

The power, lighting and control cables shall be furnished and installed in accordance with most appropriate routes, well-coordinated with other services, for interconnection of electrical and mechanical equipment, fixtures etc., shown on the drawings.

All cables shall have phase identification colours on insulation of each core. The colour code for three phase circuits shall be red, yellow and blue for phase conductors and black for neutral conductor. Where insulated earth conductor is installed, it shall have green or green-yellow colour insulation.

Single-phase circuits shall have insulation of red colour for phase/line, black colour for neutral and green or green-yellow colour for earth conductor.

All DC circuits shall have insulation of white colour for positive, black colour for negative and green or green-yellow colour for earth conductor.

The ends of each length of multi-core armoured or unarmoured cables shall be properly marked for clock-wise and anti-clock-wise sequence of core colours.

4.2 Cables for Conduit or Channel Wiring

All cables/wiring in concealed PVC or surface mounted GI conduits or in covered channel shall be single core PVC insulated of specified grade and size, unless specifically shown on the drawings or given in BOQ.

4.3 Cables on surface / concrete trenches / trays

Cables for distribution system to be installed on surface, in cable ducts, in concrete trenches or on trays shall be single or multi-core PVC insulated and PVC sheathed of specified voltage grade and size, unless specifically shown on the drawings or given in BOQ.

4.4 Cables inside solid bottom surface M.S Trunking / Under Floor Metal Trunking

All cables/wiring inside solid bottom surface M.S Trunking / Under Floor Metal Trunking shall be 3 core PVC insulated PVC sheathed, high temperature resistant of specified grade and size, unless specifically shown on the drawing or given in the BOQ having insulation of red colour for phase/line, black colour for neutral and green or green-yellow colour for earth conductor.

4.5 Cable / Wiring Inside Lighting Column

All cables/wiring inside lighting column from cable connection box to light fixtures / lanterns shall be 3 core PVC insulated PVC sheathed, high temperature resistant of specified grade and size, unless specifically shown on the drawing or given in the BOQ having insulation of red colour for phase/line, black colour for neutral and green or green-yellow colour for earth conductor.

4.6 Underground Cables

Cables for laying directly underground shall be PVC insulated, PVC sheathed and armoured with galvanized steel/ aluminum wire. Cables fully installed in underground ducts/pipes and mechanically protected from end to end shall be PVC insulated and PVC sheathed unless specifically shown on the drawings or given in BOQ.

4.7 Cable Markers

Above ground cable markers made of Grade-25 reinforced concrete shall be erected at a maximum interval of 100 meters along the straight trench, at each bend and joint box for indicating the presence of underground cables. Where the trench changes its direction two number of markers shall be installed one in each direction to indicate the two directions of the trench. At the joint box, additionally a symbol shall be engraved just beneath the letters LV to indicate the presence of the joint box. The cable markers shall be finished in grey paint. The letters and symbols for indication shall be engraved in concrete on both sides. Letters shall be LV for low voltage cable. The colour of the engraved letters and symbol shall be red. The dimensions of the markers shall be as shown on the drawing and shall be installed on the ground.

4.8 Cable Accessories

All cable accessories shall be provided for the complete cabling and wiring system without any additional cost unless specifically mentioned in BOQ. These shall include but not limited to the items such as saddles, clamps, fixing channels, connectors, cable joints (where necessary and as approved by the Engineer), clips, lugs, colour sleeves, identification tags, bushes, glands, etc. All cable accessories should be standard products of reputable manufacturers.

5 INSTALLATION

5.1 General

All installation material, labour, tools, cable rollers and accessories for cable installation shall be furnished by the Contractor. Cable and accessories shall

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be installed as described in accordance with these Specifications, drawings and manufacturer's instructions.

The Contractor shall confirm the exact cut lengths for cable by actual measurements at site prior to the ordering. The cable lengths where shown on the drawings or in BOQ are tentative and only for general guidance. The Contractor shall be solely responsible for furnishing correct lengths of cable to avoid joints in cable length except where necessary, after obtaining approval of the Engineer.

No separate payment for such joints is admissible.

Necessary precautions for safety of cables shall be taken during the laying of cables to avoid scratches/ cuts to the cable surface. Pulling force on cable at all times shall remain well within the manufacturer's recommended limits.

Prior to installation of jointing and termination kits, the cable lengths shall be checked and tested to ensure that the cables are in sound condition, and no damage has been done during handling and installation. After installation, these shall again be tested prior to commissioning as per recommendations of the standards according to which the cable is manufactured.

5.2 Conduit or Channel Wiring

The wiring through conduit shall be started only after the conduit and channel system is completely installed and all outlet boxes, junction boxes, etc., are fixed in position.

The wires shall be pulled in conduit or channel with care, preferably without the use of any lubricant. Where necessary and if approved by the Engineer, the cable manufacturer's recommended lubricant may be used. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than ten times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body with sunk-in screw terminals. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable/wire shall be provided at each termination to facilitate repairs in future.

5.3 Cables on Surface/Trenches/Trays/Ladders

All cables for installation on surface of wall, column, ceiling, trenches, trays etc., shall be fixed to the surface by means of galvanized steel clips secured to a steel channel using suitable stud plate, nuts and washers. The distance between each cable clip shall be such so as to support the entire weight of the cable and that distance between the cable & surface and also the vertical clearance between two adjacent cables at any point is 50mm minimum. Common mounting channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

Cables shall be laid on cable trays/Cable ladders wherever marked and as shown in the drawing. All cables shall be properly fixed with cable tray/ladders by means

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of suitable saddles or other approved means. A minimum distance between cables equal to the diameter of the cable shall be maintained between cables.

5.4 Underground cables

The cables to be installed directly underground shall be laid in trenches in single tiers. Unless shown specifically on the drawing the depth of cable below finished ground level shall be 900 mm minimum measured from the top of the largest cable to the general ground level. The burial depth may be increased as required due to site conditions or when crossing other service pipes and roads. Burial depth less than 900mm and more than 1500mm shall require Engineer's approval.

When cables cross road, paved area, other services or other cables, they shall be laid in protective pipes of required size as shown on the drawings. Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged watertight be means of bituminized hessian or equivalent method as approved by the Engineer. A minimum clearance of 250mm vertically and 500mm horizontally shall be maintained between cables and other services.

The cable trench shall be excavated as per route and location shown on the drawings. Before laying of cables in the trench, the bed of the trench shall be leveled and filled with a 100mm thick layer of fine sand (as per specification section 1100). The sand layer shall be leveled and the cables placed thereon. The cables shall be covered with a layer of fine sand 100mm thick measured above the top of the cable. Cable protective bricks shall be placed over the sand cover which shall be of class-C cement concrete, minimum 50mm thick and 300mm (W) X 300mm (L) dimensions. Good quality bricks of proper strength and shape, well-formed can also be used for the purpose of protection. The bricks shall be placed over the sand layer and end-to-end to cover the entire length and breadth of the cable trench. After the concrete bricks are placed, the remainder of the trench shall be backfilled with earth in layer of loose thickness of 200mm. Each layer shall be thoroughly tamped and compacted. Backfill/ earth fill shall be compacted to 95% for traffic / paved area and 90% for non-traffic area of the maximum density of soil / sand when checked as per ASTM D 1557.

A PVC warning tape shall be provided 300 mm below normal ground level covering the entire length and breadth of the trench. The warning tape shall be yellow in colour with marking of danger and voltage of the cable printed in black and as approved by the Engineer.

Cable identification tags of corrosion resistant material shall be tied to cables with PVC cable tie at a maximum of 20 meters interval along the cable length for identification of cable and circuit. The earth continuity conductor shall be laid in the trench with the cables.

Sufficient slack shall be left in cables for this purpose the cut lengths of cables shall allow about 3% more in the measured lengths between terminations. At underground joint box, ample slack shall be left to prevent straining of cable joints due to settlement of earth. Payment shall be done as per actual lengths measured at site after installation.

The cut lengths of cables wherever stated are only as a guide. The Contractor shall measure lengths between terminations of each circuit and if the discrepancy between measured lengths at site and the one given on the drawing differ, the Contractor shall report to Engineer and act as directed. Cables, whether installed underground or in concrete trenches, shall not be bent to a radius less than 12 times the diameter of the cable or as recommended by the cable manufacturer, whichever is higher

If existing services / culverts / drain etc. are present, LV Cables shall be laid using thrust boring or the support as approved by the Engineer. No payment shall be made and its cost is deemed to be included in the item else wherein BOQ.

6 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Drawing related to the item.

6.2 Light Circuit Wiring

6.2.1 Measurement

Measurement shall be made for the total number of light circuit wiring from LT distribution board to point/switch/push button including wiring between switches/push buttons on the same circuit, acceptably carried out by the Contractor as a complete unit.

6.2.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the circuit wiring from the LT distribution board to point/switch/push button including wiring between switches/push buttons on the same circuit with required number of specified size single core PVC insulated cable, earth continuity conductor complete with specified type of surface mounted / concealed conduit (PVC or steel) and all accessories complete in all respects.

For light circuit wiring installed in already installed solid bottom surface M.S Trunking / Under Floor Metal Trunking, payment for such circuits shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the circuit wiring from LT distribution board to point/switch/push button including wiring between switches/push buttons on the same circuit with required number of specified size multi core PVC insulated PVC sheathed cable, and all accessories complete in all respects. However, the cost of these already installed solid bottom surface M.S Trunking / Under Floor Metal Trunking shall not be included in the overall circuit cost

6.3 Wiring of Light / Fan Point (Point to Switch, Point to Point, Two Way or Group Controlled Light Points)

6.3.1 Measurement

Measurement shall be made for the total no. of wiring of light/fan points (point to switch, point to point, two way or group controlled light point), acceptably carried out by the Contractor as a complete unit.

6.3.2 Payment

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each, and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the wiring between light point to switch,

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point to point and two way light points, including required no. of specified size single core PVC insulated cable, specified type of surface mounted/concealed conduit (PVC or Steel), earth continuity conductor, flexible cable, ceiling rose, one way or two way 10A light control switch, fan dimmer, sheet steel box and other accessories, etc., complete in all respects.

For Point to Switch, Point to Point, Two Way or Group Controlled Light Points wiring installed in already installed solid bottom surface M.S Trunking / Under Floor Metal Trunking, payment for such circuits shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of the circuit wiring between light Point to Switch, Point to Point, Two Way or Group Controlled Light Points with required number of specified size multi core PVC insulated PVC sheathed cable, and all accessories complete in all respects. However, the cost of these already installed solid bottom surface M.S Trunking / Under Floor Metal Trunking shall not be included in the overall circuit cost.

6.4 Wiring of Power Circuits (Distributor to load break switch/ MCB installed in weatherproof enclosure/ MCCB installed in weatherproof enclosure, spur outlets, socket outlets & between sockets)

6.4.1 Measurement

Measurement shall be made for the total number of units / running feet of each type of wiring acceptably carried out by the Contractor as a complete unit.

6.4.2 Payment

Payment shall be made for the total number of units / running feet of each type of power circuits wiring as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of wiring of load break switches, spur outlets, socket outlets etc. from LT switchboard / distribution board to load break switches, spur outlets, sockets or between sockets with specified size and number of single core PVC cables including specified type of surface mounted / concealed conduit (PVC or Steel), ECC and all other accessories etc.

6.5 LT Cables

6.5.1 Measurement

Measurement shall be made for the total running feet for each size and type of LT acceptably supplied and installed by the Contractor. If existing services / culverts / drain etc. are present, LV Cables shall be laid using thrust boring or the support as approved by the Engineer. No payment shall be made and its cost is deemed to be included in the item else wherein BOQ.

6.5.2 Payment

Payment shall be made for the total running feet of each size and type of LT cable measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of LT including all accessories

such as cable joints, lugs, color sleeves, glands, bush, etc. complete with plugging of protective pipe/ sleeve ends for water tightening. If existing services / culverts / drain etc. are present, LV Cables shall be laid using thrust boring or the support as approved by the Engineer No payment shall be made and its cost is deemed to be included in the item else wherein BOQ.

6.6 Excavation / Backfilling

6.6.1 Measurement

Measurement shall be made for the total cubic feet of excavation / backfilling of trenches acceptably completed by the contractor according to the specification and as shown on drawings.

6.6.2 Payment

Payment shall be made for the total cubic feet of excavation / backfilling of cable trench measured as carried out above at the contract unit price and shall constitute full completion for excavation / backfilling and all the works related to the item.

No separate payment shall be made for the under mentioned specified work related to the B.O.Q. item excavation and backfilling. The cost thereof shall be deemed to have been included in the quoted rates of above work.

- Dewatering during excavation and backfilling.
- Providing and filling of fine sand in trenches.
- Compacted backfilling of trenches with specified material and disposal of surplus and rejected material.
- Providing and laying of 300mm x 300mm x 50mm thick concrete (gade-20) protective tiles in trenches.
- Providing and laying of PVC warning tape.

6.7 Cable Marker

6.7.1 Measurement:

Measurement shall be made for the total number of cable marker acceptably supplied and installed by the Contractor as a complete unit.

6.7.2 Payment:

Payment shall be made for the total number of cable marker as provided above at the contract unit price and shall constitute full compensation for supplying & installing reinforced concrete cable markers, excavation, backfilling, concrete curing, and painting etc.

***** End of Section – 8212 *****

SECTION - 8220

WIRING ACCESSORIES

1. SCOPE OF WORK

The work under this Section consists of supplying, installing, and commissioning of all material and services of the complete Wiring Accessories including switches, switch sockets, etc., as specified herein, as shown on the Tender Drawings and explained in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at Site with other services for exact location and position of all wiring accessories.

The wiring accessories such as switches, switch socket outlets, socket outlets and ceiling roses, etc. shall also comply with the General Specifications for Electrical Works Sec. 8001 and with other relevant provisions of the Tender Documents.

2. GENERAL

The locations of the wiring accessories such as switches, sockets, etc. are tentatively shown on the drawings. The Contractor shall ensure the exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer. The Contractor shall be responsible for proper functioning of wiring accessories after installation and commissioning.

The description of switches, switch sockets, socket outlets etc. are given in the Bill of Quantities, stated as drawings and in this section. The Contractor shall submit sample of each and every item of wiring accessories for the approval of the Engineer.

3. APPLICABLE STANDARDS/CODES

The latest edition of following standards & codes shall be applicable for the materials specified within the scope of this section:

BS 7671	-	Requirements for Electrical Installations
BS EN 60669-1	-	Switches for household and similar fixed-electrical installations. General requirements
IEC 60309	-	Plugs, socket-outlets & couplers for industrial purposes
BS EN 60384-14	-	Fixed capacitors for use in electronic equipment - Fixed capacitors for electromagnetic interference suppression and connection to the supply mains.
BS 67	-	Specification for Ceiling roses.
BS 546	-	Specifications - 2-pole and earthing pin plugs, socket outlets and socket outlet adaptors.
BS 1362	-	Specification for general purpose fuse links for domestic and similar purposes.
BS 1363	-	13A plugs, socket outlets, connection units & adaptors.
BS 5733	-	Specification for general requirements for electrical accessories.

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BS 4573	-	Specification for 2-pin reversible plugs and shaver socket-outlets
IEC 60884-1	-	Plugs & socket-outlets for household & similar purposes
CEE 7	-	standard AC plugs and sockets
BS EN 60529	-	Degrees of protection provided by enclosures (IP Code)

4. MATERIAL

4.1 Switches/Blank Face Plates

Switches for controlling light and fan points shall be single pole, rated for 10A, 250 volts AC. The body of the switches shall be of thermoplastic with faceplate suitable for flush mounting and color as approved by the Engr. Switches shall be gang type having silver tipped contacts and shall operate with snap action.

Unless otherwise specified wherever switches control only the light points, these shall be plate type gang switches installed on common outlet boxes. Where only sheet steel back box is indicated on drawings, blank face plates shall be provided of same make and model as that of switches.

Where specified weather proof or metal front plates shall be used with single grid type switches, the plate shall be finished in specified colour or as otherwise directed by the Engineer.

Bell push switch shall be spring loaded type with embossed identification symbol.

Two-way and intermediate switches shall be used to control lights from two or more different locations particularly in staircase as shown on the drawings.

The cost of supply, installation, testing and commissioning of switches including their respective back boxes etc., complete in all respects is covered in the respective wiring item. No separate payment is deemed admissible.

4.2 13A/16A International Switch-Socket Outlets

Switch socket/socket units shall be, 13/16 Amps 250V, AC with faceplate of colour as approved by Engineer. The outlets shall be heavy-duty type suitable for mounting on sheet steel outlet box. The 13/16A international Switch socket outlets shall have sheltered live contacts and designed such that the earth pin of plug is engaged to socket earth before making of live contacts. Where metal plate switches are installed, the switch socket units shall also be provided with front plate of similar design.

Weather proof socket outlet shall be designed for outdoor use or in areas heavily exposed to dust and / or splashing water. The socket outlet shall be constructed from extremely robust polycarbonate that provides minimum degree of ingress protection of IP65. If the specified degree of IP protection cannot be achieved then the socket outlet shall be supplied with suitable weather proof enclosure.

4.3 16 A Schuko Socket Outlets

16 Amp Socket Outlets shall be 2 pin + earth German type (Schuko) socket outlets with faceplate of colour as approved by the Engineer.

The outlets shall be heavy-duty type suitable for mounting on sheet steel outlet

box. The 16 Amp Schuko Socket Outlets shall be designed such that the earth pin of plug is engaged to socket earth prior to making contact to the live contacts.

Weather proof socket outlet shall be designed for outdoor use or in areas heavily exposed to dust and / or splashing water. The socket outlet shall be constructed from extremely robust polycarbonate that provides minimum degree of ingress protection of IP55. If the specified degree of IP protection cannot be achieved then the socket outlet shall be supplied with suitable weather proof enclosure.

4.4 1-Phase 3-Pin / 3-Phase 5-Pin Industrial Socket Outlets

250V / 500 V, Single / 3- Phase plus neutral & earth, 3/5 pin, industrial type socket outlets shall be weather proof conforming to the standard and requirements of relevant IEC codes.

The socket outlets shall be of heavy-duty type suitable for indoor as well as outdoor installation. The socket outlets shall be mounted on polycarbonate enclosure and have gasketed cover and window, captive cover screw type. All industrial socket outlets shall be supplied with matching plugs.

4.5 Connection Unit

Connection Unit shall be used to supply to appliances where so specified.

4.5.1 13A/20A, 250V AC Spur/Flex Outlet

It shall be rated for 13A, 250V AC with neon lamp indicator (if required). The body shall be of thermoplastic material. Installation shall be surface/ concealed as required.

Face plate and colour to be as per approval of Engineer. Connectors shall be of best quality (for Phase, Neutral and Earth) and suitable for the size of wiring.

4.5.2 20A Double Pole Switch

It shall be of poly carbonate material with brass and phosphor bronze contacts. The switch shall have double 1-way with earth switch connections and neon lamp indicator (if required) and 1 gang switch. The following features as per requirement in B.O.Q or as shown on drawing.

- Fuse – Rating as per requirement of appliance
- Grommetted outlet on face plate suitable for flexible wiring connection to appliance

4.6 Fan Dimmers

The fan regulator/dimmer shall be made of low voltage electronic components with essential radio frequency compressor and shall be designed for smooth speed control/variation of fans. The regulators/dimmer and fan control switches shall be of same make and colour as that of the approved wiring accessories. The regulator/dimmer and fan-controlling switch shall preferably be mounted on same face plate. They shall be suitable for flush mounting on a sheet steel outlet back box.

The cost of supply, installation, testing and commissioning of fan dimmers including their respective back boxes etc., complete in all respects is covered in the respective wiring item. No separate payment/adjustment admissible.

4.7 Sheet Steel Back Boxes

The sheet steel boxes for installation of switches, fan dimmers, socket, outlets and blank face plates shall be made of 16 SWG sheet steel having appropriate dimensions as required for surface or recessed conduiting.

The box shall have suitable arrangement for receiving the conduit(s). An earth terminal shall be provided for connecting at least three earth wires of 4-sq.mm size. The box for Communication and Security Systems shall be provided with blank faceplate as specified under clause 4.1 above.

For surface type wiring, sheet steel back boxes shall be provided with cover plates made with same gauge, having counter sunk screws to hold the plate and provisions for fixation of the respective wiring accessories/blank plates. The box shall be finished in powder-coated paint. The sheet steel back box shall be as approved by the Engineer.

4.8 Ceiling Roses

The ceiling roses shall be suitable for 5 amps 250 volts single-phase ac. It shall have white plastic moulded base plate and copper or brass terminals suitable for connecting at least two wires of 2.5 sq. mm size The ceiling rose shall have a cover with cable inlet hole suitable for multicore PVC insulated and PVC sheathed cable.

4.9 15 Amps Switch Socket Outlets

Switch socket/Socket units shall be round 3 pin, 15 Amps, 250V AC switch socket/socket outlets with face plate of colour as approved by the Engineer. The outlets shall be heavy-duty type polycarbonate suitable for mounting on sheet steel outlet box. The sockets shall have neon indication.

4.10 Under Floor Service Box:

The underfloor service box shall be heavy duty stainless steel box, reinforced with a pre-galvanized sheet steel infill plate consisting of following types:

Type-A

This type of floor outlet box shall comprise 2 nos. 16A schuko socket outlets for small power, 1 no. of simplex RJ-45 outlet and 1 no. of duplex RJ-45 outlet for telecommunication.

Type-B

This type of floor outlet box shall comprise 2 nos. 16A schuko socket outlets for small power, and 1 no. of duplex fiber optic outlet for telecommunication.

Type-C

This type of floor outlet box shall comprise blank plate and shall be utilized to tie up LT cables.

These service boxes shall come with perforation to accept trunking/ knockout holes for appropriate size conduits. These shall be IP30 rated, provided with disposable lid to prevent ingress during screeding.

16 Amp Socket Outlets shall be 2 pin + earth German type (Schuko) socket outlets with faceplate of colour as approved by the Engineer.

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The outlets shall be heavy-duty polycarbonate type suitable for mounting on sheet steel floor outlet box.

The 16 Amp Schuko Socket Outlets shall be designed such that the earth pin of plug is engaged to socket earth prior to making contact to the live contacts.

4.11 Exhaust Fans

Exhaust fans shall be three blade or multi blade type of metal / PVC construction as approved by the Engineer.

Fans shall be direct driven and supplied complete with electric motor, back draft dampers and anti-vermin screen.

The bearings shall be ball roller or sleeves type of permanently lubricated and sealed type.

Wheels shall be heavily and rigidly constructed and accurately balanced both statically and dynamically and be free from objectionable vibration or noises.

5. INSTALLATION

5.1 General

The mounting heights of all wiring accessories are stated on the drawings. In case the mounting height is not mentioned, the instructions of the Engineer at site shall be obtained before fixing.

5.2 Switches/Blank Face Plates, 13A/16A International Switch Socket Outlets, 16A Schuko Socket Outlets, 1-Phase 3-Pin / 3-Phase 5-Pin Industrial Socket Outlets, Connection Units, Fan dimmers, Sheet Steel Back Boxes, Ceiling rose, 15 Amps Switch Socket, Under Floor Service Box

All wiring accessories shall be installed on 1.63 mm (16 SWG) thick sheet steel box recessed in wall/column/floor. The faceplate shall be fixed on sheet steel box by means of flat head galvanized or brass screws sunk in the faceplate so as to finish flush with the surface. Matching screw caps shall be installed on the opening for screw in faceplates.

The industrial type sockets in polycarbonate enclosure shall be installed on wall/floor as shown on drawing.

The floor outlet box shall be installed on floor as shown on drawing.

6. MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

6.2 Ceiling Fan / Wall Bracket Fan

6.2.1 Measurement

Measurement shall be made for each type of fan including all accessories acceptably supplied and installed by the Contractor as complete unit.

6.2.2 Payment:

Payment shall be made for the number of units measured as provided above at the contract unit price each and constitute full compensation for supplying, installing, connecting, testing and completion of each type of fan including all accessories such as connecting cables & connectors, clamp, wall supports, internal wiring, wiring between fan point and fan terminals, nuts, bolts, screws, etc., as required and complete in all respects.

6.3 Switches/Blank Face Plates, 13A/16A International Switch Socket Outlets, 16A Schuko Socket Outlets, 1-Phase 3-Pin / 3-Phase 5-Pin Industrial Socket Outlets, Connection Units, Fan dimmers, Sheet Steel Back Boxes, Ceiling rose, 15 Amps Switch Socket, Under Floor Service Box

6.3.1 Measurement:

Measurement above stated items shall be made for the total number of each item complete with sheet steel back boxes/ polycarbonate enclosure and all accessories acceptably supplied and installed by the Contractor as a complete unit.

6.3.2 Payment:

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each item stated above including screws, screw caps, sheet steel box, polycarbonate enclosure, nuts, bolts and other accessories as required.

***** End of Section – 8220 *****

SECTION - 8230

CONDUITS AND PIPES

1. SCOPE OF WORK

The work under this section consists of supplying, installing and commissioning of all material and services of the complete Conduits and Pipes as specified herein and/or shown on Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact route, location and position of the conduits and pipes.

The conduits and pipes with accessories shall also comply with the General Specifications for Electrical Works, Section-8001 and with other relevant provisions of the Tender Document.

2. GENERAL

The extent of works shown on the drawing does not indicate the exact position of conduits and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings and actual equipment layout plan as per site requirements and as directed by the Engineer.

The conduit system shall be continuous with manufacturer's recommended accessories.

The quality and material for the accessories of conduits and pipes such as sockets, end cap, elbows, bushings, bends, inspection/pull boxes, round boxes, etc., necessary for the complete installation shall be similar to that of conduits or pipes. All the accessories shall be supplied by the Contractor without any extra cost and deemed to have been included in the price of conduits/pipes.

Pull wire shall be laid in all empty conduits.

Appropriate size flexible conduits and pipes shall be used at expansion joints of the buildings and structures.

Normal and emergency circuits shall run in separate conduits.

All conduits and pipes which are to be installed in hazardous designated area shall be Class I division 1 compliant unless required otherwise.

3. APPLICABLE STANDARD/CODES

The latest edition of the following standards and codes shall be applicable for the materials specified within the scope of this section:

BS 61386	-	Conduit Systems for Cable Management.
BS 4607	-	Non-metallic conduits and fittings for electrical Installations.
BS EN ISO 1452-1:2009	-	Plastics piping systems for water supply and for buried & above – ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) UPVC. General
BS EN 10255	-	Non-alloy steel tubes for welding & threading. Technical delivery conditions

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IEC 60614	-	Conduit for electrical installation
BS3505	-	uPVC Pressure Pipe & Fitting

4. MATERIAL

4.1 Galvanized Iron (G.I.) Conduits and Accessories

G.I. conduits shall be used on surface for lighting and power circuits wherever specified and required, as shown on drawings or given in BOQ.

The G.I. conduits shall be made of medium gauge mild steel, galvanized inside and outside by hot dip galvanized process. The conduit shall be free from stains, burrs or any other defects. The accessories for G.I. conduit such as sockets, bends etc. shall also be galvanized inside and outside and of the same quality and specification as the conduit. Each length of conduit shall be furnished with threaded ends.

The round junction boxes for ceiling light points shall have minimum dimensions of 64mm diameter and 64mm depth. The junction boxes for wall light points shall have minimum dimensions of 64mm diameter and 40mm deep. Round junction boxes shall be provided with one piece cover plate fixed to the box by means of brass screws. All junction boxes and other accessories shall also be hot dip galvanized to ensure protection against corrosion.

4.2 PVC Conduits and Accessories

The PVC conduits and accessories for lighting and power circuits shall be furnished by the Contractor as shown on the drawings or given in BOQ. The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction. Bending of conduits by heating or otherwise will be allowed in special situations only for which the consent of the Engineer shall be required. The use of sharp 90 degree bends and tees will not be allowed for concealed wiring.

The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 63 mm diameter and depth. The junction boxes for wall light points shall have minimum dimensions of 63 mm diameter and 38 mm deep. Round junction boxes shall be provided with one piece PVC cover plate fixed to the box by means of brass screws.

4.3 Inspection/Pull and Adaptable Boxes

Inspection/Pull boxes and adaptable boxes shall be provided in GI / PVC conduit runs wherever required to facilitate pulling operation and/or change in directions of conduit installation.

The drawings are diagrammatic and do not indicate the position and spacing of inspection/pull boxes or adaptable boxes. However, these shall be as per Engineer's approval.

4.3.1 Inspection/Pull Boxes

The rectangular inspection/pull boxes shall be made of 16 SWG heavy gauge sheet steel of suitable design to receive conduits. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum depth of the box shall not be

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less than four times the cable manufacturer recommended bending radius of the cable.

All surface type boxes shall have cover of same gauge sheet steel, while for concealed type boxes shall have a white plastic sheet cover of appropriate size. The covers shall be fixed to the box by means of counter sunk galvanized screws.

4.3.2 Adaptable Boxes

Adaptable boxes shall also be made of 16 SWG sheet steel and painted and finished to the same quality as the Lighting distribution boards. The adaptable box shall preferably be fixed adjacent to the DB and have suitable dimensions to match the installation with DB. However, in any case, the depth of adaptable box shall be according to number & size of cables & conduits and shall not be less than the following:

- Conduits upto 25 mm dia. : Min. depth = 50mm
- Conduits upto 32 mm dia. : Min. depth = 65mm
- Conduits upto 50 mm dia. : Min. depth = 90mm
- Conduits more than 50 mm dia. : Min. depth = 2 xdia.

4.4 uPVC Pipes and fittings

Un-plasticized PVC pressure pipes and fittings shall conform to BS EN ISO1452-1:2009 and shall be of Class D (working pressure - 12 bars) and class-B (working pressure - 6 bars). The buried uPVC pipes should be able to withstand the external load acting upon it by continuous movements of heavy duty vehicles such as trucks, cranes, forklift etc. where pipe changes direction; manufacturer smooth bend shall be used.

Fittings and accessories for use with uPVC pressure pipes shall be of the same class and manufacture as the pipe and shall have the required shapes and dimensions of turned ends to fit the uPVC pressure pipes. uPVC pipes and accessories shall be suitable for jointing with rubber rings or solvent.

Bending of pipes by heating or otherwise will not be allowed. The use of sharp 90 degree bends and tees will not be allowed. The bends shall conform to same specifications as given for PVC conduits. For joining of pipe all precautions and procedures recommended by manufacturer shall be allowed.

Hard PVC pipe range spacers with locking arrangements shall be used if there is more than one pipe running in parallel. The distance between range spacers shall not be more than 2 meters. Range spacers shall be prefabricated/precast and decay resistant.

Flexible pipes shall be used as deemed essential or as approved by the Engineer.

5. INSTALLATION

5.1 Galvanized Iron (G.I) Conduits and Accessories

The G.I. conduits on surface shall be installed where shown on drawings/ mentioned in BOQ. The conduits shall be installed parallel or perpendicular to the surface of walls, structural members, ceiling, etc., by means of C.I. saddles and clamps of approved design. The conduits shall be kept at least 150 mm away from any other services pipes.

The saddles shall be installed on surface by means of nylon or wooden plugs and galvanized screws. Appropriate size of holes in structure shall be made by drilling, the thickness of saddles shall not be less than 6mm and clamps shall be of 16 SWG G.I. The surface conduits shall be supported at a maximum of one meter spacing along horizontal and vertical runs. All accessories for complete installation of conduit system shall be provided by the Contractor. The pull boxes etc. if required shall be used for surface conduit system. The entire conduit system alongwith the accessories shall be galvanized.

5.2 PVC Conduits and Accessories

5.2.1 Concealed PVC Conduit

Where concealed PVC conduit system is shown on drawings/ mentioned in BOQ, the conduit shall be installed concealed in roof, wall, column, etc. Conduits shall be laid under floor only where specifically stated. The entire conduit system shall be installed and checked before wiring is carried out. Any obstruction found shall be cleared before the installation of cable.

When concealed, the conduit shall have a minimum of 32mm cover of concrete measured from the top of conduit to finished surface. In the reinforced cement concrete (RCC) work the conduit shall be laid before pouring of concrete. Under no circumstances shall chases be made in the RCC structure for concealing conduit and accessories after pouring of concrete. The conduit shall be supported on top of bottom reinforcement of slab. All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab or beam.

Where conduits have to be concealed in cement concrete (CC) work after concreting or in block masonry, chase shall be made with appropriate tools and shall not be made deeper than required. The conduit shall then be fixed firmly in the recess and covered with cement concrete mixture. The work of cutting in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from the Engineer before starting chasing and cutting.

The termination of conduits at or near the equipment / switchboard is shown diagrammatically on the drawings. The exact locations of the termination shall be coordinated with the equipment/ switchboard to be installed. Any extension of conduit to suit the site condition shall be made without any extra cost. Conduit ends pointing upwards or downwards shall be properly plugged in order to present the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged in order to prevent the entry of foreign materials. All opening through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all terminations of conduit, sharp edges of conduit ends shall be prevented to avoid the cutting or damaging of wires or cables during pulling through the conduits.

Under floor conduit shall be installed at a minimum depth of 50 mm from the finished floor level or as shown on the drawings. The conduits shall be installed empty, before finishing of floor or in RCC work, with an 18 SWG steel wire drawn through the conduit for pulling cable. No conduits shall be laid under floor in bathroom.

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5.2.2 Surface PVC Conduits

The surface PVC conduits shall be installed where shown on drawings / mentioned in BOQ. The conduits shall be installed parallel or perpendicular to the surface of walls, structural members, ceiling, etc., by means of PVC saddles and clamps of approved design. The conduits shall be kept at least 150 mm away from parallel runs of flues, steam pipes and hot water pipes.

The saddles shall be installed on surface by means of nylon or wooden plugs and galvanized screws. Appropriate size of holes in structure shall made by drilling, the thickness of saddles and clamps shall be at appropriate thickness and prime quality.

The surface conduits shall be supported at maximum of 1000mm spacing along horizontal and vertical runs. The Contractor shall provide all accessories for complete installing of conduit system. The pull boxes, etc. as stated for concealed conduits shall also be applicable for surface conduit system.

5.3 uPVC Pipes and Fittings

uPVC pipes shall be installed as shown on the drawings. The depth of the pipe shall vary according to the conditions at site, and approval of Engineer shall be obtained prior to installation. In general the pipes shall be installed underground at the following depths measured from the top of the pipe.

- Under roads/pavements : 900 mm below finished surface.
- Under drain / culvert : 1000 mm below bottom slab.
- When crossing other services : 250/500 mm vertical/horizontal.

The trench of required dimensions shall be excavated and the bottom of trench cleaned and leveled. A 100 mm bed of fine sand shall be provided over which the PVC pipes installed after proper alignment. Where two or more pipes are installed in the same trench the clearance between pipes shall not be less than 50 mm. This shall be done by the provision of pipe range spacers as shown in the drawings & as per Engineers approval. After laying of pipe the trench shall be backfilled with clean screened sand at least 100 mm above the top most pipes. The remaining portion of trench shall be backfilled with selected earth in layers well compacted. Warning tape shall be laid all along the pipe trench at a depth of 300 mm from finished ground level.

After installation, the ends of the pipe shall be plugged with manufactured end cap impervious to water and chemicals. All joints shall be sealed adequately not only to prevent entry of foreign elements but water tightness shall be ensured as well.

The installation of pipes shall be completed in all respects including its fixing at terminations, before cabling work is started. All sharp edges and burrs shall be removed by using reamer or any approved device. The pipe shall be through cleaned of dirt and dust from inside whereas the pipes shall be installed in proper co-ordination with other works.

The protective PVC pipe for cable entering building shall be installed so as to lead cable into the cable trench. The required number of pipes shall be fixed before completing the work in the plinth. If an opening is provided to the cable trench or electrical pit from outside, the required number of pipes shall be installed and part of the opening remained unutilized and annular space after

laying of cable shall be properly packed and sealed using polyurethane sealant which should be impervious to water and chemical to make it completely water-tight.

Empty/Spare pipes shall be provided with 5 mm dia rope pulled from end to end and plugged with manufactured end cap.

Flexible pipes of compatible material and size shall be used wherever deemed essential.

6. MEASUREMENT AND PAYMENT

6.1 General

The Contractors bid amount against each item of Bill of Quantities as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawings related to the item.

6.2 uPVC Pipes and Accessories

6.2.1 Measurement:

Measurement shall be made for the total running meter of each type and size of pipes and accessories acceptably supplied and installed by the Contractor according to specification and as shown on drawings.

6.2.2 Payment:

Payment shall be made for the total running meter of each type and size of pipes measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing and completion of the laying of the pipes including all accessories related to the item.

No separate payments shall be made for the under mentioned specified work related to the supply and installation of pipe. The cost thereof shall be deemed to have been included in the quoted rates of above work.

- Excavation and backfilling.
- Dewatering during excavation and backfilling.
- Providing and filling of fine sand in trenches.
- Providing pipe range spacers.
- Providing flexible pipes and accessories, jointing material/ compound, saddles, sockets, elbows, bend, junction boxes, pull box ,reducers, 5 mm dia. rope for empty pipe, soft metal bush, making threads and plugging of pipe with manufactured end cap etc. whether used or left spare.
- Compacted backfilling of trenches with specified material and disposal of surplus and rejected material.
- Watertight/fire and heat resistant polyurethane sealants for sealing all unutilized opening/pipes after laying of cables.

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6.3 Conduits (G.I. and PVC) and Accessories

6.3.1 Measurement:

Measurement shall be made for the total running meter of each type and size of conduits and accessories acceptably supplied and installed by the Contractor according to specification and as shown on drawings.

6.3.2 Payment:

Payment shall be made for the total running meter of each type and size of conduits measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing and completion of the laying of the conduits including all accessories related to the item.

No separate payments shall be made for the under mentioned specified work related to the supply and installation of undermentioned items.

- Providing flexible pipes and accessories, jointing material/ compound, saddles, sockets, elbows, bend, junction boxes, pull box ,reducers, 16SWG GI pull wire for empty conduit, and 5 mm dia. rope for empty pipe, soft metal bush, making threads and plugging of pipe with manufactured end cap etc. whether used or left spare.

The cost thereof shall be deemed to have been included in the quoted rates of above work.

***** End of Section – 8230 *****

SECTION - 8240

EARTHING / GROUNDING SYSTEM

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of the complete Earthing system as specified herein, as shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact route, location and position of the earth electrode, counterpoise conductor and ECC etc.

The Earthing/ Grounding system shall also comply with the General Specifications for Electrical Works Section - 8001 and with other relevant provisions of the Tender Documents.

2. GENERAL

The earthing/ Grounding system consists of earth electrodes, earthing leads, earth connecting points, earth continuity conductors, counterpoise conductor, equipment ground lead and all accessories necessary for the satisfactory operation of the associated electrical system.

A dedicated earthing grid shall be installed underground in the vicinity of the buildings/structures as shown on the drawings. All mechanical and electrical systems shall be solidly connected to this earthing grid. The earthing grid shall be of bare tinned copper conductor strip laid at the same depth as that of the earth pits connected to it. The main distribution, connection pit, earth connecting point etc. and the lightning protection system must be integrated to assure an extensive integrated ground-grid.

The electrical contractor has to supervise the installation in order to guarantee the proper execution of the works ensuring overall earthing resistance within permissible limits of applicable standards.

3. APPLICABLE STANDARDS/CODES

The latest editions of following standards / codes shall be applicable for the materials specified within the scope of this section:

BS 7430	-	Code of practice for protective earthing of electrical installations
BS 951	-	Electrical earthing - Clamps for earthing and bonding Specifications
BS EN 12163	-	Copper and Copper Alloys – Rods for general purposes
BS EN 50522	-	Earthing of power installations exceeding 1 kV a.c
IEEE Std.80	-	IEEE Guide for Safety in AC Substation Grounding
BS EN 13601	-	Copper and Copper Alloys - Copper rod, bar and wire for General electrical purposes
BS EN 13602	-	Copper and Copper Alloys - Drawn round, copper wire for the Manufacture of electrical conductors

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BS EN 60228	-	Conductors of insulated cables
BS 6346	-	PVC insulated cables
BS EN 12164	-	Copper and Copper Alloys – Rod for free machining purposes
BS EN 12167	-	Copper and Copper Alloys – Profiles and bars for general Purposes
BS 6004	-	Electric cables, PVC insulated, non-armoured cables for voltages up to & including 450/750Volts for electric power, lighting & internal wiring
BS EN 62561-5	-	Lightning protection system components (LPSC). Requirements for earth electrode inspection housings and earth electrode seals

4. MATERIAL

4.1 Earth Electrodes

4.1.1 Plate Type

The plate type earth electrode shall comprise a 600 x 600 x 3mm 99.9% pure high conductivity electrolytic copper plate. The surface of the plate shall be tinned for protection. The plate shall have four terminals for connecting the earthing leads. Nuts bolts and washers shall be either of brass or tinned copper. A 50 mm dia. G.I. pipe shall be provided from inspection chamber to earth plate for watering purpose. This pipe shall have 10 mm dia. holes at 500 mm center to center all along the length.

At the ground level a medium / heavy weight concrete inspection chamber with cast iron cover shall be constructed having dimensions as shown on the drawings. The inspection chamber shall have a cover supported on angle iron frame. The cover shall be hinged type, as approved by the Engineer and shall finish flush with the ground level.

4.1.2 Copper Clad Steel Rod Type

This type of earth electrode shall comprise a 3 meter long, 19 mm dia. copper clad steel rod having flat head at drive end and pointed conical tip at the driven end. The tip shall be hardened to facilitate driving. At the top of the rod, a brass clamp for bolted connections shall be provided suitable for connection to the down conductor or earthing lead as required.

The inspection chamber with heavy/ medium duty C.I. cover shall be provided as instructed by the Engineer.

4.2 Earthing Leads

The earthing leads shall connect the earth electrode to earth connecting point (ECP) inside the inspection chamber unless required otherwise. It shall be of stranded electrolytic copper. It can be bare tinned copper or PVC insulated (green or green/yellow) of sizes shown on the drawings. The cost of earthing leads deemed to have been included in the price of earth electrode and no separate payment shall be made for it.

4.3 Earth Continuity Conductors

Earth continuity conductors (ECC) shall be stranded bare tinned copper conductor or single core PVC insulated, copper conductor cable of sizes indicated on the drawings. All thimbles, lugs, sockets, nuts, washers & other accessories necessary for the complete installation of ECC shall be provided by the Contractor without any extra cost.

The specifications for single core PVC insulated cables used as ECC shall be same as those given in section "LT Cables" of the technical specifications. PVC insulated cables when used as ECC shall be green or green/yellow.

4.4 Counterpoise Conductor

Counterpoise Conductor shall be hard drawn high conductivity bare stranded copper conductor of size 16 sq.mm. All installation material including thimbles, lugs, sockets, nuts, washers and other accessories required for the complete installation shall be provided without any extra cost.

4.5 Earth Connecting Points (ECPs)

Earth connecting points shall comprise tinned copper bar, rectangular in shape, having dimensions of at least 50 x 6 mm and 500 mm long or 50 x 6mm and 50mm long inside inspection chambers. At least six terminals for connection shall be arranged on the bar, which can be increased or decreased as required by the Engineer. The length of earth connecting points shall be suitably increased, if more than six earth wires are required to be terminated on the same ECP.

The terminals shall have brass or tinned copper bolts, nuts and washers for protection against corrosion. Two holes shall be provided off center of the copper bar for fixing to the wall by means of 10 mm dia. nut and bolt and shall be insulated by means of rubber gaskets/washers, porcelain insulators, etc.

4.6 Grounding Conductor Mesh

Grounding Conductors mesh shall be either stranded circular bare tinned copper conductor or tinned flat copper strip of sizes indicated on the drawings. All associated accessories necessary for the complete installation of Grounding Conductor Mesh shall be provided by the Contractor without any extra cost.

The grounding conductor shall be as shown on drawing or as mentioned in BOQ and/or as required by the Engineer. The grounding conductor shall be cad welded at intersections and with PVC insulated stranded copper conductor, of sizes as indicated on drawings, connected at the end to the Earth Connecting Point (ECP) installed at 300mm above finished floor level. The stub ups of PVC insulated copper conductor from the earthing mesh shall be along the columns. Test shall be carried out at each step/levels to ensure good electrical conductivity.

5. INSTALLATION

5.1 General

Complete earthing/ grounding systems as shown on the drawing shall be installed by the Contractor. The earthing system shall give earth resistance, including the resistance of soil, earth leads and ECC equal to or less than one ohm.

At all connections of earth continuity conductors to LT Switch Boards, LT Distribution Boards, Equipment and Motor Control Centers or any other metallic body, proper size copper or brass sockets, thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper

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wire at joints or terminations shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket.

Lead sheaths or steel tape armours are not permitted as grounding conductors. At any joint or terminations, the ECC shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

The earthing system shall be designed and installed to ensure that when any part of the earthing system is disconnected for the purpose of carrying out periodic testing an alternative path to earth is available.

The earth continuity conductor shall in general run in cable trench or in conduits/pipes as shown on the drawings. For under floor runs, these shall be installed in pipe/conduit of appropriate sizes. Where laid along underground cables, these shall be laid directly underground in unpaved areas and in pipes under paved areas.

The earthing system shall be tested after complete installation of earth electrodes.

5.2 Earth Electrodes

5.2.1 Plate Type

The electrode plate shall be installed at a minimum depth of 16.5 feet (5 meters) from finished ground level or 4 inches (100mm) below permanent water level whichever is less. The minimum horizontal distance between earth electrodes shall be 10 feet (3 metres). Proper mixture of lime and charcoal shall be made and buried along with the copper plate in the ground to increase the soil conductivity. The electrode shall be installed as per details shown on the drawings. The inspection chambers shall be constructed at locations approved by the Engineer. Suitable treatment on covers to protect against harsh atmospheric conditions shall be made as per instruction of Engineer.

5.2.2 Copper Clad Steel Rod Type

In case the soil conditions at site is permitted and approved by the Engineer, this type of earth electrode may be installed by hammering the electrode in soil, until the top of the rod is about 12 inches (300 mm) below the proposed finished ground level. If hammering down of rod is not possible due to site conditions, a pit shall be first excavated in bare ground up to the required depth and electrode shall be installed upright in the pit. The excavated pit shall be backfilled in layers of 20 inches (500 mm), each layer tamped and compacted and filled with ground enhancement material, if required. The inspection chambers shall be constructed at locations approved by the Engineer. Suitable treatment on covers to protect against harsh atmospheric conditions shall be made as per instruction of Engineer.

5.3 Grounding Conductor Mesh

The Grounding Conductor Mesh of sizes shown on the drawings shall be installed underground in the vicinity of the buildings/structures as shown on the drawings. All mechanical and electrical systems shall be solidly connected to this grounding conductor mesh. This grounding conductor mesh shall be laid at the same depth as that of the earth pits connected to it.

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The grounding conductor mesh shall be laid in soil below the foundation reinforced steel bars. The grounding mesh shall be connected to the Earth connecting point (ECP) in the equipment & electrical/ telecommunication rooms via PVC insulated stranded copper conductor of sizes as indicated on drawings, raised along the columns.

5.4 Earth Continuity Conductors (ECCs)

The earth continuity conductors of sizes shown on the drawings shall be installed all along the cable runs and connected to the earthing bar/terminals provided in equipment. The bodies of equipment and all switchboards shall also be connected to earth by specified size of ECC. All other metal work shall also be connected to earth by specified size of ECC. Appropriate size and numbers clamp/saddles shall be utilized to ensure smooth and safe installation of all type of ECCs.

At any joint or terminations, the ECC shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

5.5 Earth Connecting Points

The earth connecting points shall be installed at locations shown on the drawings. These shall be fixed on wall surface by means of brass screws with nuts, washers, porcelain insulators and other insulating material as instructed by the Engineer.

6. MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supplying, installation, testing, and commissioning of all work specified herein, as shown on the Tender drawing related to the item.

6.2 Earth Electrode

6.2.1 Measurement:

Measurement shall be made for the total no. of each type of earth electrode acceptably supplied and installed by the Contractor as a complete unit.

6.2.2 Payment:

Payment shall be made for the number of units measured, as provided above, at the Contract unit price each, and shall constitute full compensation for supplying, installing, testing, commissioning and completion of earth electrodes including copper plate or copper clad steel rod, earthing lead, excavation, backfilling, Ground enhancing material, inspection chamber with cast iron cover, GI pipes for earthing leads/watering, nuts, bolts, washers, lugs, brazing and all related civil works, complete with suitable treatment of cover.

1.1. Grounding Conductor Mesh

6.4.1 Measurement:

Measurement shall be made for the total running feet of grounding conductors acceptably supplied and installed by the Contractor.

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6.4.2 Payment:

Payment shall be made for the total running feet of grounding conductors measured, as provided above, at the Contract unit price each, and shall constitute full compensation for supplying, installing, testing, commissioning and completion of the grounding conductors including all accessories, such as sockets, thimbles, saddles, lugs, bolts nuts, brazing / cad welding etc.

6.3 Earth Continuity Conductor (ECC)/ Earthing Leads/ Counterpoise Conductor/ Equipment Ground Lead

6.3.1 Measurement:

Measurement shall be made for the total running feet of each size and type of earth continuity conductor (ECC) / Earthing Leads acceptably supplied and installed by the Contractor.

6.3.2 Payment:

Payment shall be made for the total running feet of each size and type of ECC/ Earthing Leads measured, as provided above, at the Contract unit price and shall constitute full compensation for supplying, installing, connecting, testing and completing of ECC/ Earthing Leads including all accessories such as sockets, clamps/saddles, thimbles, lugs, bolts, nuts, washers, brazing, etc.

6.4 Earth Connecting Point

6.4.1 Measurement:

Measurement shall be made for the total no. of earth connecting points acceptably supplied and installed by the Contractor as a complete unit.

6.4.2 Payment:

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing and completion of earth connecting point and all other associated accessories such as nuts, bolts, washers, lugs, etc.

***** End of Section – 8240 *****

SECTION - 8250

LIGHTNING PROTECTION SYSTEM

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all materials and accessories of the complete Lightning Protection System as specified herein, as shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact route, location and position of the lightning protection system.

The lightning protection system with accessories shall also comply with the General Specifications for Electrical Works Section - 8001 and with other relevant provisions of the Tender Documents.

2. GENERAL

The Contractor shall install the system as specified herein and in accordance with the referred/latest standard. The extent of work specified or shown on the drawings is schematic and does not indicate the exact position of testing terminals, conductor connections, etc. However, the Contractor shall ensure that the system is complete in all respect as intended by the specifications. The earthing resistance of lightning protection system at any point in the system shall not exceed TEN OHMS. In this regard, Contractor shall take all necessary measures, with due approval from the Engineer to ensure that earthing resistance remains within permissible limits. The cost of all necessary measures shall deem to be included in the relevant BOQ item of Earthing and no separate payment shall be admissible in this regard.

The roofs of building has to be equipped with lightning arresters / Air terminals / roof conductors/ down conductors/ supporting structure. Inspection and measuring joints have to be provided in the down conductors on suitable locations as shown on the drawings and / or as recommended by the manufacturer however, approval for the same shall be taken from the Engineer prior to commencement of work at site.

The lightning protection system shall be of the enhanced type which is designed to attract lightning to a preferred point and safely convey the lightning energy to ground with minimal risk of side flashing via predetermined route.

Contractor shall submit the appropriate Risk Assessment for the Lightning Protection System based on the relevant IEC compliant software. The results of the Risk Assessment shall be taken into account while finalizing the selection of complete lightning protection system's components. Also, the design should be such that the proposed system shall be sufficient to protect all structures, equipment, devices, material etc. of the project from the expected lightning strike in the zone. Moreover, the rolling sphere method & protection angle method-based analysis and assessment shall be carried out by the Contractor and should be submitted for the Engineer's review and approval prior to commencement of lightning protection system related works at site. The cost of these analysis and assessment shall deem to have been included in the rate of relevant BOQ item of the lightning protection system. Additional payment, whatsoever, shall not be admissible in this regards.

The structural design considerations, in accordance with the winds and seismic loads given in the relevant sections, shall be taken into account for the proposed components of the Lightning Protection system and the calculations / analysis shall be submitted to the Engineer for review and approval prior to commencement of works at site.

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3. APPLICABLE STANDARDS/CODES

The latest editions of following standards / codes shall be applicable for the materials specified within the scope of this section:

IEC 62305-2	-	Protection against lightning - Risk management
BS EN 62561-1	-	Lightning protection system components (LPSC) - Requirements for connection components
BS EN 62561-2	-	Lightning protection system components (LPSC) - Requirements for conductors and earth electrode
BS EN 62561-4	-	Lightning protection system components (LPSC) - Requirements for conductor fasteners
BS EN 13601	-	Copper and Copper Alloys - Copper rod, bar and wire for general electrical purposes+
BS 6346	-	PVC insulated cables
BS EN 60228	-	Conductors of insulated cables
BS 7884	-	Specification for copper and copper-cadmium stranded conductors for overhead electric traction and power transmission systems
BS 6004	-	Electric cables, PVC insulated, non-armoured cables for voltages upto & including 450/750Volts for electric power, lighting & internal wiring
French National Standard	–	NF C 17-102
IEC Test Standard	–	IEC60-1:1989

4. MATERIAL

The lightning protection system shall comprise;

- Early Streamer Emission
- Mounting Support
- Lightning Air Terminal
- Down conductors
- Roof conductors
- Testing terminals
- Grounding Conductor
- Earth electrode (Copper Clad Steel Rod Type)
- Concrete Inspection pit with cover
- Exothermic Cad-Welding Connections & accessories

4.1. Air Terminal System

The lightning air terminal shall be an Early Streamer Emission terminal which will respond dynamically upon leader activity in the near area. The lightning air terminal shall be configured as a spheroid which is comprised of separate electrically isolated panels surrounding an earthed central finial. The insulation material used to electrically isolate the panels shall be comprised of a base

polymer which provides high ozone and UV resistance with a dielectric strength of 24 – 38 KV/mm. The external shape of the advanced lightning rod shall be such that it will limit the development of sharp point corona discharge under static thunderstorm conditions. The central finial shall be elevated above the spheroid to a length of 86mm. The upper section of the central finial shall be rated to withstand 200KA. Arcing shall occur between the panel sections of the spheroid and the finial tip only upon the progression of a lightning leader. The lightning air terminal shall have no moving parts and will have no dependence on external power supply or batteries. Under a normal atmosphere all components of the advanced lightning terminal shall be non-corroding. The lightning air terminal shall not be installed in a corrosive environment unless the manufacturer's written approval has first been granted. The lightning air terminal shall be installed as per the manufacturer's instructions.

4.2. Support structure

The buildings will be protected against the risk of atmospheric discharge by a lightning conductor fixed to the roof with a supporting structure 23 ft meters above the highest point of any other structure/obstacles or as indicated on the drawing.

The mounting pole used to support the lightning air terminal shall either be circular insulating fiberglass tube or aluminum. The pole shall have an outside diameter of 68mm. The down conductor shall pass through the center of the pole for the entire length of the pole.

The system shall comprise of all necessary components required for proper fixing of air terminal system on roof with required no. of roof / down conductors.

4.3. Down / Roof Conductors

The down / roof conductors for lightning protection system shall be as shown on drawing or as mentioned in BOQ and/or as required by the Engineer. All connections between metal work on the roof shall be with the same conductor sizes and material as of roof conductor. All accessories for fixing of copper conductor to concrete surface shall be of tinned copper or brass as approved by the Engineer.

The copper tinned copper strip down conductors shall be fixed securely after every one meter with all accessories. The down conductor system is appropriately connected to the air and earth termination network and test shall be carried out at each step/levels to ensure good electrical conductivity.

4.4. Testing Terminals

For each tinned copper strip down conductor a testing terminal shall be provided. It shall be installed 1.5 meters above the finished floor level or as convenient for testing purposes and /or as directed by the Engineer. The testing terminals shall have removable connections.

The testing terminals shall be enclosed in an appropriately sized enclosure box made of "16 SWG MS Powder Coated" material with protective cover which shall be provided with each Earth test point for ensuring protection against direct contact / atmospheric effects.

The cost for this protective enclosure box deemed to have been included in the relevant BOQ item. No separate payment shall be admissible in this regard.

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4.5. Event Recording device

The system shall be installed complete with lightning strike recorder. The lightning strike recorder shall contain a mechanical 6-digit display which will register all lightning discharges with a sensitivity of 1500A 8/20µs peak current impulse.

The lightning strike recorder shall be housed in a IP67 rated enclosure and will operate without reliance on batteries or an external power source. The lightning strike recorder shall be installed as per manufacturer's instructions and after the approval of the Engineer.

4.6. Earth Electrode (Copper Clad Steel Rod Type) / Inspection

This type of earth electrode shall comprise a 3.00 meter long, 19 mm dia. copper clad steel rod in section of 1.5 m with copper coupling having flat head at drive end and pointed conical tip at the driven end. The tip shall be hardened to facilitate driving. At the top of the rod, a brass clamp for bolted connections shall be provided suitable for connection to the down conductor or earthing lead as required.

The concrete inspection pit with C.I. (Medium / Heavy Duty) cover shall be provided as specified in earthing system.

4.7. Exothermic Cad-Welding Connections & accessories

Exothermic welding shall be provided for quickly creating highly conductive connections that are tolerant to repeated fault currents using the high temperature reaction of powdered copper oxide and aluminium, within a mould, to form permanent electrical connections. These shall comprise but not limited to the following connections & accessories:

- Copper Conductor with Copper Conductor
  (25x3mm bare tinned copper strip to strip)
  - Bar to Bar "Straight" joint
  - Bar to Bar "T" joint
  - Bar to Bar "Cross" joint
- 25x3mm Flat tinned copper strip to 70 sq.mm. bare tinned copper conductor
  - Bar to Cable "T" joint
- Bar to Rebar
  (for connection of 25x3mm Tinned Copper conductor to Steel reinforcement Bar)
- Cable to Rebar
  (for connection of 70 sq.mm. Cu. Conductor PVC Insulated cable to Steel reinforcement Bar)
- Exothermic Powder
- Handle Clamps
- Moulds, Tools & Accessories

5. INSTALLATION

5.1. Air Terminal System

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The mounting pole used to support the lightning air terminal shall either be a circular insulating fiberglass tube or aluminum mast. The mounting pole and supports shall be securely fixed with brackets and guy wires where required as indicated on drawing and indicated by the manufacturer.

Lightning arresting system shall be installed by specialist supplier or his trained representative and is subject to approval of Engineer. The base of the air terminal shall be properly fixed to the support structure on roof of the building and all roof/down conductors properly bolted. The air terminal shall than be placed. The entire assembly shall be installed in compliance to wind loading / structural calculations.

5.2. Down Conductor / Testing Terminal

The down conductor shall be installed along the shortest possible route from roof to earth electrode. These shall be secured / fixed at appropriate intervals by means of Omega type pads in tinned copper fixed by stainless steel screws as shown on drawing and approved by Engineer.

In general, bends shall be avoided along the routes of down conductor and maximum possible bending radius will be provided at turns. The conductor shall be continuous & joint shall not be provided. If necessary and accepted by Engineer the joints between conductors shall be electrically and mechanically strong and effective. Straight joints in the down conductor shall be bolted. The joint shall be given a coat of anti corrosive paint after connection. All accessories such as nuts, bolts, washers, solder, paint etc. shall be furnished by the Contractor.

All metallic projections on roof, metallic handrails, monkey ladders, ventilating equipment, vent pipes, metallic louver doors, parapet walls on roof and other auxiliary equipment shall also be bonded and form part of the lightning protection network.

Flexible copper braids (25x3mm) shall be used at expansion joints.

For each down conductor a removable terminal shall be provided for testing purpose at approximately 1.5 metres height from finished ground level. The location of testing terminals are not shown on the drawings. The testing terminals shall be bolted type and made in accordance with the specifications for straight bolted joints. The connecting earth lead from testing terminals to earth electrodes shall be continuous without any joint.

All metal work, pipes etc., at the roof and within 2 metres along the route of Down conductor shall be bonded to the lightning protection system. The bonding shall be effective and approval of the Engineer shall be obtained for the bonding method.

5.3. Earth Electrode (Copper Clad Steel Rod Type)

In case the soil conditions at site permit, this type of earth electrode may be installed by hammering the electrode in soil, using driving stud until the top of the rod is about 300 mm below the proposed finished ground level. If hammering down of rod is not possible due to site conditions, a pit shall be first excavated in bare ground upto the required depth and electrode shall be installed upright in the pit. The excavated pit shall be backfilled in layers of 500 mm, each layer tamped and compacted to ensure a good and firm contact between electrode and earth.

5.4. Exothermic Cad-Welding Connections & accessories

Exothermic Cad-welding system shall be installed by specialist and qualified supplier or his trained representative and is subject to approval of Engineer.

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supplying, installation, testing, and commissioning and completion of all work specified herein, as shown on the Tender drawing related to the item.

6.2. Air Terminal System

6.2.1 Measurement

Measurement shall be made for the total number of air terminal system with supporting structure and event recording device acceptably supplied and installed by the Contractor.

6.2.2 Payment:

Payment shall be made for the total number of air terminal system measured, as provided above, at the Contract unit price each, and shall constitute full compensation for supplying, installing, testing, commissioning and completion of the air terminal system including all accessories, such as sockets, thimbles, lugs, bolts nuts, brazing, etc.

6.3. Down / Roof Conductors

6.3.1 Measurement:

Measurement shall be made for the total running feet of down / roof conductors acceptably supplied and installed by the Contractor.

6.3.2 Payment:

Payment shall be made for the total running feet of down / roof conductors measured, as provided above, at the Contract unit price each, and shall constitute full compensation for supplying, installing, testing, commissioning and completion of the down/roof conductors including all accessories, such as sockets, thimbles, saddles, lugs, bolts nuts, brazing / cad welding etc.

6.4. Earth Electrode (Copper Clad Steel Rod Type)

6.5.1 Measurement:

Measurement shall be made for the total number of copper clad steel rod type earth electrode acceptably supplied, installed and tested by the Contractor as a complete unit.

6.5.2 Payment:

Payment shall be made for the number of units measured, as provided above at the Contract Unit Price each, and shall constitute full compensation for supplying, installing, testing, commissioning and completion of the copper clad steel (rod type) earth electrode including testing terminal, earthing lead from testing terminals to earth electrodes,

excavation, backfilling, compaction, civil works for inspection chamber, cast iron cover (Medium or Heavy duty), G.I. pipe for earthing lead etc. and all accessories, such as sockets, thimbles, lugs, saddles, bolts nuts, brazing, etc.

6.5. Cad Welding Connections & accessories

6.6.1 Measurement:

Measurement of cad welding of down conductors with the reinforcing bar of the column, connection by pre-welded tail of roof / down conductor with down conductor/ cables and welding of bar to bar shall be made for the total number of points acceptably done and completed by the Contractor.

6.6.2 Payment:

Payment shall be made for the number of cad welding points, pre-welded tails completed as provided above at the contract unit price each, and shall constitute full compensation for execution and completion of the cad welding including testing at each step/level for good electrical conductivity.

6.6. Earth Testing Terminals / Earth Testing Point (ETP)

6.7.1 Measurement:

Measurement shall be made for the total no. of earth testing terminals / earth testing point (ETP) acceptably supplied and installed by the Contractor as a complete unit.

6.7.2 Payment:

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing and completion of earth testing terminals / earth testing point (ETP) and all other associated accessories such as protective cover, nuts, bolts, washers, lugs, etc.

***** End of Section – 8250 *****

SECTION - 8290

MISCELLANEOUS ITEMS

1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and accessories for Miscellaneous Items as specified herein and/or shown on the drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with all other services for exact locations, installation height and positions of the Miscellaneous Items.

The Miscellaneous Items with accessories shall also comply with the General Specifications for Electrical Works Section - 8001 and with other relevant provisions of the Contract Document.

2. GENERAL

The Miscellaneous Items as described in this section shall comply with other sections of these specifications as applicable. The Contractor shall ensure that all the miscellaneous items be supplied/fabricated from the reputable manufacturers, who have already supplied/fabricated similar items.

All proposed Ceiling Fans and Wall Bracket fans shall include a warranty of at least 2 years from the proposed OEM. All warranties are to be endorsed in the name of the Employer and an undertaking shall be submitted from Original Equipment Manufacturer (OEM) and local representatives for ensuring compliance of services to the Employer during Warranty Period. The cost incurred for such warranty shall deem to have been included in the item rate of relevant BOQ item. Additional payment, whatsoever, shall not be admissible in this regard and for extended warranty, if any.

3. APPLICABLE STANDARDS/CODES

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this section:

IEC 60947-3	-	Low Voltage Switch Gear and Control Gear - Switches, disconnectors, switch-disconnectors and fuse-combination units
BS EN ISO 1461	-	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
BS EN 15630	-	Safety requirements for electric fans and regulators.
BS EN 50085	-	Cable trunking and cable ducting systems for electrical installations.
BS EN 61537	-	Cable management. Cable tray systems and cable ladder systems
BS 4678-2	-	Specification for Cable Trunking - Part 2: Steel Underfloor (Duct) Trunking
BS EN 10346	-	Continuously hot-dip coated steel flat products for Cold forming — Technical delivery conditions
IEC 61084-2-2	-	Cable trunking systems and cable ducting systems for electrical installations - Part 2-2: Particular requirements

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BS EN 60335-2-80	-	Household and similar electrical appliances. Safety. Particular requirements for fans.
BS EN-124	-	Gully tops and manhole tops for vehicular and pedestrian areas - Definitions, classification, general principles of design, performance requirements and test methods
ISO-12944-2	-	Corrosion Protection of Steel Structures by Protective Paint Systems
BS EN 60529	-	Degrees of protection provided by enclosures (IP Code)
BS EN 60601	-	Medical Electrical Equipment and Systems
BS EN 61557-1	-	Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC - Equipment for testing, measuring or monitoring of protective measures - Part 1: General requirements
BS EN 61557-8	-	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. Equipment for testing, measuring or monitoring of protective measures - Insulation monitoring devices for IT systems
IEC 60364-7-710	-	Low-voltage electrical installations - Part 7-710: Requirements for special installations or locations - Medical locations

4. MATERIAL

4.1. Ceiling Fan

Ceiling fan shall be capacitor type, suitable for 250V AC. The air displacement shall be 12,000 cfm for 56" (1422 mm) sweep and 10,000 cfm for 48" (1219 mm) sweep at maximum speed. The fan motor shall be capacitor type and bearing shall be groove type to give noiseless operation. The fan regulator / dimmer shall be made of low voltage electronic components, and shall be suitable for the speed control of fans. The body of the regulators shall be matching with the switching accessories, suitable for flush mounting on a sheet steel outlet box. Where the regulators are to be mounted with switches they shall match with the dimensions of switches and shall be fixed on plastic outlet by means of flat headcounter sunk galvanized screws, with the head of the screws finish flush with the surface of the plate. The complete fan with blades and canopy shall be finished in white colour, or as approved by the Engineer.

The fan hook shall be made of 16 mm diameter mild steel rod. It should be in the form of a loop about 75 mm long and about 50 mm wide. The rod should be bent to have at least 200 mm extensions on both sides for tying to reinforcement steel of slab.

The fan rod shall be of G.I 20mm dia of standard size unless otherwise specified.

4.2. Wall Bracket Fan

Wall bracket fans shall be capacitor type, suitable for 250V AC and shall be of size as mentioned in the BOQ. The fan motor shall be capacitor type and bearing shall be groove type to give noiseless operation. The fan regulator shall be made of low voltage electronic compon[illegible] shall be suitable for the

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speed control of fans. The regulator shall be located in the fixed portion of the fan. The complete fan with blades and cover shall be finished in white colour or as approved by the Engineer. The fan shall be provided with a rotating mechanism for swinging the fan on its vertical axis.

4.3. Switch Disconnector / Load Break Switch/ MCCBs enclosed in Weatherproof Sheet Steel Enclosure Box

Triple pole 500 volts / Single pole 250 volts Switch Disconnectors / Load Break Switches/ MCCBs are used for supplying three phase and single phase power respectively to the equipment shown on the drawings and given in the Bill of Quantities and/or as required by the Engineer. The Switch Disconnector / Load Break Switch/ MCCBs shall be suitable to perform type of duty at AC-23 utilization category.

The Switch Disconnector / Load Break Switch/MCCB enclosed in Weatherproof Sheet Steel Box with all components and accessories shall be suitable for front operation only and shall:

- have ingress protection rating of IP65, unless otherwise specified.
- have copper/ brass links or bus bars for earth and neutral connections which shall be suitable for the cable sizes as indicated on the relevant drawings or Bill of Quantities.
- be provided with adequate clearance from live parts so that flashovers cannot be caused by switching, vermin, pests, etc.
- have incoming and outgoing cable termination arrangement, if required, through terminal blocks, line-up terminals, etc.
- have all incoming and outgoing connections from the top or bottom as required.
- be labelled with stainless steel nameplate on the front side of door.
- have doors earthed by means of flexible copper cable/strip.
- be installed as per site requirement

It shall be installed in a 16 SWG sheet steel weather proof box of such a size, which can easily accommodate the required rating of Switch Disconnector/ Load Break Switch and incoming/ outgoing wires or cables. Sufficient numbers and size of brass/ copper links connectors shall also be provided inside the sheet steel box for terminating the earth continuity conductors and neutral wires as indicated on relevant drawings.

Sufficient space between cable entry / gland and terminations shall be provided / giving due consideration for minimum allowable bending radii of incoming / outgoing cables. All holes, cut-out shall be tool or jib manufactured and free from burrs and rough edges. The doors shall be provided with cam locks and shall be hinge type. Suitable opening angle of doors shall be provided considering ease of maintenance and operation.

The cabling inside the enclosure box shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. The nameplates provided on the front of enclosure box shall be of flame retardant material preferably stainless steel. Use of plastic or any inflammable material shall not be permitted for nameplates.

All outdoor metal works on weatherproof enclosure box shall be hot dipped galvanized and coated with two coats of epoxy paint or as directed by Engineer.

4.4. Hot dipped galvanized M.S. Cable Trays / Trunking / Ladders with protective paint system

The hot dipped galvanized M.S. cable tray / trunking (with cover) shall be 14 SWG M.S. sheets. Suitable trunking design shall be provided for bends, crossings, etc., keeping in view allowable bending radius of cables.

After cutting/perforation and fabrication of each tray / trunking and cover section, the metalwork shall be galvanized and coated with two coats of epoxy paint or as indicated by the Engineer

Arrangement shall be provided to secure the cables in position on the trunking. Cables laid on tray / trunking shall be properly fixed or clamped, with smooth finished split pieces with bore diameter to suit the cable. Supports shall be arranged as far as practicable for easy removal of any cable without disturbing other cables.

Copper braid connections shall be provided at every joint, fixing accessories of cable tray to ensure continuity.

Cable trays shall be earthed with flexible copper braid/ strip.

Where specified, the cables shall run on cable trays/trunking supported to the wall and/or ceiling. The tray shall be of appropriate dimensions to ensure minimum clearance of one dia spacing between the cables. Tray and trunking shall be provided with complete accessories such as straight through joint, flexible expansion coupler, tee, cross, internal and external bend, cover etc. complete with proper support and fixing accessories, GI nuts, bolts washer etc.

The cable tray/ trunking length shall be fabricated in sections not exceeding 3 meters.

The arrangements shall be provided for manufactured bends, crossing, connection piece etc. keeping in view the allowable bending radii of the cables. The design of such trays shall include a factor of safety to guard against permanent distortion when supporting the load of the erection staff during cable installation. Arrangement shall be provided to secure the cable in position on the trays. At every building expansion joint flexible expansion couplers shall be provided, all auxiliary material not particularly specified but necessary for proper execution shall be coated as the cable tray/ trunking/ ladder and shall be included in the offer.

4.5. Under Floor Metal Trunking

Where the trunking is buried underfloor in the screed for the distribution of power circuit wiring, voice and data services under floor, it shall be produced from pre-galvanized sheet steel material having standard thickness of 1.2mm and dimensions as specified in the description of relevant BOQ item and also shown on the contract drawings. It shall have at least 2 compartments for separation of power & telecommunication circuits.

Underfloor trunking shall be tested under screeding to withstand 30 kN concentrated load.

Construction of the trunking shall be by channel method. This is to avoid damage to its galvanized coating to prevent corrosion and also to add strength to the section whilst allowing site adaptation. The top channel shall have continuous side returns to prevent the ingress of screed and shall be clamped to

the base channels with two clamping saddles and a double width connecting saddle.

Underfloor trunking shall be provided with complete accessories such as floor pedestal boxes, round grommets, extension screw terminals, offsets, etc. complete with proper support and fixing accessories, such as clamping saddle, connecting saddle, GI nuts, bolts washer, covers etc.

Underfloor trunking shall be earthed with flexible copper braid/ strip.

The underfloor trunking length shall be fabricated in sections not exceeding 2.3-2.44 meters lengths.

4.6. Manholes/ Handholes with Cover & Frame

Manholes/Handholes for electric power cables shall be constructed in accordance with the standard Specifications of Civil works. The work shall also include making of concrete chambers and concrete benching in manholes, complete as shown on the drawings. Top of the cover shall be in compliance with BS EN124. The covers shall be roughened in an approved pattern and shall tightly fit in the frame making it watertight. The manhole/handholes shall have appropriate identification code as instructed by Engineer.

Covers complete with frame shall be of the size specified and Class or category mentioned on the drawings. The specified size means the clear opening. Suitable locking and lifting arrangement shall also be provided. The frame shall be set in place at the time of pouring of concrete so that the cover shall tightly fit in the frame.

Covers shall be labelled "E" or "Electrical", "T" or "Telecommunication". The covers shall have appropriate loading capacity in accordance to its location where it is intended to be installed as specified in BS EN 124 and Drawings and approved by the Engineer.

4.7. Changeover Switch:

Changeover switches shall be rotary or cam type, 2-position, 2-pole and 3-position, 3-pole as required, complete with knob and front plate with position indication.

It shall be installed with a sheet steel back box or shall be installed in a 16 SWG sheet steel box of such a size, which can easily accommodate the required rating of Changeover Switch and incoming/ outgoing wires or cables, if required. Sufficient numbers and size of brass/ copper links connectors shall also be provided inside the sheet steel box for terminating the earth continuity conductors and neutral wires as indicated on relevant drawings.

The Changeover switch, if installed in enclosure, shall comply with the specification section 8133 and 8132.

4.8. Isolated Power System

Isolated power system shall be provided in all O.T., intensive care units, Coronary care unit, cardiac procedure rooms, and resuscitation rooms. It shall be suitable for all medical locations classified by IEC 60364-7-710. Each isolated circuit shall be controlled by a switch having disconnecting poles. The isolation shall be achieved by means of isolating transformers having no electrical connection between primary and secondary of the transformer winding. The circuits supplying the primary of the isolating transformer shall operate at 400/230 V between conductors and the secondary voltage shall not exceed

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400/230 volts between conductors of each circuit. All circuits supplied from the secondaries shall be ungrounded and shall have an approved overcurrent device of proper ratings in each conductor. An isolation power centre shall not be installed in hazardous locations, it shall be permitted to be located in an anaesthetizing (hazardous classified) location provided it is installed above hazardous location or in other than hazardous location.

An isolated branch circuit supplying an anaesthetizing location shall not supply any other location.

The isolated circuit conductors shall be identified as follows:

Isolated Conductor No. 1 – Orange
Isolated Conductor No. 2 – Brown

For 3 - phase systems, the third conductor shall be identified as yellow.

Wire pulling compounds that increase the dielectric constants shall not be used on the secondary conductors of the isolated power supply.

The rating of isolating transformer shall not exceed 10 kVA.

Each isolated power system shall be provided with an isolation monitor those measures and indicates possible leakage or fault current from either isolated conductor to ground and the thermal and electric overload of the insulation transformer in accordance with EN 61557-1, EN 61557-8 and IEC 60364-7-710.

A green signal lamp, conspicuously visible to persons in the anaesthetizing location remains lighted when the system is isolated from ground. A red signal lamp and an audible warning signal (remote) shall energize when the total hazard current from either isolated conductor of ground reaches a threshold value of 5 milliamps under nominal live voltage conditions. The live monitor shall not alarm for a fault hazard of less than 3.7 milliamps or for a total hazard current of less than 5.00 milliamps.

4.8.1.Components

The following components shall be provided by the manufacturer of the Hospital Isolation Power system as one integral unit.

4.8.1.1. Transformers

1. The transformer shall be a medical-grade single-phase unit, specifically designed for isolation in medical locations. It shall be equipped with an electrostatic shield between the primary and secondary windings to prevent any direct shorting and to reduce the coupling of harmonic distortions between the circuits. This shield shall be grounded to the transformer enclosure, ensuring compliance with EN 61558-2-15.

2. The total leakage current to ground from the transformer shall not exceed 0.5 mA, as specified for medical isolation transformers, ensuring adherence to the highest safety standards for medical environments.

3. The transformer regulation shall not exceed 3% under full load conditions, maintaining stable output even

under varying load conditions, in compliance with the IEC 60364-7-710 standard for medical locations.

4. The transformer shall be single-phase, 50-60 Hz, with primary and secondary voltages specified according to the project requirements. The design shall conform to IEC standards and be optimized for use in medical environments where operational continuity is critical.

5. The transformer shall use a high-performance insulation system rated for a maximum temperature rise of 40°C above ambient under full load conditions. The insulation shall be in accordance with Class B standards (130°C) as per EN 61558-1 and EN 61558-2-15, providing durability and safety in continuous operation.

6. The transformer core shall be of a robust laminated design, securely clamped and bolted to ensure structural integrity and low noise operation. The core and coils shall be isolated from the enclosure using a vibration-dampening system, impregnated with a high-quality varnish, and wrapped with insulating material to prevent exposure of any bare conductors.

7. The transformer shall be designed to operate quietly, with sound levels not exceeding 27 dB for units up to 5 kVA, and 35 dB for units between 7.5 and 10 kVA. Each transformer unit shall undergo sound level testing, and certified reports shall be provided upon request to confirm compliance with the specified sound level criteria.

4.8.1.2. Circuit Breaker

All circuit breakers provided shall be 2-pole with a minimum interrupting capacity of 10,000 amperes RMS. The circuit breakers shall be thermal-magnetic type, designed to protect both the conductors and connected equipment in accordance with IEC 60947-2 and IEC 60364 standards.

4.8.1.3. Line Insulation Monitor (LIM)

1. The LIM shall use advanced digital signal processing (DSP) to continuously monitor the insulation resistance of the isolated power systems, detecting faults in compliance with IEC 61557-8. The LIM shall be capable of accurately measuring all types of faults, including resistive and capacitive faults, in balanced, unbalanced, and hybrid configurations. LIMs that switch internally between lines and ground are not acceptable. The LIM's contribution to the system's hazard current shall not exceed 50 µA.The LIM shall have the following specifications:

- **Operating Voltage:** 110-230 VAC
- **Measurement Range:** 0-999 kΩ
- **Accuracy:** ±5% across the full measurement range

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- **Alarm Level:** Programmable between 50-500 kΩ with ±5% accuracy
- **Alarm Hysteresis:** 10% of the set threshold
- **Alarm Type:** Continuous, with programmable delay for low insulation and temperature alarms
- **Operating Frequency:** 50-60 Hz
- **Monitoring:** Supports both single-phase and three-phase systems
- **Internal Resistance:** 100 kΩ
- **Self-Consumption:** 5 VA maximum
- **Compliance:** IEC 60364-7-710, EN 61557-1, EN 61557-8

2. The LIM shall have a built-in self-test function that automatically recalibrates the unit every 60 minutes. A manual test switch shall be provided to initiate immediate recalibration and a complete test of all indicating lamps and meters.

3. The device shall feature a digital display and a bar graph for visual representation of the insulation resistance and fault conditions. The digital meter shall display readings from 0 to 999 kΩ, while the LED bar graph shall provide an analog indication ranging from 0% to 160% of the set alarm threshold.

4. The LIM shall be equipped with a communication interface (RS485) supporting Modbus RTU protocol, allowing integration with external monitoring systems. An infrared LED port for data transmission is optional.

5. The LIM shall provide both audible and visual alarms for fault conditions. The front panel shall include a green "Safe" indicator, a red "Hazard" indicator, and a yellow "Silenced" indicator. An audible alarm shall activate when the insulation resistance drops below the set threshold. The alarm shall have high, low, and off settings, with a silence button provided on the face of the unit.

6. The device shall include auxiliary relay outputs rated at 5A, 250 VAC for connection to external alarm systems and remote signalling devices. The LIM shall also feature loss-of-ground detection, which triggers the alarm system in the event of a lost ground connection.

7. The LIM shall have a robust design with all switches, meters, and indicating lamps flush-mounted to the front panel. The front face shall be protected by a polymer overlay, ensuring resistance to cleaning agents commonly used in medical environments.

8. The design shall consist of two interconnected circuit boards housed within a protective casing, ensuring

easy access for maintenance without the need for dismounting the unit. Access to internal components shall be through the front panel, secured by unique fasteners to prevent unauthorized access.

9. The LIM shall comply with relevant safety standards, including UL1022 and CSA 22.2 for line isolation monitors.

4.8.1.4. Remote Indicator Alarm

1. The remote indicator alarm shall be flush-mounted with a stainless-steel front trim. It shall feature a constant green light to indicate safe operating conditions and a red indicator that illuminates when the insulation resistance drops below the set threshold. An audible signal shall sound simultaneously with the red indicator.

2. A silencing switch for the audible signal shall be provided. Upon pressing the switch, a yellow warning light shall illuminate, indicating that the audible alarm has been silenced. The system shall automatically reset when the fault condition is resolved. The wiring from the LIM to the remote indicator shall be designed to minimize additional leakage current in the system.

4.8.2. Construction

4.8.2.1. Enclosure

1. The enclosure shall have a protection rating of **IP54** as standard, ensuring protection against dust and water ingress, suitable for medical environments. The enclosure shall comply with the **IEC 61439-1** and **IEC 62208** standards for low-voltage switchgear and control gear assemblies, ensuring robust construction and reliability in critical medical applications.

2. The enclosure shall be constructed from high-quality 1.5 mm (approximately 14-gauge) steel, which is degreased, phosphatized, and coated with a baked epoxy-polyester powder finish to ensure durability and corrosion resistance. The front trim shall be made of Type 304 stainless steel with a #4 brushed finish, providing a clean and robust appearance suitable for medical environments. The enclosure shall be designed for flush mounting, unless otherwise specified in the project plan. For units up to 5 kVA, the enclosure depth shall not exceed 200 mm (approximately 8 inches), For units between 7.5 kVA and 10 kVA, the enclosure depth shall not exceed 300 mm (approximately 12 inches).

3. The front panel shall be solid, without any grilles or louvers, ensuring that the enclosure is fully sealed to meet the IP54 rating. The enclosure and transformer shall be designed to manage heat efficiently, ensuring that the heat generated under full load conditions does not impact the normal operation of the circuit breakers

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and LIM. The maximum temperature rise on the front panel shall not exceed 40°C above ambient temperature under continuous full load conditions. Certification of compliance with this temperature limit shall be provided upon request. The area behind the hinged door shall be of a dead-front design, with all components securely enclosed. Concealed hinges shall be used to maintain a clean and tamper-resistant appearance.

4.8.2.2. Wiring

1. All wiring within the panels shall comply with the relevant IEC standards, particularly IEC 60364, ensuring high safety and reliability in medical environments. Low leakage insulation shall be utilized for all secondary wiring within the panels, in accordance with the standards for medical locations. The total leakage current for all panel types shall not exceed 0.5 mA, ensuring compliance with the stringent requirements of medical-grade isolation systems.

2. The panels manufacturer shall provide certified test data for each individual panel, detailing the maximum leakage current of the complete assembly. This certification ensures that the panels meet the specified safety and performance criteria as outlined in IEC 61557-1 and IEC 61557-8 standards.

3. The contractor shall wire all external receptacles to the panels using copper stranded conductors with cross-linked polyethylene (XLPE) insulation or an equivalent material. The insulation shall have a dielectric constant of 3.5 or less, ensuring minimal capacitive coupling and high performance in isolated circuits. Under no circumstances shall wire pulling compounds be used when installing wiring for isolated circuits, as this could compromise the integrity and performance of the insulation. All wiring shall be color-coded in accordance with IEC 60446, ensuring clear identification and compliance with international standards.

4.8.2.3. Power & Ground Modules

1. The module backbox shall be fabricated from high-quality mild steel, ensuring durability and compliance with IEC 62208 standards for empty enclosures for low-voltage switchgear and control gear assemblies. When the module is surface mounted, the backbox shall be designed with a finished appearance, with all seams fully welded and ground smooth to create a seamless exterior. The backbox shall undergo a multi-stage surface treatment process, including degreasing, priming, and a final coating with a baked epoxy-polyester powder finish, ensuring resistance to corrosion and a long-lasting, durable finishThe only exposed screws on the trim shall be the four screws holding the trim to the backbox. The trim for the module shall be constructed from 1.5 mm (approximately 14-gauge) Type 304 stainless steel with a #4 brushed finish, providing a robust and aesthetically pleasing appearance that is suitable for medical environments.

2. The only exposed screws on the trim shall be the four screws used to secure the trim to the backbox. These screws shall be stainless steel, matching the finish of the trim, and shall be designed to be tamper-resistant to maintain the integrity and security of the enclosure.

4.9. Bed Head Units

The luminaries and panel shall be wall mounted type with Medical Trunking incorporating an integrated medical rail.

The luminaries shall comprise the following:

- 2x30 watts horizontal illuminance giving total lux at a horizontal level of 0.85m above the floor.
- 3x30 watts examination light to give 300 lux on the longitudinal axis of the examination level at 0.85 above the floor.
- Duplex outlets = 4 Nos.
- Telecommunication outlet = 1 No. (as shown on drawings)
- Equipotential grounding outlet = 1 No.
-
- Check quantity sockets as per drawing

5. INSTALLATION

5.1. General

The mounting heights, depths and other dimensions of all the Miscellaneous Items are stated on the drawings or in general notes. In case of any discrepancy, the instructions of the Engineer shall be obtained before fixing the item.

5.2. Ceiling Fan

Fan hooks shall be installed in the RCC ceiling and to the reinforcement before pouring of concrete.

The installation of fans shall include fixing of blades, down rod, clamp, canopy, including testing and commissioning. The down rod shall be of required length having long threads and shall be provided with check nuts to secure it firmly with the clamp and with the body of the fan. A split pin shall be provided both at the fan body end and at the clamp for safety. Any scratches on the body of the fan or fan rod appearing during installation shall be cleaned and painted properly with the same quality paint as provided by the manufacturer.

Wiring between the ceiling rose and the fan terminals shall be carried out with at least three core 1.0 sq.mm PVC insulated PVC sheathed flexible cable.

5.3. Wall Bracket Fan

The wall bracket fans shall be installed on the wall and shall be firmly fixed by means of flat head galvanized screws.

Wiring between the ceiling rose and the fan terminals shall be with atleast three core 1.0 sq.mm PVC insulated PVC sheathed flexible cable.

5.4. Switch Disconnector / Load Break Switch/MCCB enclosed in Weatherproof Sheet Steel Enclosure Box

Triple pole 500 volts / Single pole 250 volts Switch Disconnectors / Load Break Switches/MCCB shall be installed inside 1.63 mm (16 SWG) thick sheet steel box with screws or some suitable arrangements as approved by Engineer. White faceplate for sheet steel box shall be fixed by means of flat head galvanized screws sunk in the plastic plate so as to finish flush with the wall surface.

5.5. Hot dipped galvanized M.S. Cable Trays / Trunking / Ladders with protective paint system

The cable trays / trunking shall be installed on supports fixed to the wall and/or ceilings/trusses. The supports shall be fixed to civil works by means of Rawl bolts. The additional hangers and other metalwork required for the installation of the trays / trunking shall be galvanized and finished by method as specified for the cable tray / trunking.

The distance between alternate supports (span) in straight runs shall be finalized as per loading and in no case shall exceed 2 metres. In addition to these, supports shall be provided near each bend or change in direction, end of trunking/ tray.

The straight jointing, bends and other accessories shall be fixed with cable tray/ trunking in such a manner that they are in one line with no sharp edges/ protruded surfaces. Rivet head nuts shall be installed on inner side of tray/ trunking.

On straight lengths over 65'-8" (20 meter) and at every building expansion joint suitable flexible expansion couplers shall be provided.

At each joint, bend earth continuity shall be ensured by using copper earth braid and copper lugs in electro-tinned finish.

5.6. Under Floor Metal Trunking

The structural floor slab shall be level and smooth. Humps and protruding cement must be hacked to level to ensure the trunking being laid will maintain the minimum screed thickness of 38mm over the trunking. It is also recommended that a mesh such as chicken wire mesh be placed over the trunking runs to prevent screed damage or cracking at a later stage.

In general, following steps shall be followed regarding installation of underfloor metal trunking system in correlation with the underfloor service boxes, unless recommended otherwise by the manufacturer:

- Use trunking layout drawing to select a fixed starting point for installation, for instance a junction box. Tie two guide lines approximately 150mm above the floor slab at 90 degrees to each other. Position the junction box below the intersection of the guide lines.
- Position the floor boxes and trunkings to reflect the layout drawing. The junction box's position can be used as a reference point. Bend 90 degree up the perforated section of the box's side plate. Insert the trunking approximately 40mm into the box.
- Use connecting and clamping saddles to secure all screw connections and to fasten the trunkings to the slab. Use base plate holes provided to fasten floor box to the slab.
- The box should be properly covered with a disposable lid and taped to prevent the ingress of cement during screeding. The disposable lid top can be set as a screed depth datum. The system is now ready for screeding to

take place.

- Once the screed is completely dried, the disposable lid can be removed, and the box interiors can be fitted. Use the levelling system to adjust the box height to reach the level of the required screed depth (box is factory set to 56mm or 69mm). Once the wiring is completed, the trap and frame can then be installed. Should extra wiring space/ plug top clearance be required, use levelling system to top up the space.

5.7. Manholes/ Handholes with CI /DI Cover & Frame

The manholes/handholes shall be constructed according to the Specifications of the civil works and standard practice. Proper curing of the concrete shall be done for at least 15 days. Before constructing, the Contractor shall submit shop drawing of manhole/hand hole showing steel reinforcement, embedded pipes, clearances, etc. for approval of the Engineer. Quality of cement used in the manhole shall be sulphate resistant.

5.8. Change over Switch

The Changeover switch shall be installed inside 1.63 mm (16 SWG) thick sheet steel box recessed in wall/column with screws or some suitable arrangements as approved by Engineer. White faceplate for sheet steel box shall be fixed by means of flat head galvanized screws sunk in the plastic plate so as to finish flush with the wall surface.

5.9. Isolated Power System

5.10. Isolated Power System

Install complete isolated power system to meet all the requirements of IEC 60364-7-710, EN 602208 and EN 61439.

The isolated power panel shall be installed at the locations shown in the drawing and as per manufacturer's instructions.

The isolated power system shall not be installed in anaesthetizing (hazardous classified) location provided it is installed above hazardous or in a non-hazardous location. In case the system is to be located in a hazardous classified location it shall be installed in accordance with IEC 60079.

The contractor shall furnish and install isolated distribution system panels for designated rooms as indicated on the drawings. Location of panels is indicated on the drawings and cannot be changed without written permission from the consulting electrical Engineer and architect.

The panel(s) shall be factory wired and tested and include a shielded low leakage isolation transformer, primary and secondary circuit breakers, and LIM.

The contractor shall include the cost of, and make all arrangements for testing all underground isolated systems in the hospital by a qualified technician provided by the manufacture of the isolation systems or his authorized agent. The testing shall include a complete inspection of all connections and materials used. The contractor shall be prepared to demonstrate to the qualified technician that proper polarity was observed, and installation practices were in accordance with the drawings and specifications for these systems. Testing shall be carried out in the presence of the Engineer.

The qualified technician shall check and record system current leakages. The factory technician shall further simulate faults on the isolated system of a magnitude high enough to bring the total system leakage, which the LIM detects,

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above the calibrated point, thus verifying correct operation of the LIM. The faults simulated shall be combinations of resistive and capacitive faults.

The tests specified below under items a) to e) in addition to the requirements of chapters 71 and 72 of BS 7671: Part 7 (Inspection and Testing) shall be carried out, both prior to commissioning and after alterations or repairs and before re-commissioning.

a. Functional test of insulation monitoring devices of medical IT (IPS) systems and acoustical/visual alarm systems.

b. Measurements to verify that the supplementary equipotential bonding is in accordance with 2.13.1 and 2.13.2 (IEC 60634-7-710).

c. Verification of the integrity of the facilities required with 2.13.3 (IEC 60634-7-710) for equipotential bonding

d. Verification of the integrity of the requirements of 2.20.1 to 2.21.3.1 (IEC 60634-7-710) for safety services.

e. Measurements of leakage current of the output circuit and of the enclosure of medical IT transformers in no-load condition.

The technician shall also test the system impedance of the entire isolated power system to ensure compliance with the applicable sections of IEC 60364-7-710. The measured system impedance shall become part of the permanent logged records of each panel.

After all tests are complete, a letter shall be given to the hospital and the Engineer. The letter shall state that the system conforms to all codes, good installation practices, and the specifications.

Upon completion of all tests, the qualified technician shall meet with hospital medical and maintenance staff to thoroughly explain the operation of the equipment installed, and the need and procedure for periodically testing and logging test results. The technician shall furnish log books to the maintenance department, enter the first readings of all panels in these log books, and clearly instruct the hospital maintenance staff how to enter future readings.

All questions from the hospital staff shall be answered completely and thoroughly at this time. The Engineer shall be notified of the dates and times of all tests so the consulting engineer may witness any of the tests or meetings conducted by the factory technician

5.11. Bed Head Units

The luminaire and panel shall be wall mounted type. It shall be directly mounted to Medical trunking rail at a height of 1700 mm from furnished floor level. The locations of luminaries shall be installed as shown on the drawing and as per manufacturer's instructions

6. MEASUREMENT AND PAYMENT

6.1. General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein, as shown on the Tender Drawings and given in the Bill of Quantities related to the item.

6.2. Ceiling Fan / Wall Bracket Fan

6.2.1 Measurement

Measurement shall be made for each type of fan including standard size rods and all accessories acceptably supplied and installed by the Contractor as complete unit.

6.2.2 Payment:

Payment shall be made for the number of units measured as provided above at the contract unit price each and constitute full compensation for supplying, installing, connecting, testing and completion of each type of fan including all accessories such as connecting cables & connectors, suspension rods and pendent arrangement, clamp, canopy, dimmer, GI pipe, ceiling supports, internal wiring, wiring between ceiling rose and fan terminals, mounting disc, nuts, bolts, screws, etc., as required and complete in all respects.

6.3. Switch Disconnector / Load Break Switch/ MCCB enclosed in Weatherproof Sheet Steel Enclosure Box

6.3.1 Measurement:

Measurement shall be made for the number of each item acceptably supplied and installed by the Contractor as a complete unit.

6.3.2 Payment:

Payment shall be made for the number of units measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each item including sheet steel weatherproof enclosure box, plate and accessories as required.

6.4. Hot dipped galvanized M.S. Cable Trays / Trunking / Ladders with protective paint system

6.4.1 Measurement:

Measurement shall be made for the total running meters of each size of M.S. cable tray/cable trunking with all accessories acceptably supplied and installed by the contractor.

6.4.2 Payment:

Payment shall be made for the total running meters as provided above at the contract unit price and shall constitute full compensation for supplying, installing, and completion of each size of M.S cable tray/cable trunking for cables complete with all installation material and accessories such as covers, mounting brackets, bend, elbow, nuts and bolts etc.

6.5. Under Floor Metal Trunking

6.5.1 Measurement:

Measurement shall be made for the total running meters of each size of underfloor pre-galvanized sheet steel metal trunking with all accessories acceptably supplied and installed by the contractor.

6.5.2 Payment:

Payment shall be made for the total running meters as provided above at the contract unit price and shall constitute full compensation for supplying, installing, and completion of each size of underfloor pre-galvanized sheet steel metal trunking trunking for wiring / cables complete with all installation material and accessories such as floor pedestal boxes, round grommets, extension screw terminals, offsets, clamping saddle, connecting saddle, GI nuts, bolts washer etc.

6.6. Manholes/Handholes with CI Cover & Frame

6.6.1 Measurement:

Measurement shall be made for the number of manholes/handhole with CI cover & frame acceptably constructed and installed in position as shown on the Drawings or as directed by the Engineer.

6.6.2 Payment:

Payment shall be made for the number of manholes/handhole with CI cover & frame as measured above at the contract unit price and shall constitute full compensation for the CI cover, frame, excavation/back filling, disposal of surplus material, reinforcement, concreting, curing, embedded parts and all associated civil works, etc.

6.7. Changeover Switch

6.7.1 Measurement:

Measurement above stated item shall be made for the total number of each item complete with sheet steel back boxes/ polycarbonate enclosure and all accessories acceptably supplied and installed by the Contractor as a complete unit.

6.7.2 Payment:

Payment shall be made for the total number of units measured, as provided above, at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing and completion of each item stated above including screws, screw caps, sheet steel box, polycarbonate enclosure, nuts, bolts and other accessories as required.

6.8. Isolated Power System

6.7.1. Measurement:

Measurement shall be made for the total no. of complete system including isolating transformer line, isolation monitor remote indicator, annunciate panel its wiring conducting etc. acceptably supplied and installed by the Contractor as per Specification given in Section 8290-4.9.

6.7.2. Payment:

Payment shall be made for the total number of complete system as provided above at the Contract unit price each system and shall constitute full compensation for supplying, installation, testing and commissioning and completion of the Isolated Power System including all accessories such as nuts, bolts, s[illegible], thimbles, etc.

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6.8. Bed Head Units

6.8.1. Measurement:

Measurement shall be made for each Bed Head unit acceptably supplied and installed by the Contractor as a complete unit.

6.8.2. Payment:

Payment shall be made for the number of Bed Head unit as provided above at the Contract unit price and shall constitute full compensation for designing, supplying, installing of Bed Head units including mounting arrangements, supports, nuts, bolts, etc. to complete in all respects.

*** End of Section 8290 ***

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SECTION – 8002

GENERAL TECHNICAL REQUIREMENTS FOR COMMUNICATION WORKS

1.0 GENERAL REQUIREMENTS

This section states the general technical conditions and requirements applicable to the design, manufacture, supply, installation, testing, commissioning and training of equipment and material related to the communication systems including all associated displays and other Human Machine Interface (HMI), and communications network included in this Contract. These conditions shall be read in conjunction with the General Conditions, Special Conditions, Technical Specifications, Schedule of Prices/BoQ, Drawings, etc. and other relevant provision of the Contract.

The General Technical Requirements with accessories shall also comply with the General specifications for Electrical Works, Section – 8001, and with other relevant provisions of the Contract Documents.

1.1. Scope of Work

The Contractor shall supply and execute the installation of the Communication Systems equipment in such a manner that all requirements of the technical specifications and drawings are fully met for proper and satisfactory operation of the systems as intended. The Contractor shall carryout all work in skilled and workmanlike manner in compliance with modern methods of engineering. The Communication Systems shall broadly include but not limited to the following.

- Structured Cabling Network (Section-8312)
- IP Private Automatic Branch Exchange (Section-8314)
- Intelligent Addressable Fire Alarm System (Section-8331)
- IP Closed Circuit Television (CCTV) System (Section-8335)
- Public Address System (Section-8341)
- CATV System (Section-8371)
- IP Nurse Call System (Section-8343)
- Access Control System (Section-8373)

The Contractor shall take the responsibilities of General Integrator for all the sub-systems and equipment within the Scope of Work, and ensure the integration of the whole system including interfaces with other systems.

The Contractor is free to offer any design of equipment which in his opinion will be equal to or better than the requirement in this specification without any additional cost and time. Whereas alternative offer is proposed, the Contractor shall furnish details of such alternatives to enable their merits to be assessed. Contractor shall submit to Engineer detailed calculations and layout drawings for approval.

1.2. Regulations and Standards

The systems, installations and works shall be manufactured and executed in accordance with technical specifications, following the state of the art and the best techniques in use.

Standards specifications and codes of the following listed authorities wherever cited herein are referred to by use of the abbreviations shown below.

All equipment shall be designed, manufactured and tested generally in accordance with the latest revision of the standards laid down by the following institutions or

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other approved institutions, except where specifically directed otherwise:

-	British Standards Institute	BS
-	National Fire Protection Association	NFPA
-	Deutch Industrie Norms	DIN
-	International Electro-technical Commission, Switzerland	IEC
-	Institute of Electrical and Electronics Engineers Inc. USA	IEEE
-	National Electrical Manufacturers Association – USA	NEMA
-	National Electrical Code - USA	NEC
-	International Standardization Organization	ISO
-	Euro-Norm	EN

Wherever applicable, the equipment shall also conform to the requirement of Pakistan Standards Institution (PSI).

1.3. Execution of the Works

1.3.1. Contractor's Responsibility

The Contractor shall bear full and total system-wide responsibility for all systems and products selected, designed, furnished, and installed under this Contract.

The design shall take into account all site and environmental factors.

The reconfiguration, reprogramming and integration for existing communication systems along with co-ordination with ISP Service Provider / Client's telecom team for incoming cables connections inside JPMC Medical Tower is the sole responsibility of the Contractor, and it is expressly agreed by Contractor that anything which is usually furnished as part of such reconfiguration and reprogramming as is called for in this Contract and which is necessary for its proper completion shall be furnished as part of this Specification without additional costs and extensions of time whether or not shown in detail on the drawings, described in detail in the Specifications and BOQ.

1.3.2 Installation Requirements

The works shall be performed by workmen skilled in the particular trades involve and shall include all works necessary to complete the installation in a professional manner so as to present a neat and finished appearance.

The Contractor shall supply all accessories and other items essential for the proper performance and completion of the works.

2.0 GENERAL SPECIFICATIONS FOR EQUIPMENT

2.1 Use of Proven Technology

For all Original Equipment Manufacturer (OEM) equipment, the Contractor shall clearly identify the brand of the equipment, the country where the equipment has been manufactured, as well as the local agent in Pakistan who is able to provide local maintenance assistance.

Local agent's reference shall include at least (but not limited to)

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- Company name,
- Address in Pakistan,
- Contact persons,
- Phone numbers,
- Valid Email,
- Reference of the company in similar fields.
- Authorized Distribution Certificate from OEM
- Certified Engineer's Certificate

Equipment manufactured in Israel and India is not acceptable. The bidder shall clearly mention in his bid the origin of the equipment that he is proposing.

2.2 Quality Assurance

All materials and equipment shall be new and of best quality. Standard components of suppliers regularly engaged in their manufacture shall be offered. All systems and components shall have been thoroughly tested and proven in actual use.

Manufacturers quality control shall be in accordance with the ISO 9000 - series (or DIN equivalent) recommendations. Manufacturers whose quality control has been certified according to ISO 9000 – series will only be acceptable. Certified copy shall be attached to bid. Hardware and software design, quality assurance in the production process, as well as documentation shall be in line with ISO 9000-series.

2.3 Standard Products

Materials furnished under this specifications shall be standard product of manufacturers regularly engaged in the production of such equipment and shall be the manufacturers latest standard design and latest available model. Contractor shall submit end of line (EOL) / end of sales (EOS) of each proposed product with its material submittal for engineer's review and approval. Outdated products and products near to end of line (EOL) / end of sales (EOS) shall not be considered.

2.4 Equipment List

The Contractor shall submit to the Engineer for approval a complete list of materials and equipment to be incorporated in the work. This list shall include at least the manufacturers name, catalogue numbers, dimensions, and other descriptive data as may be required. No consideration will be given to partial lists submitted from time to time.

Approval of material will be based on manufacturer's published data submitted with the list approval of the materials and equipment will be tentative subject to submission of complete shop drawings indicating compliance with the Contract documents.

2.5 Shop Drawings

The Contractor shall prepare the detailed shop, coordination, sectional and installation drawings, as well as manufacturer's recommended calculations and obtain approval of the Engineer prior to execution.

3.0 DESIGN REQUIREMENTS

3.1 Ambient Conditions

Refer General Specification, Section 8001 for ambient conditions.

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3.2 **Computer, Server, Equipment, Hardware & Software**

Wherever computers, servers, equipment, hardware & software are utilized in any system covered in this tender, the Contractor shall ensure compliance to the following general requirements:

- All computers & servers shall be with CPU, LED monitor display, keyboard and mouse etc.
- The housing for the computers & servers shall be provided and shall be deemed to be included in the relevant system Bill of Quantities (BOQ) item. No separate payment shall be made for the computer & server housing. The Contractor shall ensure adequate cooling of the computer& server components and if required, forced cooling with thermostatic control shall be included.
- All the computer systems & servers shall be supplied with licensed software which shall include latest version of Operating System and Application Software.
- The workstations shall be supplied with licensed software which shall include latest version of MS Windows™, Operating System and Application Software.
- Back-up software shall be supplied on separate portable hard device.
- Computers & servers shall be of the latest specifications available at the time of procurement / construction and shall minimally comply with the following:
- Industrial type, desktop/rack mounted computers/servers shall be of the latest specifications and shall meet the requirements of specified systems.
- All computers & servers shall be provided with individual intelligent UPS with integrated sealed battery, in case a centralized UPS is not available at a particular/remote location.
- All essential interconnecting cabling and protection shall be provided.

3.3 **Unit of Measurement**

The units to be followed for indication of dimensions in drawings for any kind of measurements shall be in accordance with the metric system.

3.4 **Guarantees, Tolerances, Rejection**

The Contractor shall furnish a Certificate of Compliance for each equipment jointly signed by the Contractor and the manufacturer of the equipment that the equipment conforms to the standards and all other requirements laid down in Contract Specifications and that both the Contractor and the manufacturer assume joint responsibility in respect of performance of the equipment.

During and/or after the installation of equipment, manufacturers representative for each equipment shall visit the site and shall verify that the equipment has been installed as per manufacturer's instructions and the Certificate of Compliance, jointly signed by the Contractor and the manufacturer shall also cover any amendments / modifications made in the installation by the Contractor with due approval of the manufacturer.

All costs in this connection shall be borne by the Contractor.

All equipment and material shall be so designed that the tolerances according to the relevant IEC and other applicable standards and regulations as well as the special requirements for the overall equipment are adhered to, and must demonstrate

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compliance both at the manufacturer's works and at site. Should the equipment/material fail to meet the guarantees after due account has been taken of the specified tolerances, the equipment/material will be made available to the Contractor so as to allow the Contractor to carry out rectification on the equipment / material by modifying or replacing defective or wrongly designed parts or equipment/material as a whole.

If the guaranteed values are not achieved even after remedial work has been carried out, the Employer and / or Engineer may reject the equipment(s) as a whole or that part of the system which is causing the non-fulfillment of the guarantee or the completion of system.

If an item of equipment/material has to be rejected because of major deficiencies which are not remediable, then such equipment / material or item shall remain available to the Employer free of charge until such time as a replacement is ready for installation. All costs for such rectification shall be the responsibility of Contractor. Any work which does not impair serviceability and integrity of equipment / material as a whole shall not be deemed as violating the guarantee obligation of Contractor, provided that the Contractor remedies that within 4 weeks.

The Contractor shall guarantee to complete all work called for, so that equipment and material supplied by him are ready for connection and operation within the given period.

The decision regarding the acceptability or otherwise of the equipment and material offered shall be made by the Employer / Engineer whose decision shall be final.

3.5 Language

The language for general correspondence, technical information and data, instruction manuals, literature, pamphlets, drawings, standards and test data shall be exclusively in English. All markings on equipment, dials, name plates and other items shall also be legible in English and also in Urdu where specified. Shipping marks, addresses and instruction on individual packages shall also be printed in capital letters in English only.

The Contractor shall be responsible for replacing at his own cost any item lost or misplaced due to inadequate labeling or marking in any language other than English.

3.6 Name Plate

All equipment shall be provided with stainless steel name plates which shall be mounted in a visible position. The entries on the name plate shall be indelibly marked in English by engraving and shall include the data in accordance with relevant IEC and other relevant standard applicable to each equipment. In addition, any specified requirement stated in these specifications shall also be complied.

The Contractor shall also supply all labels, instruction and warning plates necessary for the identification and safe operation of the plant and all instructions shall be in English and where specified in Urdu languages. All labels, nameplates, instructions and warning plates shall be securely fixed to items of plant and equipment with stainless steel rivets, plated self-tapping screws or by other approved means. The use of adhesives will not be permitted.

3.7 Equipment Designation

All equipment, cables and wires shall be numbered in accordance with the standardization procedures laid down in IEC 750. The system shown on the drawings is intended only as a guideline and bidders shall be solely responsible to

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ensure that proper coordination with other sections and disciplines takes place.

3.8 **Statement of Compliance**

Bidders shall confirm para wise in writing their compliance with the items of these specifications in the form of a qualified Statement of Compliance at the time of material submittal stage. No consideration will be given to the bid without this important document.

3.9 **Bid Drawings and Data**

The Bidder shall supply with his bid, three sets of the following information, along with the information specified for each equipment in these specifications. Bids with incomplete information are liable to be rejected.

a. Fully dimensioned and detailed drawings of the communication systems equipment complete with all information necessary for the evaluation of design by the Engineer. These drawings shall be based on the technical requirements and shall specifically include, but not be limited to the following:

   i. General Arrangement plan, elevations and sections, complete with all dimensions.

   ii. Reference and descriptive literature pertaining to above drawings and equipment furnished.

b. All schematic drawings, technical data, literature and information to facilitate proper evaluation of the equipment and material.

c. Lists of supplies made by Contractor and manufacturer of equipment similar to the equipment to be furnished under this Contract. The lists shall indicate models, type, quantities, and years of supply and names of the purchasers.

3.10 **Drawings and Technical Data after Award of Work**

a) The Contractor shall submit four copies of detailed shop drawings, coordination drawings, technical data, calculations and schedules to the Engineer for review and obtain approval at least 15 working days prior to execution of work. In general, these detailed shall include, but not be limited to the following:

- Riser / Line / Schematic / Single Diagrams
- General Wiring and Cabling Routing Diagrams
- Rack Wiring and Equipment Diagrams
- Conduit and Cable Schedule and Diagrams
- Grounding Layout and Details
- Foundation and Trench Arrangement Drawings
- Plans, Elevations and Sections.
- Manufacturer's Catalogues
- Video storage calculation of manufacturer's software for cameras
- Sound pressure level (SPL) calculations of all proposed speakers
- Heat Map Coverage pattern for all proposed Wireless Access Point
- Testing and commissioning protocols / procedures

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b) The purpose of having drawings and other data checked and approved by the Engineer is to assist the Contractor in interpreting the technical specifications so as to eliminate mistakes in the equipment or material actually installed for the work.

3.11 Test plans

The Contractor shall provide test plans that define all the tests required to ensure that the systems meet the technical, operational and performance specifications. The test plans shall identify the capabilities and functions to be tested, including the values and situations that will comprise the test. The Contractor shall submit for Engineer's approval complete details of tests / test plans (testing and commissioning protocols / procedures) at least one week prior to testing. These shall also include details of testing method, testing equipment, diagrams, etc.

The contractor shall develop test procedures from the test plan and design documents. The procedure shall consist of detailed instructions for test set up, execution, and evaluation of test results. The test report shall document the results of the tests.

The Contractor shall furnish all labour, materials, tools and equipment required to install, connect, test and commission all communication equipment specified herein, whether or not such equipment is furnished by him or by others. No separate payment shall be made for any tools and cost shall be deemed to be included in the cost of the Contract.

For all equipment to be installed by the Contractor, the Contractor shall supply and install all erection materials such as foundation bolts, washers, nuts, etc. as required and without any additional costs.

The Contractor shall set out the works himself as per Specifications and Drawings and shall properly position the equipment on specified foundation/location. In general, the manufacturer's instructions for installation shall be followed. Any defect or faulty operation of equipment due to the Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost.

3.12 Operational and Maintenance Manuals

The Contractor shall provide copies of the manuals bound in hardback, loose leaf binders to Engineer. Provide a draft copy with the Performance Verification Test Procedure for use during site tests and update with any changes required prior to final acceptance.

The Contractor shall identify each manual's contents on the cover. The manuals shall include the names, addresses, and telephone numbers of each sub-contractor installing equipment and systems, and of the nearest service representative for each item of equipment and each system. The manuals shall have a table of contents and tab sheets. The contractor shall update all manuals to include modifications made during installations check out, and acceptance. Manuals provided shall include:

- Functional Design Manual Hardware Manual
- Operator's Manual
- Software Manual
- Maintenance Manual

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a) Functional Design Manuals: The Functional Design Manuals shall identify the operational requirements for the system and explain the theory of operation, and specific functions.

Hardware and software functions, interfaces and requirements shall be provided for all system operating models.

b) Hardware Manuals: The Hardware Manuals shall describe all equipment provided, including:

- general description and specifications
- installation and check-out procedures
- electrical schematics and layout drawings
- alignment and calibration procedures
- manufacturers repairs parts list indicating source of supply
- interface definition
- signal identification and timing diagrams

c) Software Manual: The Software Manual shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module. The manual shall be oriented to programmers and shall describe all information necessary to enable proper integration, loading, testing and program execution.

d) Operator's Manual: The Operator's Manual shall provide all procedures and instructions for operation of the system, including:

- use of the systems, command and application details
- alarm presentation
- alarm dictionary
- recovery and re-start procedures
- command directory
- preventive maintenance schedule
- operator's consoles

e) Maintenance Manual: The Maintenance Manual shall provide description of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective equipment.

4.0 SPECIAL TOOLS AND EQUIPMENT

Special tools and equipment for the maintenance, inspection and repair of the individual equipment shall be supplied by the Contractor in sufficient quantity to equip the maintenance personnel for routine work. No separate payment shall be made for any special tools and cost shall be deemed to be included in the cost of the Contract.

5.0 INSTALLATION

The Contractor shall install all system components and appurtenance in accordance with manufacturer's recommendation and provide all necessary interconnections, services and adjustments required for a complete operable system.

All electrical work shall be in accordance with VDE regulations and as specified.

The Contractor shall provide instrumentation and communication grounding as necessary. All equipment installed outdoors shall be housed in an minimum IP65

enclosure, unless otherwise shown. All penetrations shall be sealed to preclude the entry of water using a silicone material. Enclosure installed in clean dry indoor environment shall be IP42.

6.0 WARRENTY OF GOODS

The Contractor shall provide one (1) year warranty after issuance of Defects Liability Certificate from his proposed Original Equipment Manufacturer (OEM) for any of the equipment furnished in this Contract.

7.0 AFTER – SALE SERVICE

After the expiry of the warranty period, the Contractor shall be able to provide maintenance support and any spare part at least during the 10 years following the substantial acceptance of the related equipment/system.

8.0 SITE TESTING

The Contractor shall provide field testing of the Communication Systems and on-site operational acceptance test of the complete operational systems in the presence of the Engineer and Employer.

9.0 MAINTENANCE AND SERVICES

The Contractor shall provide all services, materials, and equipment necessary for successful operations of the entire system during defect liability period. Provide necessary material required for the work. Minimize impacts on facility operations when performing scheduled adjustments and non-scheduled work. All equipment/system shall have the provision of tele maintenance / trouble shooting by the manufacturer of the equipment from their factory/service facility. The necessary modem shall be incorporated in the equipment supplied and it shall be totally free during Defects Liability Period.

10.0 MEASUREMENT AND PAYMENT

Unless specifically stated otherwise, the cost of all material, equipment, labour, services, etc. required to complete the work shall be considered to be included in the amounts stated against each item of the Schedule of Prices.

For items with specified quantities as given in the Schedule of prices, adjustment shall be made in the amount payable to the Contractor in accordance with the actual quantity of work acceptably completed by the Contractor. The payment shall be made at the unit rates stated in the Schedule of Prices. No such adjustments shall be made for items specified in 'Lot' and 'Job' units.

Unless specifically provided for in the Schedule of Prices and Quantities, no payment shall be made for the works stated in this section. Cost shall be deemed to be included in the cost of the Contract.

The rates quoted shall be inclusive of all works and services required for completion of each item as a complete job of work also including surveys, investigations, associated civil works, co-ordinations, etc.

The measurement and payment of items under Schedule of Prices shall be made as under:

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10.1 **Items with Unit of Measurement as Number (No.)**

a) Measurement: Measurement of acceptably completed works of these items will be made on the basis of actual number provided, installed in position, tested and commissioned.

b) Payment: Payment will be made for acceptable measured quantity of respective items on the basis of unit rate per number quoted in the Schedule of Prices. The unit rate shall include all cost of providing and installing associated accessories, installation materials, etc. and shall constitute full compensation for all the works related to these items.

10.2 **Items with Unit of Measurement as Lot / Job'**

a) Measurement: Measurement of acceptably completed works of items stated in the unit of Lot / Job, provided and wherever required installed in position, tested and commissioned.

b) Payment: Payment will be made for acceptable measured quantity of respective items on the basis of lump-sum price per Lot / Job quoted in the Schedule of Prices and shall constitute full compensation for all the works related to these items.

10.3 **Items with Unit of Measurement as "Running feet" (Rft.)**

a) Measurement: Measurement of acceptably complete works of this item will be made on the basis of actual length in feet as measured along the centre line of respective work acceptably provided, installed in position, tested and commissioned. No measurement shall be made of sag in overhead conductors and slack in underground cables.

b) Payment: Payment will be made for acceptable measured quantity of overhead conductor/cable on the basis of unit rate per feet length quoted in the Schedule of Prices. The unit rate shall include all cost of equipment, material and accessories and shall constitute full compensation for all the works related to the above items. No payment shall be made for sag in overhead conductors and slack in underground cables.

*** End of Section 8002 ***

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SECTION – 8312

STRUCTURED CABLING NETWORK

1.0 SCOPE OF WORK

The work under this section consists of supplying, installing, connecting, testing, commissioning and training of all material and services for Structured Cabling Network as specified herein, as shown on the Contract Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the Structured Cabling Network Layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the system.

The Structured Cabling Network work with accessories shall also comply with the General Specifications for Electrical Works Section - 8001, General Technical Requirements for Communication Works Section – 8002 and with other relevant provisions of the Contract Document.

2.0 GENERAL

To ensure optimum performance, passive equipment (cabling, patch panel, patch cord etc.) of the structured cabling network and CCTV system etc. shall be sourced from the one manufacturer. This shall eliminate potential problems such as electrical and mechanical mismatch between different manufacturers.

The characteristics of the cabling system shall support all application including Gigabit and 10 Gigabit Ethernet.

The system shall be of 'star' topology and shall consist of the following:

- Horizontal cable.
- Consolidation point cable (CP cable)
- Multi-user Telecommunications Outlet (MUTO);
- Telecommunication outlet (TO).

This will support analogue and digital applications, data, local area network, and video on a common platform.

3.0 APPLICABLE STANDARDS AND CODES

The following standards and all "normative addendums" shall be applicable to this document and must be adhered to for any installation work performed.

ISO/IEC 11801	Information technology – Generic cabling for customer premises.
ISO/IEC/TR3 8802-1	Information technology – Telecommunication and information exchange between systems – local and metropolitan area networks – Specific requirements – Part 1 overview of Local Area Network Standard.
ISO/IEC 8802-3	Information technology – Telecommunication and information exchange between systems – local and metropolitan area networks – Specific requirements – Part 3 Carrier sense multiple access with collision detection access method and physical layer specifications

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ISO/IEC 61935-1	Generic specification for the testing of generic cabling in accordance with ISO/IEC 11801 – Part 1: Installed cabling.
IEC 60364-1	Electrical installation of buildings – Part 1: Scope, object and fundamental principles.
IEC 60950	Safety of information technology equipment, including electrical business equipment.
EN50173	Information technology – Generic cabling for customer premises.
EN50174-1	Information technology – Cabling installation. Specification and quality assurance.
EN50174-2	Information technology – Cabling installation. Installation panning practices inside buildings.
ANSI/TIA/EIA-568	Commercial Building Telecommunications Cabling Standard.
ANSI/TIA/EIA-569	Commercial Building Standard for Telecommunications Pathways and Spaces.
TIA/EIA TSB-72	Centralized Optical Fibre Cabling Guidelines.
TIA/EIA TSB-75	Additional Horizontal Cabling Practices for Open Offices.

This list is not restrictive. The contractor shall have to take account of the new standards which could come into effect during the progress of design and installation.

4.0 MATERIALS

4.1 **Firewall**

Firewall shall have minimum specification as under:

- Hardware Accelerated 10 GE SFP+ Slots	:	2
- Hardware Accelerated GE SFP Slots	:	8
- Hardware Accelerated GE RJ45 Ports	:	8
- GE RJ45 Management	:	2
- USB Ports (Client / Server)	:	1/2
- Console Port	:	1
- Onboard Storage	:	120 GB
- Included Transceivers	:	2 SFP SX
- Firewall Latency (64 byte, UDP)	:	3 µs
- Throughput	:	30 Gbps
- Licenses	:	All included

4.2 **Wireless Controller**

Wireless Controller shall have minimum specification as under:

- 4 x 100/1000 Ports.
- 3.5-Gbps throughput
- 140 access points
- 2000 clients
- 4096 VLANs
- Management Interface Ports
- IEEE 802.11a/b/g, 802.11n, 802.11h, 802.11d.

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- IEEE 802.11ac.

4.3 **Wireless Access Point**

Wireless Access Point shall have minimum specification as under:

- 2 x 100/1000 Ports.
- 802.11ac Wave 2 support
- MU-MIMO 4x4, 3 spatial streams
- Flexible radio assignment
- Management Interface Ports
- IEEE 802.11a/b/g, 802.11n, 802.11h, 802.11d.
- IEEE 802.11ac.
- PoE.
- Capacity to connect users as shown on drawings.

4.4 **Layer-2 Managed Ethernet Switch (24 port)**

Layer-2 Ethernet Switch shall have minimum specification as under:

- The proposed switch should have 24 x 10/100/1000GE ports full POE+
- Should have 4 x 1G/10G fixed uplinks.
- Should support at least 90Mpps Forwarding rate.
- Should support at least 150Mpps Forwarding rate (with stacking).
- Minimum stacking bandwidth capacity 75Gbps.
- Should support switching capacity at least 120 Gbps.
- Should support at least 15000 MAC Addresses
- Fully redundant AC power supplies
- SVI's supported at least: 512.
- No. of VLAN IDs supported : 4096
- Advance network monitoring system.
- Should support Policy-based automation and assurance for wired and wireless.
- Should support following features:
    a. IEEE 802.3ad Link Aggregation Control Protocol (LACP).
    b. IEEE 802.1s: Multiple Spanning Tree Protocols (MSTP).
    c. IEEE 802.1w
    d. IEEE 802.1x.
    e. IEEE 802.3ad: Link Aggregation Control Protocol (LACP).
    f. IEEE 802.3at PoE+ (up to 30W per port).
    g. IEEE 802.3af.
    h. IEEE 802.1d: Spanning Tree Protocol.
    i. IEEE 802.1p: Cos prioritization.
    j. IEEE 802.1q.
    k. IEEE 802.1AB Link Layer Discovery Protocol (LLDP).
    l. Jumbo frames supported: 9198bytes.
    m. Port Security
    n. Routing protocols: OSPF, IS-IS, RIP.
    o. SNMP: v1, v2, v3
    p. Network Time Protocol (NTP)
- Role-based CLI management and access.

4.5 **Layer-2 Managed Ethernet Switch (48 port)**

Layer-2 Ethernet Switch shall have minimum specification as under:

- The proposed switch should have 48 x 10/100/1000GE ports full POE+
- Should have 4 x 1G/10G fixed uplinks.
- Should support at least 120Mpps Forwarding rate.

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- Should support at least 180Mpps Forwarding rate (with stacking).
- Minimum stacking bandwidth capacity 75Gbps.
- Should support switching capacity at least 170Gbps.
- Should support at least 15000 MAC Addresses
- Fully redundant AC power supplies
- SVI's supported at least: 512.
- No. of VLAN IDs supported : 4096
- Advance network monitoring system.
- Should support Policy-based automation and assurance for wired and wireless
- Should support following features:
    a. IEEE 802.3ad Link Aggregation Control Protocol (LACP).
    b. IEEE 802.1s: Multiple Spanning Tree Protocols (MSTP).
    c. IEEE 802.1w
    d. IEEE 802.1x.
    e. IEEE 802.3ad: Link Aggregation Control Protocol (LACP).
    f. IEEE 802.3at PoE+
    g. IEEE 802.3af.
    h. IEEE 802.1d: Spanning Tree Protocol.
    i. IEEE 802.1p: Cos prioritization.
    j. IEEE 802.1q.
    k. IEEE 802.1AB Link Layer Discovery Protocol (LLDP).
    l. Jumbo frames supported: 9198bytes.
    m. Port Security
    n. Routing protocols : OSPF, IS-IS , RIP.
    o. SNMP: v1, v2, v3
    p. Network Time Protocol (NTP)
    - Role-based CLI management and access.

4.6 **Layer-3 Managed Fiber Distribution Switch (8 port)**

Layer-3 Fiber Switch shall have minimum specification as under:

- The proposed switch should have 6 x 1G SFP ports.
- 2 x 1G/10G uplink ports
- Dual Power Supply
- Fans less
- Minimum switching capacity of 60 Gbps
- No. of VLAN IDs supported : 4000
- Operating temperature range must be between -40° C to 74° C
- Should support Policy-based automation and assurance for wired and wireless
- Should support following features:
    a. IEEE 802.3ad
    b. IEEE 802.1s:
    c. IEEE 802.1w
    d. IEEE 802.1x.
    e. IEEE 802.3af.
    f. IEEE 802.1d: Spanning Tree Protocol.
    g. IEEE 802.1p: Cos prioritization.
    h. IEEE 802.1q.
    i. IEEE 802.1AB Link Layer Discovery Protocol (LLDP).
    j. Jumbo frames supported: 9216bytes.
    k. RMON standard.
    l. Port Security
    m. Routing protocols: Static Routing & RIP, OSPF, IS-IS, BGP, VRRP
    n. SNMP: v1, v2c, v3
    o. Network Time Protocol (NTP)
    p. flow based filtering in hardware (Layer 1 to Layer 4)

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q. DHCP IP and Address Resolution Protocol (ARP) spoof protection
r. Internet Group Management Protocol (IGMP) v1/v2/v3 snooping
s. Protocol Independent Multicast– Sparse-Mode (PIM-SM), Source Specific Multicast (PIM-SSM)
t. Protocol Independent Multicast–Dense-Mode (PIM-DM), Bidirectional Protocol

- Intuitive CLI in a scriptable Python & BASH environment via console, Telnet or Secure Shell (SSH) v2 over IPv4/IPv6
- Network Automation and Programmability Abstraction Layer with Multivendor (NAPALM) support
- Congestion avoidance: Support for end to-end head-of-line (E2E-HOL) blocking prevention, IEEE 802.1Qbb Priority based Flow Control (PFC) and IEEE 802.3x Flow Control (FC)
- Priority queues: Eight hardware-based queues per port for flexible QoS
- Policy-based routing and server load balancing
- User Network Profile (UNP) simplifies NAC by dynamically providing pre-defined policy configuration to authenticated clients — VLAN, ACL, BW

4.7 Layer-3 Managed Fiber Distribution Switch (48 port)

Layer-3 Ethernet Switch shall have minimum specification as under:

- The proposed switch should have 48x1/10/25G SFP/SFP+ ports.
- Should have modular uplinks 1/40G SFP.
- Should support up to 1Bpps forwarding rate
- Should support switching capacity at least 3Tbps.
- Should support at least 80,000 MAC Addresses
- Should support 1+1 dual power supplies
- SVI's supported at least: 1000.
- No. of VLAN IDs supported : 4096
- Should support Policy-based automation and assurance for wired and wireless
- Should support following features:
  a. IEEE 802.3ad
  b. IEEE 802.1s:
  c. IEEE 802.1w
  d. IEEE 802.1x.
  e. IEEE 802.3ae for 10G SKU, IEEE 802.3ba on the 40G SKU.
  f. IEEE 802.3af.
  g. IEEE 802.1d: Spanning Tree Protocol.
  h. IEEE 802.1p: Cos prioritization.
  i. IEEE 802.1q.
  j. IEEE 802.1AB Link Layer Discovery Protocol (LLDP).
  k. Jumbo frames supported: 9216bytes.
  l. RMON I and II standards.
  m. Port Security
  n. Routing protocols: OSPFv3, IS-ISv4, RIP v1/v2, BGPv4.
  o. SNMP: v1, v2c, v3
  p. Multiprotocol label switching(MPLS)
  q. Network Time Protocol (NTP)
  r. ACL ingress: 1000
  s. ACL egress: 1000
- Role-based CLI management and access.

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4.8 Network Monitoring System

Contractor is to furnish OEM's proposed recommended network monitoring system including latest generation server with required nos. of LED Screens compatible with the proposed overall IT system including power supply, all essential interconnecting hardware, software, cabling, required licenses, network cards, modules etc. with all installation and mounting accessories. Complete in all respect for satisfactory operation of the entire NMS.

4.9 Network Administrator Workstation

Network Administrator Workstation having latest generation Computer version comprising 21" LCD screen, CPU with license operating system, licensed Client's end software, anti-virus software, wireless keyboard, wireless mouse with all essential interconnecting cables including all installation and mounting accessories as required for system operation. Complete in all respect.

4.10 Copper Connectors

The copper jacks must comply with EN 60603-7 and EN 28877 and be of the insulation displacement type. They are must be capable of terminating 0.50 to 0.65 solid and 7 x 0,15 to 0,20 mm stranded wires.

The jacks have the following features:

- Tool less assembly
- Capable of being wired to both 568B and 568A
- Flexible cable entry
- UTP version as appropriate
- Category 6A
- Integral shutter

The jacks have the following performance:

- Lead-through resistance 17 mΩ <Resistance <20 mΩ
- Insulation resistance > 10 mΩ
- Maximum diameter of the wire sheath 1,60mm
- Cat 6A (at 500 MHz)
    - Attenuation < 11.2dB
    - Return loss >= 12.6dB
    - NEXT >= 32.3dB

4.11 Fiber Connectors

The fiber connectors must comply with IEC 61754

The fiber socket must have the following features:

- Small form factor connector
- Duplex
- High density
- Field terminated in under two minutes
- Integral shutter for dust protection and optical safety
- Plastic body parts

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4.12 Telecommunication Wall Outlets

Wall outlets must be available with RJ45 sockets. The wall outlets should be fully shuttered. The copper outlets must be capable of being flush mounted. Wall outlets must have space for visibly labelling each jack or socket.

4.13 Patch Panels

19" panels must be available to take a minimum of 24 copper loaded RJ45 jacks or 12 & 24 duplex fiber connections per 1U. Other connection densities must be available.

Copper : 16 & 24 per panel
Fiber : 12, 24 & 48 per panel

The panels will be designed for keystone fitting of the jacks / sockets.

The copper panels will have cable management and tie down points (where required) for copper cable.

The fiber panels will have cable management, fiber management and slack storage for fiber cables and ensure that the minimum bend radius is not exceeded.

Fiber panels must be able to manage a range of cable sizes from 2 fiber cables to 96 fiber cables. They must be sliding or front loading to ensure easy access to the fiber.

For fiber wall mounted options for 6, 12 and 24 fibers must be available for SOHO or backbone installation.

Panels must have the facility to label each socket/jack.

Colored identifiers should be available in at least 4 colours to allow visible identification of jacks / sockets.

Blanking plugs for unused ports must be available to suit the patch panel colour.

4.14 Patch cord Management

1U Patch cord management panels should have a minimum of 5 rings to accommodate up to 72 patch cords.

4.15 Patch Cables

RJ-45 copper patch cords shall be Category 6A. The copper patch cords must be made from stranded wires for full flexibility. They must comply with ISO 11801. The patch cords must be available in a range of lengths to facilitate easy patch cord management.

The fiber patch cords must be made from duplex ruggedised cable. The fiber core and cladding sizes must be of the same nominal value as the cable to ensure lowest channel loss. The plugs on the ends must be appropriate for those on the permanent link and on the active equipment. The patch cords must be available in a range of lengths to facilitate easy patch cord management.

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4.16 **Copper Cable**

Copper cable will be 100 Ohm impedance. The cable will be Category 6A to match the system specification. The cables will be available in 4 pair or 2 x 4 pair.

The cable shall have the following performance:

- Conductor diameter : 24 AWG
- Conductor resistance at 20o C (max.) : < 98.6 Ω/km
- Dielectric strength at 50 Hz : 1 kV / 1 min
- Insulation resistance (min.) : > 5000 mΩ / km
- Characteristic impedance : 100 +/15% from 1 to 100 MHz
- Sheath material : LSZH

4.17 **Optical Fiber Cable**

50um/125um Multimode mode (OM3/OM4) LSZH fiber optic cable shall be provided for indoor use.

The multimode cable must operate at both 850 nm and 1300 nm and single mode cable must operate at both 1310 nm and 1550 nm with the following minimum performance. The fiber must be suitable for operation according to IEEE 802.3z (Gigabit Ethernet) on distances exceeding 500 m at 1300 nm.

Optical performance of the Cable:

- Single mode cable (1310 / 1550nm) : ≤ 0,4 / 0,4 dB / km
- 50 / 125µm cable (850/1300nm) : ≤ 2,7 / 0,8 dB / km

Cable must be available for indoor use and indoor / outdoor use for campus backbones.

Rodent resistant cable and armoured must be available for use where ever required.

Mechanical Performance:

- Cable minimum bend radius

- Indoor cable:

  20 times cable diameter, during installation and 10 times cable diameter, after installation.

- Indoor / outdoor:

  25 times cable diameter, during installation and 20 times cable diameter, after installation.

  - Minimum bend radius in the TO : 20mm
  - Operating temperature range: 10 to +60o C
  - Rated LSZH

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4.18 **19" Cabinet**

Cabinet shall be 19 inch, with tie and retainers for cabling system and 600mm x 600mm, 600mm x 800mm and 800mm x 1000mm cabinet shall be suitable to install:

- Color of rack: Black / as required by architect.
- Plexiglass door.
- Frame thickness 2mm, mounting rail thickness 2mm, roof thickness 1.63mm, rear door thickness 1.63mm and side panels thickness 1.2mm.
- At least two cooling fan.
- Cable entries from both top and bottom panel.
- Cabling guide system in each internal side of cabinet for front and back side.
- Earthing / grounding point.
- Door lock with key locking capacities.
- Right or left opening of door of rack shall be provided as per requirement of room.
- Optical patch panel for fibre optic;
- Copper patch panel for twisted pair Cat 6A cable;
- A cabling guide system in each internal side of the cabinet for the front side;
- A cabling guide system in each internal side of the cabinet for the backside;
- An earthing point, multi-socket strip for supply power to the active equipment;
- Metallic door shall be provided with key locking capabilities.

Power distribution unit (PDU) must have following specification:

- At least two extra sockets as per requirement of active equipment installed inside rack.
- PDU with sockets compatible with active equipment / data switches.
- Industrial male plug / compatible with power socket.
- Two PDUs in each rack for active equipments that have dual power supply.

5.0 INSTALLATION

5.1 Conformance of the Installation to Specification

The Contractor will:

Install all the cable plant in accordance with the manufacturer's guidelines and relevant specification.

Ensure all the steps have been taken to ensure that the terminal equipment can be installed to specification and mount any equipment or electronics as close to the wiring wall fields (if appropriate) as possible, taking into consideration future growth, to facilitate administration and service.

Provide a test report to ensure that the cabling meets the required specification (Class E):

Ensure that the patch cables or cross connections must have the same impedance characteristics as the cable.

Not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

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Ensure that the maximum pulling tensions of the cables are not exceeded at any time during the placement of the facilities.

Use correct cable basket or tray work according to IEC 50174-1.

Use appropriate installation equipment, specified by the equipment manufacturer, or equivalent, to install all cables, panels, Telecom Sockets and patch cords.

Plug conduits and entrance holes where the cabling has been installed by the installation contractor in the main equipment room, manholes, riser and other cable entrance locations with re-ununtterable duct seal or flame retardant putty.

Provide an approved ground at all newly distribution frames and other locations insuring proper bonding to any existing facilities. The contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes and framework. All grounds shall consist of appropriate gauge copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground.

5.2 Installation Handover

The cabling system will be handed over to the purchaser or the purchaser representative. A manufacturer's system warranty shall be applied for:

Where appropriate, the documentation supplied includes component acceptance test documentation. Such documentation includes:

a. Evidence of conformance of cables, connectors, cable assemblies etc.

b. Cable acceptance test records and other information;

c. Cable assembly acceptance test records and other information;

d. Delivery information (e.g. dates of receipt and batch numbers or other unique product identifiers of cables and accessories).

5.3 Final Cable Documentation

On completion, the contractor will provide final cabling documentation which will include:

- Site plans to include the identifications and locations of nodes, pathways, cables, termination points, closures, patch panels, protection devices;
- As-built information to include nodal, route and cable connectivity, closures (in a schematic or report based format);
- Installed cabling acceptance test records;
- Evidence of conformance to the installation specification from cabling installer or main contractor;
- Handover certificate;
- Earthing and equipotential bonding details.

6.0 TESTING AND COMMISSIONING

6.1 System Tests

All permanent links shall be tested. Acceptance is in accordance with standard ISO 11801:

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The horizontal copper cabling system must be tested in accordance with the procedure described below. Tests shall be performed using a level II filed tester as defined in ISO/IEC 11801 – an automatic tester or scanner. The following parameters of the link shall be verified:

- Headroom report (The worst-case margin for a parameter determined by the selected standard (this may be NEXT, ACR, PSNEXT or another measurement).
- Wire map
- Resistance
- Link length
- Insertion loss
- Return loss
- Near end crosstalk (NEXT)
- Power sum near end crosstalk (PSNEXT)
- Equal level far end crosstalk (ELFEXT)
- Power sum equal level far end crosstalk (PSELFEXT)
- Attenuation to crosstalk ratio (ACR)
- Power sum attenuation to crosstalk ratio (PS ACR)
- Delay skew
- Impedance
- DC loop resistance

The insertion loss of fibre permanent links shall be tested using either a light source and power meter or an OTDR. Tests shall be performed at either 850 nm and / or 1300 nm. When tests are conducted using a power meter and stabilized light source, testing in one direction is sufficient. When tests are conducted using an OTDR, testing in both directions is required. In both cases, 100% of installed links shall be tested.

The following shall also be confirmed:

- Continuity
- The link length does not exceed the authorized maximum value;
- Radius of curvature of the cables conforms to values in the design guide;
- Cable preparation and the assembly of the jacks is to the manufacturer's instructions
- Cables ties and confinement are tight enough without squeezing the cable
- The insulation of the copper wires is continuous.
- The earthing and bonding of all metallic pathway systems is undertaken according to the installation specification.
- The metal racking, distribution panels and patch panels are bonded at both ends.
- The metal continuity of the farms of the same distributor is carried out.
- The screens of the cables (where applicable) are connected to earth at both ends.
- The main earthing and bonding is to EN 50174-1.

All cables and cords, distribution frames and outlet locations must be labeled according to industry standards. Labels should be computer generated or typewritten.

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6.2 Commissioning

After handover the installation will be commissioned and brought into service.

A probationary period may be defined, during which the installer will be expected to correct any defects appearing in the installation.

All components of the Structured Cabling Network should be sourced from one manufacturer to ensure minimal impedance mismatch and best possible NEXT performance and to guarantee the Category-6A performance from end to end.

The Structured Cabling Network should operate without introducing or being affected by electromagnetic radiation from other sources. Maintaining segregation from other services or screenings are to be ensured to achieve acceptable immunity.

7.0 MEASUREMENT AND PAYMENT

7.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Contract Drawings related to the item.

7.2 Firewall

7.2.1 **Measurement**: Measurement shall be made for the total number of Firewall each acceptably supplied and installed by the Contractor as a complete unit.

7.2.2 **Payment:** Payment shall be made for the total no. of units of Firewall measured as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing, connecting, configuring, programming, testing, commissioning and completion of the Firewall with required transceiver as mentioned including power supply, all essential interconnecting cables, mounting and installation accessories for satisfactory operation of the entire system. Complete in all respect.

7.3 Wireless Controller

7.3.1 **Measurement**: Measurement shall be made for the total number of Wireless Controller each acceptably supplied and installed by the Contractor as a complete unit.

7.3.2 **Payment:** Payment shall be made for the total no. of units of Wireless Controller measured as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing, connecting, configuring, programming, testing, commissioning and completion of the Wireless Controller as mentioned including power supply, all essential interconnecting cables, mounting and installation accessories for satisfactory operation of the entire system. Complete in all respect.

7.4 Wireless Access Point

7.4.1 **Measurement**: Measurement shall be made for the total number of Wireless Access Point each acceptably supplied and installed by the Contractor as a complete unit.

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7.4.2 **Payment:** Payment shall be made for the total no. of units of Wireless Access Point measured as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing, connecting, configuring, programming, testing, commissioning and completion of the Wireless Access Point as mentioned including all essential interconnecting cables, mounting and installation accessories for satisfactory operation of the entire system. Complete in all respect.

7.5 Layer-3 Managed Fiber Switch / Layer-2 Managed Access PoE Switch

7.5.1 **Measurement**: Measurement shall be made for the total number of Layer-3 Managed Fiber Switch / Layer-2 Managed Access PoE Switch each acceptably supplied and installed by the Contractor as a complete unit.

7.5.2 **Payment:** Payment shall be made for the total no. of units of Layer-3 Managed Fiber Switch / Layer-2 Managed Access PoE Switch measured as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing, connecting, configuring, programming, testing, commissioning and completion of the Layer-3 Managed Fiber Switch / Layer-2 Managed Access power over Ethernet PoE Switch with required Copper and Fiber SFP ports transceiver as mentioned in BOQ including power supply, all essential interconnecting cables, mounting and installation accessories for satisfactory operation of the entire system. Complete in all respect.

7.6 Network Monitoring System

7.6.1 **Measurement**: Measurement shall be made for the Network Monitoring System each acceptably supplied and installed by the Contractor as a complete job

7.6.2 **Payment:** Payment shall be made for the complete job of OEM's proposed recommended network monitoring system including latest generation server with required nos. of LED Screens compatible with the proposed overall IT system including power supply, all essential interconnecting hardware, software, cabling, required licenses, network cards, modules etc. with all installation and mounting accessories. Complete in all respect for satisfactory operation of the entire NMS.

7.7 Network Administrator Workstation

7.7.1 **Measurement**: Measurement shall be made for the Network Administrator Workstation each acceptably supplied and installed by the Contractor as a complete job.

7.7.2 **Payment:** Payment shall be made for the complete job of Network Administrator Workstation having latest generation Computer version comprising 21" LCD screen, CPU with license operating system, licensed Client's end software, anti-virus software, wireless keyboard, wireless mouse with all essential interconnecting cables including all installation and mounting accessories as required for system operation. Complete in all respect.

7.8 Wiring of RJ45 Telecommunication outlet with Cat-6A UTP LSZH cable

7.8.1 **Measurement:** Measurement shall be made for the total number of RJ45 Telecommunication outlet with Cat-6A UTP LSZH acceptably supplied and installed by the Contractor.

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7.8.2 **Payment:** Payment shall be made for the total number of wiring of RJ45 Telecommunication outlet measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, laying, testing, commissioning and completion of the Wiring of RJ45 Telecommunication outlet upto relevant Building/Floor Distributor / MDF with Cat-6A UTP LSZH cable in already installed conduit / cable trunking.

7.9 **Cat 6A UTP LSZH Giga Speed / Fiber Optic Patch Cord**

7.9.1 **Measurement:** Measurement shall be made for the total number Cat 6A UTP LSZH Giga Speed / Fiber Optic Patch Cord of each type acceptably carried out by the Contractor as a complete unit.

7.9.2 **Payment:** Payment shall be made for the total no. of units of Cat 6A UTP LSZH Giga Speed / Fiber Optic Patch Cord measured as provided above at the Contract unit prices each and shall constitute for supplying, installing, testing, commissioning and completion of the Cat 6A UTP LSZH Giga speed Patch Cord with RJ45 connectors at both ends / Duplex Fiber Optic Patch Cord with required connectors at both ends.

7.10 **Cat-6A UTP RJ45 Telecommunication Outlet**

7.10.1 **Measurement:** Measurement shall be made for the total number of Cat-6A UTP RJ45 Telecommunication Outlet of each type acceptably carried out by the Contractor as a complete unit.

7.10.2 **Payment**: Payment shall be made for the total no. of units of Cat-6A UTP RJ45 Telecommunication Outlet measured as provided above at the Contract unit prices each and shall constitute for supplying, installing connecting, testing, commissioning and completion of the Cat-6A UTP RJ45 Telecommunication Outlet with faceplate and sheet steel back box including all installation and mounting accessories.

7.11 **16/24 port RJ45 loaded Cat 6A UTP Giga Speed Patch Panel / Front Cable Management / Intermediate Disconnection Module (IDC)**

7.11.1 **Measurement**: Measurement shall be made for the total number of 16/24 port RJ45 loaded Cat 6A UTP Giga Speed Patch Panel with built-in rear cable management / Front Cable Management / Intermediate Disconnection Module (IDC) of each type acceptably supplied and installed by the Contractor as a complete unit.

7.11.2 **Payment**: Payment shall be made for the total no. of units of 16/24 port RJ45 loaded Cat 6A UTP Giga Speed Patch Panel with built-in rear cable management / Front Cable Management / Intermediate Disconnection Module (IDC) measured, as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing connecting, testing, commissioning and completion of the 16/24 port RJ45 loaded Cat 6A UTP Giga Speed Patch Panel with built-in rear cable management / Front Cable Management / Intermediate Disconnection Module (IDC) with mounting frame including all installation and mounting accessories.

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7.12 **Cat-6A UTP LSZH Cable / Multipair Cat-3 LSZH Telephone Backbone Cable / Fiber Optic Backbone Cable**

7.12.1 **Measurement**: Measurement shall be made for total running feet of Cat-6A UTP LSZH Cable / Multipair Cat-3 LSZH Telephone Backbone Cable / Fiber Optic Backbone Cable acceptably supplied and installed by the Contractor.

7.12.2 **Payment**: Payment shall be made for total running feet of Cat-6A UTP LSZH Cable / Multipair Cat-3 LSZH Telephone Backbone Cable / Fiber Optic Backbone Cable as provided above at the contract unit prices each and shall constitute full compensation for supplying, installing, connecting, laying, testing, commissioning and completion of Cat-6A UTP LSZH Cable / Multipair Cat-3 LSZH Telephone Backbone Cable / Fiber Optic Backbone Cable in already installed PVC conduit / Cable Trunking / Cable Tray.

7.13 **12 / 24 / 48 port Duplex LC loaded Fiber Optic Patch Panel**

7.13.1 **Measurement**: Measurement shall be made for the total number of 12 / 24/48 ports Duplex LC loaded Fiber Optic Patch Panel of each acceptably supplied and installed by the Contractor as a complete unit.

7.13.2 **Payment**: Payment shall be made for the total no. of units of 12 / 24/48 port Duplex LC loaded Fiber Optic Patch Panel measured as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing connecting, testing, commissioning and completion of the 12/24/48 port Duplex LC loaded Fiber Optic Patch Panel with pigtails and splice tray including all installation and mounting accessories.

7.14 **Racks / Cabinets**

7.14.1 **Measurement**: Measurement shall be made for the total number of Racks / Cabinets acceptably supplied and installed by the Contractor as a complete unit.

7.14.2 **Payment**: Payment shall be made for the total no. of units of Racks / Cabinets, measured, as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing and completion of the Racks / Cabinets including hoops, side management, cable trays, required nos. of fans, fan trays, required power sockets, interconnecting cables from UDB to Rack. Complete in all respect.

*** End of Section 8312 ***

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SECTION - 8331

INTELLIGENT ADDRESSABLE FIRE ALARM SYSTEM

1.0 SCOPE OF WORK

The work under this section consists of supply, installation, configuring, programming, testing, commissioning and training of all equipment, material, accessories and services for Intelligent Addressable Fire Alarm System shall be complete in all respect as described in these specifications, drawings, BOQ and in accordance with International Organization for Standardization (ISO).

The Contractor will discuss the intelligent addressable fire alarm system layout with the Engineer and coordinate at site with other services for exact route, location and position of electrical lines and equipments.

The intelligent addressable fire alarm system with accessories shall also comply with the General Specifications for Electrical Works Section - 8001, General Technical Requirements for Communication Works Section – 8002 and with other relevant provisions of the Contract Document.

2.0 GENERAL

All outlet boxes shall be considered part of the devices installed on them and shall be supplied alongwith the devices.

The system shall operate on 24 VDC from a battery charger with manufacturer's recommended standby batteries. The incoming supply shall be 230 VAC from emergency circuit.

All the active items of the intelligent addressable fire alarm system shall ideally be listed as a product of a single manufacturer.

Contractor shall provide following information on wall chart mounted near FACP.

- Complete layout of addressable fire alarm system showing locations of all fire and sounder locations.
- Standby battery specification, including ampere-hour capacity Voltage per Cell, number of Cells, and the battery type.
- Operating and maintenance instruction in BLACK colour.
- Emergency instructions in RED colour.
- Name, address & telephone number of the Servicing Contractor.

The characters of written instructions shall be minimum 6 mm high.

Intelligent addressable fire alarm system shall interface with Public Address System in accordance with NFPA72.

Intelligent addressable fire alarm system shall interface with Access Control System in accordance with NFPA101.

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Intelligent addressable fire alarm control panel shall have a provision for remote parallel monitoring of individual devices for fire and fault etc.

3.0 APPLICABLE STANDARDS/CODES

The following standards & codes shall be applicable for the materials covered within the scope of this section:

NFPA 72 - National Fire Alarm Code

NFPA 101 - Life Safety Code

BS 5839 - Fire Code British Standard

Each and all items of the Addressable Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by under writers laboratories (UL) label / FM Approval or Certified / Vds Approval or Certified.

4.0 MATERIAL

4.1 Addressable Fire Alarm Control Panel

The main FACP shall perform the following functions:

4.1.1 Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

4.1.2 Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.

4.1.3 Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

4.1.4 Visually and audibly annunciate any trouble, supervisory, alarm condition on panel display and annunciators.

a. When a fire alarm condition is detected and reported initiating devices or appliances, the following functions shall immediately occur:

i. The system alarm LED shall flash.

ii. A local audible device in the control panel shall sound a distinctive signal.

iii. The LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

iv. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

v. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated outputs (alarm notification appliances and/or relays) shall be activated.

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b. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

i. The system trouble LED shall flash.

ii. A local audible device in the control panel shall sound a distinctive signal.

iii. The LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.

iv. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

v. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated outputs (trouble notification appliances and/or relays) shall be activated.

c. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

i. The system trouble LED shall flash.

ii. A local audible device in the control panel shall sound a distinctive signal.

iii. The LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.

iv. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

v. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated outputs (notification appliances and/or relays) shall be activated.

d. When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

i. The system pre-alarm LED shall flash.

ii. A local audible device in the control panel shall sound a distinctive signal.

iii. The LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

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iv. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

v. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated outputs (alarm notification appliances and/or relays) shall be activated.

4.1.5 Acknowledge Switch

a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarms or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.

b. Depression of the Acknowledge switch shall also silence all remote annunciator sounders.

4.1.6 Signal Silence Switch

Depression of the Signal Silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

a. Drill Switch

Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

b. System Reset Switch

Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that de-activate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

c. Lamp Test

The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

d. Scroll Display Keys

There shall be scroll display keys for fire alarm, security, supervisory, trouble, and other events. Depression of the scroll

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display key shall display the next event in the selected queue allowing the operator to view events by type.

e. Print Screen

Depression of the PRINT SCREEN switch shall send the information currently displayed on the display to the printer.

4.1.7 System Capacity and General Operation

a. The control panel shall be capable of expansion. Each module loop shall support minimum 127 analog/addressable devices.

b. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit liquid crystal display, individual, status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the intelligent addressable fire alarm system.

c. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

d. Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the requirements of NFPA 72 / BS 5839.

e. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.

f. History Events: The panel shall maintain a history file of the events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall maintain a 1000 event Alarm History.

g. Drill the system shall support means to activate all silenceable fire output circuits in the event of a practice evacuation or "drill". If enabled for local control, the front panel switch shall be held for a minimum of 2 seconds prior to activating the drill function.

h. Passwords and Users: The system shall support two password levels, master and user. Minimum 4 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

i. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector

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accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

4.1.8 Loop (Signaling Line Circuit) Control Module

a. The Loop Control Module shall monitor and control 127 devices.

b. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

c. The Loop Control Module shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 4 (Class B) circuit.

d. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

4.1.9 Enclosures

a. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

b. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.

c. The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.

d. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

4.1.10 Power Supply

a. The Addressable Main Power Supply shall operate on 230 VAC, 50 Hz, and shall provide all necessary power for the FACP.

b. The Addressable Main Power Supply shall provide a battery charger for 4 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries within a 48-hour period.

c. The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

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d. The Addressable Main Power Supply shall be power-limited per 1995 UL864 requirements.

4.1.11 Printer

a. Printers shall be of the automatic type, printing code, time, date, location, category, and condition.

b. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table and UL, ULC listed for use. The printer shall communicate with the control using an interface complying with Electrical Industries Association standard EIA-232D.

c. Thermal printers are not acceptable.

d. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back up if AC mains are lost. The strip printer shall be UL 864 listed.

e. Adequate number of printer paper rolls shall be provided.

4.1.12 Field Programming

a. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.

b. It shall be possible to program through the standard FACP keyboard all system functions.

c. All field defined programs shall be stored in non-volatile memory.

4.2 **Notification Appliances**

4.2.1 Audible visual sounders shall operate on 24 VDC nominal.

4.2.2 Audible visual shall be field programmable without the use of special tools, at a sound level of at least 10 dBA above the ambient noise level.

4.2.3 Shall be flush or surface mounted as shown on plans.

4.2.4 Strobe lights / Flasher shall meet the requirements of the ADA, UL/EN54 Standard and shall be fully synchronized.

4.2.5 Audible Visual Combination Devices

a. Shall meet the applicable requirements of Section A listed above for audibility / Relevant BS Codes.

b. Shall meet the requirements of Section B listed above for visibility / Relevant BS Codes.

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4.3 Addressable Devices - General

4.3.1 Addressable devices shall provide an address-setting means using rotary decimal switches.

4.3.2 Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type addressable switches.

4.3.3 Detectors shall be analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.

4.3.4 All sensors, call points and sounders shall also have an integral short circuit isolator, which in the event of a single cable fault will isolate the "culprit" piece of cable and retain all devices on loop operationally in less than 1 second

4.3.5 Addressable smoke and thermal detectors shall provide status LED. LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and LED shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LED can be programmed off via the fire control panel program.

4.3.6 The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.

4.3.7 Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

4.3.8 The detectors shall be ceiling-mount and shall include a separate twist-lock base, which includes a tamper proof feature.

4.3.9 The following bases and auxiliary functions shall be available:

a. Sounder base rated at 85 DBA minimum.

b. Form-C Relay base rated 30VDC, 2.0A

c. Isolator base

4.3.10 The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

4.3.11 Addressable Manual Call Station / Point with built-in isolator module

a. Addressable Manual Station shall on command from the fire alarm control panel send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key or can be a break glass as per OEM's recommendation.

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b. All operated stations shall have a positive, visual indication of operation and utilize a key type reset / break glass.

4.3.11 Intelligent Addressable Multi Optical and Heat Detector with base, built in isolator module

a. The intelligent Addressable Multi Optical and Heat Detector shall be an' addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability, to adapt to' its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall 'allow a wide sensitivity window, no less than 1 to 4% per' foot obscuration. These detectors shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

b. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

c. The intelligent Addressable Multi-sensor detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

d. The intelligent Addressable Multi Optical and Heat Detector shall have a capability to have integral sounder on the detector or detector base for alarm notification.

4.3.12 Intelligent Addressable Thermal / Heat Detector with Base, Built-in Isolator Module

Thermal / Heat detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a -rate-of-rise element rated' at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

4.3.14 Addressable Dry Contact Monitor Module

a. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.

b. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

c. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

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d. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

4.3.15 Addressable Control Module

a. Addressable Control Modules shall be provided. For fan shutdown and, other auxiliary control functions, the control module may be set to operate as a dry contract relay.

b. The control module shall mount in a standard 4-inch square (101.6 mm square), 2 1/8 inch (54 mm) deep electrical box, or to a surface mounted back box.

4.4 Batteries and External Charger

4.4.1 The intelligent Addressable Multi Optical and Heat Detector shall

a. Shall be 12 volt, Gell-Cell type.

b. Battery shall have sufficient capacity to power the Intelligent addressable fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure.

c. The batteries are to be completely maintenance free and shall be provided as per manufacturer's recommendation. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

4.4.2 External Battery Charger

a. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/240-volt 50 hertz source.

b. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

c. Shall have protection to prevent discharge through the charger.

d. Shall have protection for overloads and short circuits on both AC and DC sides.

4.5 Wiring and Cabling

Wiring and cabling of Fire and alarm system shall be carried out in conduits. 1.5 mm^2 fire resistant enhanced cables with LSZH outer sheath shall be provided for the intelligent addressable fire alarm system. The cable shall be work for 120 minutes in fire condition.

All wires and cables shall be color-coded, tagged and checked for open, short or ground faults. No transposition of colors will be permitted. All wiring shall be made on terminal blocks of proper size and type for the services involved. Cable joints shall only be allowed on the detector bases.

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5.0 INSTALLATION

5.1 Intelligent Addressable Fire Alarm System Equipment

The installation of Intelligent addressable fire alarm system equipment shall be in strict accordance with the manufacturer's instructions / recommendations and these specifications.

The testing of Fire Alarm equipment shall be in compliance with the relevant standards and regulations. During testing of equipment, emphasis shall be laid on the following:

- Operational Safety
- Regular functioning of the system and devices
- Protection against false alarms

Various detectors like smoke, heat, manual call point etc. shall be subjected to the basic tests and sensivity tests. The automatic detectors shall be tested in various ways to check real and false alarm behaviors.

6.0 TRAINING

A training session shall be presented by a fully qualified, trained representative of the equipment manufacturer/supplier who is thoroughly knowledgeable of the specific installation. The training shall be given to personnel responsible for operation and maintenance of the system.

The training session shall include but not limited to the following:

6.1 Detailed explanation of wall charts as mentioned in Article 2.0 of this section.

6.2 Function of each control switch

6.3 Periodic operational testing of panel/devices.

6.4 Maintenance of fire log book supplied by manufacturer.

6.5 Actions to be taken upon receiving following signals:

6.5.1 False alarm indication

6.5.2 Trouble on any initiating or indicating zone

6.5.3 Common alarm or common trouble indication

6.5.4 Low battery voltage indication

6.6 Field modifiable programming.

7.0 MEASUREMENT AND PAYMENT

7.1 **General**

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion of all work specified herein and/or as shown on the Tender Drawing related to the item.

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7.2 **Intelligent Addressable Automatic Multi & Heat Detectors with built-in isolator module**

7.2.1 **Measurement:** Measurement shall be made for the total number of each type of automatic multi & heat detectors with built-in isolator module acceptably supplied and installed by the Contractor as complete unit.

7.2.2 **Payment:** Payment shall be made for the number of units measured as provided above at the contract unit price and shall constitute full compensation for supplying, installing, configuring, testing, commissioning and completion of each type of the intelligent addressable automatic multi & heat detectors with built-in sounder and isolator module including bases and back boxes as required including all mounting & installation accessories.

7.3 **Intelligent Addressable Manual Call Point with built-in isolator module**

7.3.1 **Measurement:** Measurement shall be made for the total number of each type of intelligent addressable manual call point with built-in isolator module acceptably supplied and installed by the Contractor as complete unit.

7.3.2 **Payment:** Payment shall be made for the number of units measured as provided above at the contract unit price and shall constitute full compensation for supplying, installing, configuring, testing, commissioning and completion of each type of the intelligent addressable manual call point with built-in isolator module including bases and back boxes as required including all mounting & installation accessories.

7.4 **Loop Powered Audio Visual Sounder with built-in isolator module**

7.4.1 **Measurement:** Measurement shall be made for the number of Audio Visual Sounder with built-in isolator module acceptably supplied and installed by the Contractor as complete unit.

7.4.2 **Payment:** Payment shall be made for the number of units measured as provided above at the Contract unit price and shall constitute full compensation for supplying, installing, configuring, testing, commissioning and completion of each type of Audio Visual Sounder with built-in isolator module including all mounting accessories like outlet boxes etc.

7.5 **Loop Powered Control Module / Monitor Module**

7.5.1 **Measurement:** Measurement shall be made for the number of Loop Powered Control Module / Monitor Module / Interface Module acceptably supplied and installed by the Contractor as complete unit.

7.5.2 **Payment:** Payment shall be made for the number of units measured as provided above at the Contract unit price and shall constitute full compensation for supplying, installing, configuring, testing, commissioning and completion of each type of Loop Powered Control Module / Monitor Module / Interface Module as required for interfacing of various system / devices including interconnecting wiring up to the relevant interface point with all mounting accessories like outlet boxes etc.

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7.6 **Intelligent Addressable Fire Alarm Control Panel**

7.6.1 **Measurement:** Measurement shall be made for fire alarm control panel including all related equipment as given in BOQ such as power supply, built-in printer, relays, batteries, batteries charger, LAN card, etc. alongwith all accessories acceptably supplied and installed by the Contractor as a complete job

7.6.2 **Payment:** Payment shall be made for the complete job measured as provided above at the contract unit price and shall constitute full compensation for supplying, installing, programming, configuring, testing, commissioning and completion of fire alarm control panel along with maintenance free batteries, battery charger, power supply, printer LAN Ethernet / remote interface etc. as mentioned in BOQ along with all mounting an installation accessories for satisfactory operation of the entire system. Complete in all respect.

7.7 **Wiring of Fire Alarm Loops**

7.7.1 **Measurement:** Measurement shall be made for the total running feet of wiring of fire alarm loops with 2 x1.5 sq mm fire resistant (120 mins) enhanced cable and the required number of junction boxes acceptably supplied and installed by the Contractor.

7.7.2 **Payment:** Payment shall be made for the total running feet measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing, connecting testing and commissioning of fire alarm loops with 2 x1.5 sq mm fire resistant (120 mins) enhanced cable wiring including junction boxes and all accessories.

*** End of Section 8331 ***

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SECTION - 8335

CLOSED CIRCUIT TELEVISION SYSTEM (CCTV)

1.0 SCOPE OF WORK

The work under this section consists of supplying, installing, connecting, configuring, programming, testing, commissioning and training of all materials and services of the complete IP CCTV system as specified herein, or as given in the Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the IP CCTV layout with the Engineer and co-ordinate at the site with other services for exact route, location and position of the conduits, cameras and equipment.

The IP CCTV system with accessories shall also comply with the General specifications for Electrical Works Section - 8001, General Technical Requirements for Communication Works Section – 8002 and with other relevant provisions of the Contract Document.

2.0 GENERAL

The CCTV System shall be used for general and security surveillance. All the active items of the CCTV System shall be listed as a product of a single manufacturer.

The power to rack of the CCTV system shall be supplied by an uninterruptible power supply (UPS), which shall have an minimum autonomy of 5 minutes minimum.

Proposed CCTV system shall be an open standard based integrated system with IP network centric functional and management architecture aimed at providing high-speed manual/automatic operation for best performance.

System shall have Colour Video Cameras with individual IP address, with Fixed or P/T/Z Lens, Server, Network Attached Storage (NAS) / Raid backup device for recording, Application Software, Colour Video displays, Keyboards with Joystick Controllers / Mouse-Keyboard, software based Video Matrix Switcher, Workstation for System Administration / Management / Maintenance etc.

Central Management Server and Network Storage management shall offer both video stream management and video stream storage management. Recording frame rate & resolution in respect of individual channel shall be programmable.

System should ensure that once recorded, the video can not be altered, ensuring the audit trail is intact for evidential purposes.

Contractor shall submit storage calculations of manufacturer's recommended software on H.264/H.265 or better compression technique based on 1080p recording at 30 fps for 24 hour operation for 30 days of storage for number of cameras as given in BOQ with 25% expansion capacity.

Cameras shall be capable of video analytics function shall generate an alarm for any non-defined behavioral change. Video Analytics shall provide advanced detection and tracking capabilities covering a wide range of behavioral events.

Surveillance CCTV System shall operate on 230 V, 50 Hz single phase power supply. Power for all the equipment will be conditioned using on-line UPS with minimum 30 minutes or more back up.

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If any equipment operates on any voltage other than the supply voltage and supply frequency, necessary conversion/correction device for supply shall be supplied along with the equipment. IP cameras shall receive power from POE / POE+ Ethernet switches.

Housing of cameras shall be integrated by the camera manufacturer.

System must provide built-in facility of watermarking or digital certificate to ensure tamperproof recording so that these can be used as evidence at a later date, if so desired. The recording shall support audit trail feature.

All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password.

System shall be triplex i.e. it should provide facility of Viewing, Recording & Reply simultaneously.

The offered system shall have facility to export the desired portion of clipping (from a desired date/time to another desired date/time) on Portable hard drive. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.

PTZ Cameras shall have 64 or more pre-defined positions to be selected through suitable input alarm.

System shall have provision of LAN connectivity for remote monitoring anywhere in Air Craft Painting Facility.

All the control equipments e.g. CCTV servers, NSM/Raid backup device, decoders etc. shall be provided in standard 19" racks.

3.0 APPLICABLE STANDARDS AND CODES

The following standards and codes shall be applicable for the material covered within the scope of the section.

IEC 801 – 2 Electrostatic discharges

IEC 801 – 3 Radiated Electromagnetic interference

IEC 801 – 4 Voltage transients

Install all the signal transmission components in accordance with the relevant standard ANSI Locate all surge protection within meter of building entrance:

- Dust and rain resistance IP67 or better for outdoor cameras.
- Salt mist According to IEC 60068-2-11 (for outdoor cameras)
- Vibration According to IEC 60068-2-6
- Bump test According to IEC 60068-3

4.0 EQUIPMENT

4.1 IP Fixed Colour Bullet Varifocal Camera

Image Device 1/2.8" CMOS sensor

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Resolution	2592(H) x 1944(V), 5 MP or better
Lens	Built-in Varifocal, Auto Iris
Focus length	2.8 mm – 12 mm or better
Frame rate	30 frames/sec or better
Aspect Ratio	4:3 or better
With IR	0.0 lux
Signal-to-noise ratio (SNR)	>55dB
Wide Dynamic range	100 dB or Higher
Video Compression	H.265, H.264 or better
Back Light Compensation	On/off
Power Supply	Required as per OEM
IP Rating	As per BOQ

4.2 **IP Fixed Colour Dome Varifocal Camera**

Image Device	1/2.8" CMOS sensor
Resolution	2592(H) x 1944(V), 5 MP or better
Lens	Built-in Varifocal, Auto Iris
Focus length	2.8 mm – 12 mm or better
Frame rate	30 frames/sec or better
Aspect Ratio	4:3 or better
With IR	0.0 lux
Signal-to-noise ratio (SNR)	>55dB
Wide Dynamic range	100 dB or Higher
Video Compression	H.265, H.264 or better
Back Light Compensation	On/off
Power Supply	Required as per OEM
IP Rating	As per BOQ

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4.3 IP PTZ Dome Colour Video Camera

Colour video dome camera with PTZ shall have following technical features:

Image Device	1/3" CMOS Sensor or better
Focus length	4.3 mm to 129 mm or better
Optical zoom	30 X or better
Digital zoom	12 X or better
Resolution	1920 x 1080 (2MP) or better
Aspect ratio	16:9 or better
Video Sensitivity IR	0 lux
Pan Range	360° Continuous
Presets	256
Video Compression	H.265, H.264, M-JPEG or better
Iris Control	Automatic
Signal-to-noise ratio (SNR)	>45dB
Back Light Compensation	ON/OFF
Wide Dynamic range	90 dB or Higher
Power Supply	Required as per OEM
IP Rating	As per BOQ

4.4 Central Management Server on H.264 / H.265 Compression

Central Management Server shall be used to record video streams based on the configuration assigned by administrator. Workstations & Servers within the LAN should be able to access the recorded video streams. The Central Management Server should support simultaneous play back and recording at full duplex operation.

It shall provide a high quality recording storage and play back of images. It should support integration with LAN to provide Centralized Management and shall operate on Windows/Linux OS. Support of user management for security level control and authentication required. The Central Management Server should have the following features and specifications:

Onboard CPU	Latest Generation Processor
Onboard Memory	As per system / manufacturer's requirement
HD Drive	As per system / manufacturer's requirement
Host Interface	As per system / manufacturer's requirement

RAID Support	As per system / manufacturer's requirement
Network Transport Protocols	TCP / IP and open system protocol
Network File Protocols	CIFS, NFS, HTTP/HTTPS, FTP, NTP, SNMP, SMTP, DHCP and DNS
Drive Status / Space Monitoring	Supported
Operating System (OS)	MS Windows OS (Latest Version) or Linux
Power Supply	Hot pluggable Redundant Power Supply

4.5 **Workstation**

Latest industrial standard workstation with all required accessories for operation of IP CCTV system as specified shall be provided with wireless keyboards, mouse, video card, sound card, 10/100/1000 Base-T Ethernet Port, latest operating system, CCTV software and antivirus software.

4.6 **Network Video Storage on H.264 / H.265 compression / Video Recorder**

Network Video Storage on H.264 / H.265 compression / Video Recorder and data base server in accordance with manufacture's recommendation for operation of CCTV system as specified herein and shown on drawing / BOQ.

Contractor shall submit storage calculation on manufacturer's recommended software on H.264 / H.265 or better compression technique based on 1080p recording at 30 fps for 24 hour operation for 30 days of storage for number of cameras given in BOQ and shown on the drawing with 25% expansion capacity.

4.7 **Camera Housing & Mount**

i) The camera mount/housing should ideally be of the same make as that of camera or any other make satisfying the criteria mentioned in clause 2.0 and suitable for the offered model number of camera as specified by the manufacturer. In case of camera housing/mount having the make other than the camera itself, the supplier shall provide valid/authentic document by the manufacturer proving the suitability of camera with the housing offered.

ii) Should be compact and indoor/outdoor types as required.

iii) Should support the weight of Camera and accessories such as housing, pan & tilt head in any vertical or horizontal position etc.

4.8 **Speed Dome Controller / PTZ Controller**

Speed dome controller should have variable speed joystick, LCD display for programming and it should be able to control the speed dome for PAN/TILT/ZOOM.

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4.9 Ultra High Definition (UHD) 4k LED Display

42" or available higher size as per the proposed OEM quoted by vendor shall have color LED display shall have following minimum technical specification.

▪ Resolution	3840x2160 pixels
▪ Brightness	700 nit
▪ Orientation	Landscape / Portrait
▪ Haze	Non Glare
▪ Operation Hour	24/7
▪ Display Mode	HDMI, DVI, DP, VGA
▪ Contract ratio	4000:1
▪ Aspect ratio	16:9
▪ Bezel Width	Narrow
▪ Power Source	230 VAC/50 Hz

Contractor shall bid 42 inch display for Matrix / Spot viewing including cost of all essential equipment, decoders, software, license and interconnecting cable as required for complete satisfactory operation of CCTV monitoring system.

4.10 Console

The Console shall be designed to provide a smooth, level work area, while complying with accepted human factor criteria. All ergonomic standards shall be taken into consideration, including view/reach distances, keyboard height, and knee well space. The adjustable work surface shall provide further flexibility allowing for customized height positioning. Slanted working surface for screen,

- Materials 1 in (25.5mm) Particle Board
- Finish high-pressure plastic laminate surface veneer
- Static Load 50 lb. / linear ft. (MAXIMUM 250 lb. (90 Kg) per surface on Adjustable Work surfaces)

A frame composed of cross members made up with assembled profiles using angle brackets and junction plates,

Upper front panels with appropriate fixtures to integrate all equipments and screens, Horizontal working surface for PTZ controller, mouse, and telephone set, including on the front string the keyboards drawers, headset panels and lighting panel.

5.0 VIDEO SURVEILLANCE APPLICATION SOFTWARE

The software shall operate on open architecture for integration with perimeter safety, access control, public address and fire / safety systems based on open standards.

Digital video surveillance control software should be capable to display and manage the entire surveillance system. It should be capable of supporting variety of device such as IP cameras, PTZ controller, NVR, NAS boxes/Raid backup device etc.

The software should support flexible 1/2/4/16 windows split of 42" screen display or scroll mode on the PC monitor or on preview displays as per site requirement. The software should be able to control all cameras i.e. PTZ control, Iris control, auto/manual focus and color balance of camera, selection of presets, video tour selection etc.

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The software is required to generate reports of stored device configuration. The control software is required to provide alarm and alarm log. The log shall be able to be achieved, printed and displayed using a device filter, a device group filter and/or a time window.

The software should have user authority configurable on per device or per device group basis. The user shall have the facility to request the access of any camera and can control the camera for a reservation period.
Control of camera is released after the reservation period.

The system shall provide user activity log (audit trail) with user date, time stamp and action performed etc.

The administrator should be able to add, edit & delete users with rights. It shall be possible to view ability/rights of each user or the cameras which can be viewed & controlled as per the permission assigned by he administrator.

The users should be on a hierarchical basis as assigned by the administrator. The higher priority person can take control of cameras, which are already being controlled by a lower priority user. There should be minimum 3 hierarchical levels of security for providing user level log in.

It should have recording modes viz. continuous, manual or programmed modes on date, time and camera-wise. All modes should be disabled and enabled using schedule configuration. It should be possible to search and replay the recorded images on date, time and camera-wise. It should provide on screen controls for remote operation of PTZ cameras. It should have the facility for schedule recording. Different recording speeds (fps) and resolution for each recording mode for each camera should be possible.

It should provide programmable motion detection and recording, to be defined area-wise. System must be able o support video motion detection algorithms to detect and track objects, learn the scene, adapt to a changing outdoor environment, ignore environmental changes including rain, hail, wind, swaying trees and gradual light changes.

The settings shall be individually configurable for each alarm and each camera pre-record duration. This shall allow the camera server to capture video prior to the alarm/event shall be selectable from a list o values ranging between 0 seconds and 5 minutes. The software for clients should also be working on a browser based system for remote users.

Retrieval: The CCTV application should allow retrieval of data instantaneously or any data/time interval chosen through search functionality of the application software. Incase data is older than 30 days and available, the retrieval should be possible.

The system should be allow for backup of specific data on any drives like CD/DVD/Blue ray Recorders or any other device in a format which can be replayed through a standard PC based software.

Log of any such activity should be maintained by the system which can be audited at a later date.

Storage: Data storage should be at a central location. The capacity of the storage should be for 24 hour operation of 30 days recording for all cameras at 1080p, 30 fps and H.264 / H.265 compression in accordance with manufacture's recommendation for operation of CCTV system as specified herein and shown on drawing / BOQ with 25% expansion capacity.

Artificial Intelligence: It shall have image tracking facility. If any object is found to be stationary for a pre-defined period the system shall track the event and alert the operator. This facility shall be provided on all cameras. The system must have the features for abandoned object, intrusion detection, camera sabotage, wrong direction,

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loitering detection, object counting, object removal, stopped vehicle, identifying tail-gating, vehicle detection features, unattended baggage identification, queuing analysis, and external text insertion feature and intruder detection.

5.1 **Network Passive**

Network passive such as patch panels, patch cords, cable management, 19" rack with fan tray & 13 Amp outlets shall be provided according to the system requirement and in accordance with specification given in Section 8312.

6.0 INSTALLATION

Installation of CCTV System shall be done in strict accordance with the manufacturer's recommendations.

7.0 TRAINING

A training session shall be presented by a fully qualified, trained representative of the equipment manufacturer/supplier who is thoroughly knowledgeable of the specific installation. The training shall be given to personnel responsible for operation and maintenance of the system.

8.0 MEASUREMENT AND PAYMENT

8.1 **General**

The Contractor bid amount, against each Bill of Quantities item as given below, shall include design, supply, installation, testing, commissioning and completion for all work specified herein and / or as shown on the Contract Drawings related to the item.

8.2 **IP Fixed Colour Camera Power Over Ethernet (POE) / IP PTZ Dome Camera**

8.2.1 **Measurement**: Measurement shall be made for the total number of IP Fixed Colour Camera / IP PTZ Dome Camera with accessories acceptably supplied and installed by the Contractor as a complete unit.

8.2.2 **Payment**: Payment shall be made for IP Fixed Colour Camera / IP PTZ Dome Camera for number of units measured as provided above at the Contractor unit price and shall constitute full compensation for supplying, installing, connecting, testing and commissioning of the IP Fixed Colour Camera / IP PTZ Dome Camera with housing including all installation and mounting accessories.

8.3 **42 inch UHD 4k Monitoring LED Displays**

8.3.1 **Measurement**: Measurement shall be made for the complete job of required number of 42 inch UHD 4k LED display for matrix / spot with decoders for viewing with all essential equipment and interconnecting cables as a complete job acceptably supplied and installed by the Contractor.

8.3.2 **Payment**: Payment shall be made for complete job measured as provided above at the Contractor unit price and shall constitute full compensation for supplying, installing, connecting, configuring, programming testing, commissioning and completion of required number of 42 inch UHD 4k LED display for matrix / spot viewing with all essential equipment i.e. decoders, interconnecting cables etc. as required complete in all respect.

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8.4 **Operator Console**

8.4.1 **Measurement**: Measurement shall be made for the Operator Console as a complete job acceptably supplied and installed by the Contractor.

8.4.2 **Payment**: Payment shall be made for Operator Console for complete job measured as provided above at the Contractor unit price and shall constitute full compensation for supplying, installing, connecting and completion of the Operator Console for housing LED Displays, computer, PA microphone & PTZ Controller with drawers and chairs including all installation and mounting accessories.

8.5 **Latest Generation version Computer comprising 21" LCD, Wireless Keyboard, Wireless Mouse and associated accessories**

8.5.1 **Measurement**: Measurement shall be made for the total number of Latest Generation version Computer comprising 21" LCD acceptably supplied and installed by the Contractor as a complete job.

8.5.2 **Payment**: Payment shall be made for the complete job of Latest Generation version Computer comprising 21" LCD for complete job measured as provided above at the Contractor unit price and shall constitute full compensation for supplying, installing connecting, testing and commissioning, configuring of Latest Generation version Computer comprising 21" LCD Screen, CPU with license operating system, license Antivirus Software, license CCTV Software, Wireless Keyboard, Wireless Mouse with all essential interconnecting cables as required for system operation.

8.6 **Network Video Recorder on H.265 / H.264 compression & Central Management Server**

8.6.1 **Measurement**: Measurement shall be made for the Network Video Recorder & Central Management Server on as a complete job acceptably supplied and installed by the Contractor.

8.6.2 **Payment**: Payment shall be made for Network Video Recorder on H.265 / H.264 compression & Central Management Server for complete job measured as provided above at the contract unit price and shall constitute full compensation for supplying, installing, testing, commissioning, configuring and completion of the Network Video Recorder on H.264 / H.265 compression standard & Central Management Server for required number of cameras as mentioned in BOQ for 24 hours 30 days with 25% expansion capacity complete in all respect.

8.7 **PTZ Controller**

8.7.1 **Measurement**: Measurement shall be made for the total number of PTZ Controller with accessories acceptably supplied and installed by the Contractor as a complete unit.

8.7.2 **Payment**: Payment shall be made for PTZ Controller for number of units measured as provided above at the Contractor unit price and shall constitute full compensation for supplying, installing connecting, testing and commissioning of the PTZ Controller with control functions complete in all respect.

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8.8 **Layer-2 Access PoE Switch**

8.8.1 **Measurement**: Measurement shall be made for the total number of Layer-2 Access PoE Switch each acceptably supplied and installed by the Contractor as a complete unit.

8.8.2 **Payment:** Payment shall be made for the total no. of units of Layer-2 Access PoE Switch measured as provided above at the Contract unit prices each and shall constitute full compensation for supplying, installing connecting, testing, commissioning, configuring and completion of the Layer-2 Access power over Ethernet PoE Switch with required Copper and Fiber SFP ports transceiver as mentioned in BOQ complete in all respect.

*** End of Section 8335 ***

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SECTION – 8341

PUBLIC ADDRESS & VOICE EVACUATION SYSTEM

1.0 SCOPE OF WORK

The work under this section consists of supply, installation, connecting, configuring, programming, testing, commissioning and training of all equipment, material, accessories and services for Public Address and Voice Evacuation System shall be complete in all respect as described in these specifications, drawings, B.O.Q and in accordance with International Organization for Standardization (ISO).

The Contractor will discuss the Public Address and Voice Evacuation System layout with the Engineer and coordinate at site with other services for exact route, location and position of electrical / telecommunication lines and equipment.

The Public Address and Voice Evacuation System with accessories shall also comply with the General specifications for Electrical Works Section - 8001, General Technical Requirements for Communication Works Section – 8002 and with other relevant provisions of the Contract Document.

2.0 GENERAL

Public Address and Voice Evacuation System shall be provided as shown on drawings.

Public address and Voice Evacuation system shall interface with the Addressable Fire Alarm System in accordance with NFPA 72.

All the active items of the Public Address and Voice Evacuation System shall be listed as a product of a single manufacturer.

The system shall make use of modular design to enable future enhancements.

Contractor shall submit Sound Pressure Level (SPL) calculation of speakers for review.

Contractor shall consider 65-70 dB as background noise level for calculation of Sound Pressure Level (SPL) of speakers.

A feedback circuit arrangement shall be provided to keep sound pressure levels at least 10 db above background noise.

A supervisory system shall monitor loudspeaker loop for open circuits, short circuit and earth leakage conditions.

Announcement facility shall be provided at Command & Control Room (CCR).

Configuration of the system for microphone control and priority setting shall be as follows:

- The highest priority input shall be used for emergency announcements from a P.A. announcer console installed in Command & Control Room (CCR).
- The medium priority input shall be used for normal public announcements from a P.A. announcer console installed in Command & Control Room (CCR).
- The lowest priority shall be accorded to the background music input / normal pre-recorded message.

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Power amplifier outputs shall be of the 100V type. The equipment rack shall be connected to the UPS.

It shall be possible to combine the zones of within floor and each floor into a group for simultaneous broad casting.

All equipment, cables and wires shall be numbered in accordance with the standardization procedures laid down in IEC 750.

Contractor shall point by point confirm in writing their compliance with the items of this specifications in the form of a qualified statement of compliance.

Materials furnished under this specification shall be standard product of manufacturers, regularly engaged in the production of such equipment. Manufacturer shall also have authorized representative in Pakistan for maintenance of the equipment.

All junction boxes, glands (if required) shall be provided and price shall be deemed included in respective BOQ Item.

3.0 APPLICABLE STANDARDS AND CODES

EN54, CE, DIN 4002, DIN 45573 and DIN 45589 shall be applicable for the material covered within the scope of this section.

4.0 MATERIAL

4.1 System Manager / Network Controller with Software:

The System Manager with input and output as shown on the drawing and required as per manufacturer's recommendation shall be provided. Required Matrix Zones Bus shall be modular and shall have the following minimum characteristics:

- Indication	Available
- LAN	Available
- Control Input	8 inputs minimum
- Control Output	5 output minimum
- Audio Input	2 input
- Standby Amplifier Input	1 x input, 1 x output
- Distortion:	Less than 1% (at rated output f = 1 kHz Sine wave)
- Emergency Power Supply	Available
- CD Player	Available

System Manager Component shall have a provision of 25% spare capacity in main console including emergency power supply in order to cater future PA equipment requirement.

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4.2 Power Amplifier

Contractor shall provide dedicated duty amplifier for each zone as specified in load calculation chart in public address & voice evacuation schematic diagram as per their proposed manufacturer.

1 Nos. of auto standby amplifier of highest wattage shall also be provided and cost of all duty and spare amplifiers shall be deemed included in respective BOQ item.

The power amplifier shall have the following characteristics:

- Rated Output Power: As per zone load calculation given in PA schematic diagram.
- Output Voltage 100 V
- Inputs and Outputs: Available

4.3 Horn Loudspeaker

Weather Proof Horn Loudspeaker suitable for mounting on wall brackets shall be used wherever required. Speakers shall be installed with junction box, ceiling rose, built-in driver unit, glands, integrated 100 V-matching transformers and wall mount bracket for which price shall be deemed included in their respective BOQ item.

Horn Loudspeaker shall have following minimum technical specification.

- Rated output power: 30 watt
- Frequency Response: 250 Hz – 10 kHz
- Sensitivity / SPL: 100 dB (1 W, 1 m) or higher
- Rated Voltage: 100 volts.
- IP Rating: IP65 Rated

4.4 Wall Loudspeaker

Wall Loudspeaker suitable for mounting on wall brackets shall be used wherever required. Speakers shall be installed with junction box, ceiling rose, built-in driver unit, glands, integrated 100 V-matching transformers and wall mount bracket for which price shall be deemed included in their respective BOQ item.

Wall Loudspeaker shall have following minimum technical specification.

- Rated output power: 30 watt
- Frequency Response: 80 Hz – 20 kHz
- Sensitivity / SPL: 85 dB (1 W, 1 m) or higher
- Rated Voltage: 100 volts.

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4.5 Ceiling Loudspeaker

Ceiling Loudspeaker shall be provided as per requirement. Speakers shall be installed with fire dome, junction box, ceiling rose, driver unit, glands, integrated 100 V-matching transformers and other required accessories for which price shall be deemed included in their respective BOQ item.

Ceiling Loudspeaker shall have following minimum technical specification.

- Rated Power — 6 watt
- Rated Voltage — 100 volts.
- Frequency Range — 80 Hz – 20 kHz
- Sound Pressure Level (SPL) — 87 dB (1 W, 1 m) or higher

4.6 Remote Microphone

The remote microphone shall have the following characteristics:

- Distortion: — Less than 1%
- Frequency Response: — 100 Hz – 20 kHz
- Signal to Noise Ratio (S/N) — ≥ 60 dB

4.7 Loudspeaker Cable

Wiring and cabling of loudspeaker cable shall be carried out in PVC/G.I conduits as required. 2 x 1.5 mm^2 fire resistant enhanced cable with LSZH outer sheath / manufacturer's recommended cable shall be provided for the wiring of loudspeaker cable for Public Address System. The cable shall be able to work for 120 minutes in fire condition.

All wires and cables shall be checked for open, short or ground faults. All wiring shall be made on terminal blocks of proper size and type for the services involved. Cable joints shall only be allowed on the speaker junction boxes. Appropriate size nos of cable glands and junction boxes shall be provided for speakers.

4.8 Remote Microphone Cable

Wiring of microphone cable shall be carried out in PVC/G.I conduits as required. Cat 6 STP LSZH cable / manufacturer's recommended cable shall be provided for the wiring of remote microphone of Public Address and Voice Evacuation System.

4.9 Public Address and Voice Evacuation Rack

Cabinet shall be 19 inch, with tie and retainers for cabling system and 600mm x 600mm, 800mm x 600mm and 1000mm x 800mm cabinet shall be suitable to install:

- Colour of rack: Black.
- Plexi glass door.
- Frame thickness 2mm, mounting rail thickness 2mm, roof thickness 1.63mm, rear door thickness 1.63mm and side panels thickness 1.2mm.
- At least two cooling fan.

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- Cable entries from both top and bottom panel.
- Cabling guide system in each internal side of cabinet for front and back side.
- Earthing / grounding point.
- Door lock with key locking capacities.
- Right or left opening of door of rack shall be provided as per requirement of room.
- A cabling guide system in each internal side of the cabinet for the front side;
- A cabling guide system in each internal side of the cabinet for the backside;
- An earthing point, multi-socket strip for supply power to the active equipment;
- Metallic door shall be provided with key locking capabilities.

Power distribution unit (PDU) must have following specification:

- At least two extra sockets as per requirement of active equipment installed inside rack.
- PDU with sockets compatible with active equipment
- Industrial male plug / compatible with power socket.
- Two PDUs in each rack for active equipments that have dual power supply.

5.0 MULTIMEDIA PROJECTOR AND MOTORIZED PROJECTOR SCREEN

5.1 Multimedia Projector:

Multimedia projector has following minimum specifications:

Resolution:	WUXGA (1920 x 1200 pixels)
Brightness:	5000 lumens
Contrast:	16000:1
Panel size:	0.64 inches (16:10 aspect ratio)
Screen size: (Diagonal)	30-300 inches
HDMI Port:	Available

5.2 Motorized Projector Screen:

Multimedia projector screen has following minimum specifications:

Aspect Ratio:	High Definition (16:9)
Screen Size:	10'.7" x 6'x8"
Screen Surface:	Matte White

All VGA, HDMI, RC Outlet with faceplate shall be provided in standard switch backbox. Contractor to interface proposed multimedia projector screen with public address system of Conference Room and cost shall be deemed included in respective BOQ item.

High Speed HDMI cable shall be provided to handle video resolutions of 1080p and beyond. The cable must be LLC Certified of any approved European brand in appropriate size of PVC conduit from HDMI outlet box to Multimedia Projector and shall be complete with termination at both ends including connectors. Complete in all respects.

Contractor shall prepare detailed conduiting layout in shop drawing for projector according to proposed selected make i.e. Conduiting layout shall be in accordance with proposed manufacturer's recommendation including all floor boxes, each type of communication cables, power cables, power sockets as required. Complete in all respect.

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6.0 TRAINING

A training session shall be presented by a fully qualified, trained representative of the equipment manufacturer/supplier who is thoroughly knowledgeable of the specific installation. The training shall be given to personnel responsible for operation and maintenance of the system.

7.0 INSTALLATION

7.1 Public Address and Voice Evacuation System Equipment

The installation of Public Address System Equipment shall be in strict accordance with the manufacturer's instructions/recommendations and these specifications.

The testing of Public Address equipment shall be in compliance with the relevant standards and regulations. During testing of equipment, emphasis shall be laid on the following:

- Zone wise and group wise microphone live broadcast routing
- Microphone priority testing

7.2 Wiring and Cabling

Wiring and cabling of Public Address and Voice Evacuation System shall be carried out as per instructions given in Section 8212 'Low Tension Cables' of these specifications.

7.3 Conduits and Accessories

Conduits and accessories for PA system shall be installed as per instructions given in section 'Conduits and Pipes', of contact specifications.

8.0 MEASUREMENT AND PAYMENT

8.1 General

The Contractor's bid amount against each Bill of quantities item as given below shall include supply, installation, testing, commissioning and completion of all work specified herein and/or as shown on the Contract Drawing related to the item.

8.2 System Manager with required Matrix Bus with Software etc.

8.2.1 **Measurement:** Measurement shall be made for System Manager with required Matrix bus with 25% spare capacity having microprocessor modular matrix, MP3 / USB / CD / SD / Tuner format playing card, input card, output card, LAN connectivity, dedicated duty amplifier for each zone as mentioned in load calculation sheet in schematic diagram, auto standby amplifier of highest wattage, automatic switchover, line fault detection system, manufacturer's recommended emergency power supply backup with DC power output, trickle charging, with suitable manufacturer's recommended backup batteries as required, PA software, SPL calculations, interfacing with fire alarm system including any other essential interconnecting equipment and cabling as required with all installation and mounting accessories for satisfactory operation of the entire public address & voice evacuation system acceptably supplied and installed by the Contractor as a complete job.

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8.2.2 **Payment:** Payment shall be made for the complete job measured as provided above at the contract unit price and shall constitute full compensation for supplying, installing, connecting, configuring, programming, testing, commissioning and completion of System Manager with required Matrix bus with 25% spare capacity having microprocessor modular matrix, MP3 / USB / CD / SD / Tuner format playing card, input card, output card, LAN connectivity, dedicated duty amplifier for each zone as mentioned in load calculation sheet in schematic diagram, auto standby amplifier of highest wattage, automatic switchover, line fault detection system, manufacturer's recommended emergency power supply backup with DC power output, trickle charging, with suitable manufacturer's recommended backup batteries as required, PA software, SPL calculations, interfacing with fire alarm system including any other essential interconnecting equipment and cabling as required with all installation and mounting accessories for satisfactory operation of the entire public address & voice evacuation system.

8.3 **Horn / Wall / Ceiling Loudspeaker with Matching Transformer**

8.3.1 **Measurement:** Measurement shall be made for the total number of each type of Horn / Wall / Ceiling Loudspeaker acceptably supplied and installed by the Contractor as complete unit.

8.3.2 **Payment:** Payment shall be made for the complete unit as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of each type of Horn / Wall / Ceiling Loudspeaker complete with driver unit, integrated matching transformer, fire dome and wall / ceiling mount brackets as specified in BOQ and specification including all mounting and installation accessories as required. Complete in all respect.

8.4 **Remote Microphone**

8.4.1 **Measurement:** Measurement shall be made for the total number of each type of Remote Microphone acceptably supplied and installed by the Contractor as complete unit.

8.4.2 **Payment:** Payment shall be made for the complete unit as provided above at the Contract unit price each and shall constitute full compensation for supplying, installing, connecting, testing, commissioning and completion of each type of Remote Microphone with essential interconnecting equipment as specified in BOQ including all mounting and installation accessories.

8.5 **Public Address Rack**

8.5.1 **Measurement**: Measurement shall be made for the total number of each type of Public Address Rack for installation of system manager, power amplifier, and accessories of public address system and terminal strips for speaker circuits and microphone, earthing point, multi-socket strip for supply power to the amplifier, Plexi glass door with key locking capabilities acceptably supplied and installed by the Contractor as a complete unit.

8.5.2 **Payment**: Payment shall be made for the complete unit as provided above at the Contract unit Price each and shall constitute full compensation for supplying, installing, connecting testing, commissioning and completion of each type of Public Address Rack for

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installation of system manager, power amplifier, and accessories of public address system and terminal strips for speaker circuits and microphone, earthing point, multi-socket strip for supply power to the amplifier, Plexi glass door with key locking capabilities acceptably supplied and installed by the Contractor as a complete unit.

8.6 **Wiring of P.A & V.A System- Loudspeaker / Microphone Cable**

8.6.1 **Measurement**: Measurement shall be made for the total running feet of wiring of Loudspeaker / Microphone of P.A & V.A System acceptably supplied and installed by the Contractor.

8.6.2 **Payment**: Payment shall be made for the total running feet as provided above at the Contract unit Price each and shall constitute full compensation for supplying, installing, connecting, laying, testing and commissioning of Loudspeaker / Microphone of P.A & V.A System acceptably supplied and installed by the Contractor including all installation accessories.

8.7 **Multimedia Projector, Motorized Projector Screen, Floor Boxes, Cabling, Conduiting etc.**

8.7.1 **Measurement**: Measurement shall be made for the complete job of Multimedia Projector, Motorized Projector Screen, Floor Boxes, Cabling, Conduiting, power sockets etc. acceptably supplied and installed by the Contractor.

8.7.2 **Payment**: Payment shall be made for the complete job of Multimedia Projector, Motorized Projector Screen, Floor Boxes, Cabling, Conduiting etc. measured as provided above at the Contract unit prices and shall constitute full compensation for detailed engineering design, supplying, installing, laying, connecting, configuring, programming, testing, commissioning and completion of the Multimedia Projector, Motorized Projector Screen, Floor Boxes, Power Sockets etc. interfacing with public address system as mentioned in BOQ including power supply, all essential interconnecting cables and conduiting and conduiting layout, mounting and installation accessories for satisfactory operation of the entire system. Complete in all respect.

*** End of Section 8341 ***

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SECTION - 8371

CABLE ANTENNA TV SYSTEM (CATV)

1.0 SCOPE OF WORK

The work under this section consists of supplying, installing, testing, commissioning and training of all material and services of Cable Antenna TV System as stated herein, as shown on the Bidding Drawings and as given in the Bill of Quantities.

The Contractor will discuss the Cable Antenna TV System layout with the Engineer and coordinate at site with other services for exact route, location and position of electrical lines and equipments.

The Cable Antenna TV System with accessories shall also comply with the general Specifications for Electrical works Section 8001and with other relevant provisions of the Bidding Documents.

2.0 GENERAL

The CATV System shall be of single manufacturer.

The CATV System under present contract covers following:

- RG-6 and RG-11 co-axial cable
- Splitters / Tapoffs and TV Sockets
- Conduits
- Cabinet

Contractor is to co-ordinate with local CATV Service Provider for installation of their active CATV equipment covered in CATV Service Provider scope of work and also route of their incoming TV Cable.

3.0 APPLICABLE STANDARDS/CODES

IEC-728 and relevant DIN Standards shall be applied for the material covered within the scope of this section.

4.0 MATERIAL

4.1 8 way Splitter

Splitter shall have the following minimum technical Specifications:

Frequency range	:	5 to 1000 MHz
Distribution/insertion	:	less than 11 dB
Isolation	:	greater than 25 dB
Screening factor	:	greater than 85 dB

4.2 4 way and 8 way Tap-off

Directional tap-off units shall have the following minimum technical Specifications:

4 Way Tap-off	:	RG11 to RG6
Frequency	:	470-862 MHz
Through loss	:	3 dB in-out

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Side loss attenuation	:	14.5 dB in-tap
Directional attenuation	:	greater than 28 dB out-tap
Isolation	:	greater than 40 dB tap-tap
8 Way Tap-off	:	RG11 to RG6
Frequency	:	470-862 MHz
Through loss	:	6.7 dB in-out
Side loss attenuation	:	15 dB in-tap
Directional attenuation	:	greater than 30 dB out-tap
Isolation	:	greater than 35 dB tap-tap

4.3 **TV sockets**

TV sockets shall have the following minimum technical Specifications:

Frequency	:	5-862 MHz
Screening factor	:	greater than 85 dB class A
Isolation	:	greater than 20 dB

4.4 **Coaxial Cable**

RG-11 Coaxial Cable shall have the following minimum technical Specifications:

Inner Conductor	:	Cu-core, bare
Dielectric Coating	:	PE foamed / PIB
Outer conductors		
First screening	:	Bonded Al-foil
Second screening	:	Cu-Sn braid
Third screening	:	Al-foil
Outer sheath	:	LSZH
Screening factor	:	greater than 115 dB
Loop resistance	:	31 ohm/km

RG-6 Coaxial Cable shall have the following minimum technical Specifications:

Inner Conductor	:	Cu-core, bare
Dielectric Coating	:	PE foamed / PIB
Outer conductors		
First screening	:	Bonded Al-foil
Second screening	:	Cu-Sn braid
Third screening	:	Al-foil
Outer sheath	:	LSZH
Screening factor	:	greater than 110 dB
Loop resistance	:	16 ohm/km

4.5 **CATV Cabinet**

CATV Cabinet for installation of tap-off, splitter with all mounting and installation accessories.

5.0 **INSTALLATION**

Installation of the CATV System shall be in strict accordance with manufacturer's instruction and recommendations. Contractor shall coordinate with the service provider for installation, testing and commissioning of CATV system.

6.0 MEASUREMENT AND PAYMENT

6.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion of all work specified herein and/or as shown on the Bidding Drawing related to the item.

6.2 Splitters / Tapoff / TV Sockets

6.2.1 **Measurement:** Measurement shall be made for the total number of each type of passive device such as splitters, tap-offs and TV sockets acceptably supplied and installed by the Contractor as a complete unit.

6.2.2 **Payment:** Payment shall be made for the number of units measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing, testing and commissioning of each type of the passive device such as splitters, tap-offs and TV sockets including all accessories.

6.3 Coaxial Cable

6.3.1 **Measurement:** Measurement shall be made for the total number of units / running feet for each type of Coaxial Cable acceptably supplied and installed by the Contractor.

6.3.2 **Payment:** Payment shall be made for the total number of units / running feet of Coaxial Cable measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing, connecting, laying, testing and commissioning of the each type of Coaxial Cable including all accessories.

6.4 CATV Cabinet

6.4.1 **Measurement:** Measurement shall be made for the total number of each type of 16 SWG CATV Cabinet for installation of tap-off, splitter etc. acceptably supplied and installed by the Contractor as a complete unit.

6.4.2 **Payment:** Payment shall be made for the number of units of 16 SWG CATV Cabinet measured as provided above at the contract unit price each and shall constitute full compensation for supplying, installing and completion of each type of the CATV Cabinet for installation of CATV Active Equipment (covered in Service Provider scope of work), tap-offs, splitters with all mounting and installation accessories as shown on drawings with 25% expansion capacity for future use.

*** End of Section 8371 ***

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SECTION – 8373

ACCESS CONTROL SYSTEM

1.0 SCOPE OF WORK

The work under this section consists of supplying, installing, programming, configuring, testing, commissioning and training of all material and services for Access Control System as specified herein, as shown on Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the Access Control System Layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the Access Control System equipment.

The Access Control System work with accessories shall also comply with the "General Technical Requirement for Communication Systems" Section – 8002, and also, "General Specifications for Electrical Works" Section – 8001 and with other relevant provisions of the Contract Document.

2.0 GENERAL

The Access Control System will interface with Fire Alarm System in accordance with NFPA101.

Activation of fire alarm system shall automatically unlock doors and doors shall remain unlocked until fire alarm system has been manually reset.

3.0 APPLICABLE STANDARDS AND CODES

The following standards and all "normative addendums" shall be applicable to this document and must be adhered to for any installation work performed.

EIA/TIA 568	Commercial Building Telecommunications Cabling Standard.
EN50133X	European Norms
NFPA 101	Life Safety Code
UL294	Access Control System
CE Certified	

4.0 MATERIAL

System shall comprise but not limited to following:

4.1 Controller Board

Door / Gate Control Panel with reader capability, power-fail and panel tamper, backup battery system etc.

The controller board shall be microprocessor based, incorporating Flash ROM (firmware) downloadable from the Host Computer, RAM (User Information, System Setups, Event Transaction Buffer) and a Clock/Calendar. The ROM shall be modularly upgradeable in the field for enhancements to system features. There shall be status indicator lights for active relays, as well as diagnostic indicator lights to aid in system troubleshooting. Controller shall have TCP / IP support.

4.2 Enclosure

The controller enclosure shall be a weather proof metal enclosure with high security key lock designed for surface mounting. It shall have a tampered, removable hinged door with a high security key lock and price shall be deemed included in respective BOQ item.

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It shall have conduit knockouts to allow from 1/2" to 1" conduit to be used for wire entry into the cabinet.

4.3 Internal Power Supply

The controller shall have an internal power supply that will accept 220 VAC / 50 Hz. The primary side of the power supply shall be protected with a fuse. The DC power shall be supply to the controller board, internal battery charger, selected card readers, and reader interface boards.

4.4 Standby Battery

The controller shall have an internal standby battery that is capable of running the system during AC power interruptions. It shall be recharged by a charging circuit incorporated into the controller board.

4.5 Intelligent Smart Reader

The control panels shall utilize multi-function smart card reader interface to communicate with card readers of various types.

The reader shall be state of art with built-in biometric fingerprint, pin code, card and RFID tags reader. It is also be required that vehicles of staff shall be automatically identified by RFID and tagging.

The control panels shall utilize an intelligent reader interface to communicate with card readers of various types. The interface shall be microprocessor based. The interface shall utilize a digitizing algorithm, which will convert the card data to a unique number, thus, eliminating the need for facility codes. A single interface shall support both entrance and exit readers with keypads associated with each door. The reader interface shall be included as standard in all Scramble Pads.

4.6 Smart Cards

Smart cards compatible with intelligent smart reader shall be provided.

4.7 Exit Push Button

Exit push button shall be provided to signal the access control panel to unlock a door and inhibit door alarms when exiting.

4.8 Magnetic Door Lock

Magnetic Door lock for minimum 1200 lbs shall be provided for each type of door where door controller and reader are shown as per manufacturer.

4.9 Server Hardware / Software

Licensed Access Control System Software as required for system operation suitable to meet system requirements shall be provided and shall be loaded in CCTV Workstation.

5.0 INSTALLATION

Installation of access control system and gate barrier & RFID access control system shall be done in strict accordance with the manufacturer's recommendations

6.0 TRAINING

A training session shall be presented by a fully qualified, trained representative of the equipment manufacturer/supplier who is thoroughly knowledgeable of the specific installation. The training shall be given to personnel responsible for operation and maintenance of the system.

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7.0 MEASUREMENT AND PAYMENT

7.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Contract Drawings related to the item.

7.2 Ethernet based Door Controller Board

7.2.1 **Measurement:** Measurement shall be made for the Ethernet based Door Controller Board comprising enclosures, reader interface, power supply, batteries etc. acceptably supplied and installed by the Contractor as complete job.

7.2.2 **Payment:** Payment shall be made for complete job of Ethernet based Door Controller Board as provided above at the Contract unit price and shall constitute full compensation for supply, installing, configuring, testing, commissioning and completion of Door Controller Board including enclosures, reader interface, power supply, batteries etc. including all installation and mounting accessories. Complete in all respect.

7.3 Intelligent Smart Reader

7.3.1 **Measurement:** Measurement shall be made for the Intelligent Smart Reader comprising Biometric, Pin Code, Touch Memory and Card Swapping acceptably supplied and installed by the Contractor as complete unit.

7.3.2 **Payment:** Payment shall be made for the Intelligent Smart Reader as provided above at the Contract unit price and shall constitute full compensation for supply, installing, configuring, testing, commissioning and completion of Intelligent Smart Reader including Biometric, Pin Code, Touch Memory and Card Swapping operation including all installation and mounting accessories. Complete in all respect.

7.4 Contact less smart card

7.4.1 **Measurement:** Measurement shall be made for Contact less smart card acceptably supplied and installed by the Contractor as complete unit.

7.4.2 **Payment:** Payment shall be made for the Contact less smart card as provided above at the Contract unit price and shall constitute full compensation for supply, installing, testing and commissioning of Contact less smart card etc. complete in all respect.

7.5 Magnetic Door Lock & Release

7.5.1 **Measurement:** Measurement shall be made for Magnetic Door Lock and Release acceptably supplied and installed by the Contractor as complete unit.

7.5.2 **Payment:** Payment shall be made for the Magnetic Door Lock and Release as provided above at the Contract unit price and shall constitute full compensation for supply and installing of Magnetic Door Lock with accessories etc. including all installation and mounting accessories. Complete in all respect.

7.6 Exit Push Button

7.6.1 **Measurement:** Measurement shall be made for Exit Push Button acceptably supplied and installed by the Contractor as complete unit.

7.6.2 **Payment:** Payment shall be made for the Exit Push Button as provided above at the Contract unit price and shall constitute full compensation for supply and installing of Exit Push Button with accessories etc. complete in all respect.

*** End of Section 8373 ***

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SECTION - 5100

P L U M B I N G

1.0 SCOPE

The work under this section consists of providing all material and equipment and performing all the work necessary for the complete execution and completion, including testing and commissioning of all systems of plumbing works as shown on the drawings and/or as specified herein and/or as directed by the Engineer. The systems included in plumbing works are as follow:

a) Cold and Hot Water Supply
b) Sanitary Drainage
c) Roof Drainage

All the above-mentioned systems shall be completed in all respects including extension of these internal systems upto the specified limits outside the building as indicated on the drawings.

2.0 GENERAL

Unless otherwise specifically stated, all pipe diameters indicated on the drawings and specified herein shall be treated as Nominal Diameters (DN) or Nominal Pipe Sizes (NPS), in accordance with the applicable standards and codes.

All the materials and equipment shall be of the specifications mentioned herein and the Contractor shall submit the sample, necessary catalogues, sketches, the name of manufacturer and guarantee, if necessary, before installation. The system shall be installed after the Engineer approves it. All material and equipment shall be new and unused.

Approval of material and equipment by the Engineer shall not absolve the Contractor of the responsibility of furnishing the same of proper size, quantity, quality and all performance characteristics to efficiently fulfill the requirements and intent of the Contract Documents.

The Contractor shall be responsible for his work until its completion and final acceptance, and shall replace any of those that may be damaged, lost or stolen without any additional cost. All openings left in floor for passage of lines of water supply, soil, waste, vent, etc. shall be covered and protected.

All open ends of pipes shall be properly plugged to prevent any foreign material from entering the pipe.

Misuse of plumbing fixtures to be installed under this Contract is prohibited during the currency of the contract.

All metal fixture trimmings shall be thoroughly covered with non-corrosive grease, which shall be maintained until all work is completed.

Upon the completion of work, all fixtures and trimmings shall be thoroughly cleaned, polished and left in perfect condition.

Before erection, all pipes, valves, fittings, etc. shall be thoroughly cleaned of oil, grease or other material.

All special tools for proper operation and maintenance of the equipment provided under this Contract shall be delivered at no additional cost.

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All pipes shall be properly installed as shown on the drawings and/or as directed by the Engineer, and shall be as straight as possible forming right angles and parallel lines with the walls and other pipelines. The position, gradients, alignment and inverts shall be as shown on the drawings and/or as directed in writing and set out by the Engineer.

The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. However, the Engineer reserves the right to change the location. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping, so installed, the Contractor shall be held liable for any damage caused to other works in the correction of piping. The Contractor shall closely coordinate with other works and utilities during the entire stage of execution.

A minimum distance between different services shall be maintained as per applicable codes and standards that is shown on the Drawings and/or as approved by the Engineer.

Pipes should be installed in such a manner that minimum distance should always be maintained between pipe and wall, beams, columns, etc. Pipes shall be supported on hangers and brackets as shown on the drawings or as directed by the Engineer.

Waste-water outlet from each fixture shall be individually trapped.

Each vent terminal shall extend to the outer air and be so installed as to minimize the possibilities of clogging and the return of foul air to the building.

When the roughing-in is completed where required after approval by the engineer, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are watertight.

Cast iron soil and drainage fittings for change in direction shall be used as follows:

*Vertical to horizontal: short sweep or long-turn for diameter 75 mm and larger; long sweep or extra-long-turn for less than 75 mm dia.

*Horizontal to vertical: quarter bend or short turn.

All fittings with hubs shall be aligned so that the hub faces upstream.

No drainage or vent piping shall be drilled.

All exterior openings provided for the passage of piping shall be properly sealed with snugly fitting collars of metal or other approved rodent-proof material securely fastened into place.

Joints at the roof, around vent pipes, shall be made watertight by the use of lead, copper, galvanized iron, or other approved flashings or flashing material. Exterior wall openings shall also be made watertight.

Each length of pipe and each pipe fitting, trap, fixture, and device used in a plumbing system shall have cast, stamped or indelibly marked on it the maker's mark or name, the weight, type, and classes of the product, when such marking is required by the approved standard that applies.

Where different sizes of pipes, or pipes and fittings are to be connected, the proper size increasers or reducers or reduced fittings shall be used between the two sizes.
Any fitting or connection which has an enlargement, chamber, or recess with a ledge, shoulder, or reduction of pipe area that offers an obstruction to flow through the drain pipe is prohibited.

Each fixture trap shall have a water seal of not less than 50 mm and not more than 100 mm. Full S, bell; crown vented traps and traps/depending for their seal upon the action of movable

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parts are prohibited. No fixture shall be double trapped. Where fixture comes in contact with wall and floors, the joint shall be watertight. Piping in ground shall be laid on a firm bed as per detail shown in the relevant drawings for its entire length.

Piping in the plumbing system shall be installed without undue strains and stresses. Vertical piping shall be securely held to keep the pipe in alignment and carry the weight of the pipe and contents. Horizontal piping shall be supported to keep it in alignment and prevent sagging. Hangers and anchors shall be of metal of sufficient strength to maintain their proportional share of pipe alignments and prevent rattling. Hangers and anchors shall be securely attached to the building under construction. It must be clearly understood that the Contractor shall be fully responsible for hangers and supports and shall obtain prior approval of design as to the shape, material, dimensions, spacing etc.

Piping in concrete or masonry walls or footings shall be placed or installed in sleeves, which will permit access to the piping for repair or replacement. Roof drain leaders installed inside columns shall be permanently embedded in concrete.

The indirect waste piping from food handling equipment etc. shall so discharge that the air gap between the indirect waste and the building drainage system is at least twice the effective diameter of the drain served.

3 COLD & HOT WATER PIPES AND PIPE FITTINGS

3.1 Scope

The work under this section of the specifications consists of providing all plant, labour equipment, appliances, material and labour for proper supply and installation of PPR Pipes and pipe fittings for cold and hot water supply including jointing, clamping, cleaning, painting etc. both above ground and underground and embedded in walls as shown on the Drawings or as specified herein.

3.2 PP-R Pipes & Fittings for Water Supply

3.2.1 Material

All cold & hot water pipe work shall be PP-R (S-2.5, SDR-6, PN-20) (Polypropylene Random-Copolymersate). The pipes shall be stabilized to high temperature, conforming to ISO 15874, DIN 8077 & DIN 8078 with heat fusion welded joints.

All PPR fittings shall be PN25 conforming to DIN 16962.

3.2.2 Installation

The run and arrangement of all pipes shall be as shown on the drawings and as directed by the Engineer during installation. All vertical pipes shall be erected plumb and shall be kept parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls or hanged with roofs. If required to change the location etc. during the execution of the work, the Contractor will do so at no additional cost. Contractor should follow the Manufacturer's recommendation for installation of the pipe and as directed by the Engineer.

All pipes passing through masonry walls shall be furnished with sleeves of G.I. sheet, 18 gauge, the inside dia. of which shall be at least 25 mm greater than the outside of the pipe passing through it.

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All pipe passing through structural elements (floor slabs, beams, columns etc.) shall be furnished with of uPVC pipes, conforming to BS 3505 or PS 3051 and BS 4346, Class 'B', the inside dia. of which shall be at least 25 mm greater than the outside of the pipe passing through it.

Sleeves in exterior walls, roof and pits shall have anchor flanges / puddle flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

3.2.3 Pipe work Supports

All supports, clips, steel rods and hangers shall be of mild steel painted with two coats of approved metallic zinc primer.

All clips and brackets shall be equipped with 1/3mm sectional rubber liners (shore-hardness A 40+50).

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches.

Each support shall carry the overall weight of pipe work and water to be borne by it. The intervals between pipe supports shall not exceed as per Manufacturer's recommendation and as directed by the Engineer.

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle from shall be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron bands.

All hanger rods shall have double nuts and beveled washers to allow the hanger rod to swing.

Multiple pipe run along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially. U-bolts shall be provided on alternate pipe bracket.

Small pipe work running along skirtings shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hang from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser.

Supports for insulated water pipe work shall be arranged such that the supporting steel work does not come into contact with the pipe surface.

Vibration isolators shall be provided with the hangers as approved by the Engineer.
Hangers and supports shall be from Hilti /Fishers or approved equivalent

3.3 G.I. Cold and Hot Water Pipes

3.3.1 Material

The galvanized pipes shall be of Medium series and conform to British Standard Specifications 1387 for "Steel Tubes and Tubular suitable for screwing to BS 21 pipe threads".

All screwed tubes and sockets shall have BS pipes thread in accordance with BS 21. In order to prevent damage to the leading thread, the ends of the sockets shall be chamfered internally.

A complete and uniform adherent coating of zinc will be provided for galvanized pipes.

Every tube shall be tested at the manufacturer's works to a hydraulic test pressure of 4.90 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection.

Tubes, which are bundled, shall be secured together by rope or soft iron or other suitable material.

The threads of all tubes shall be effectively covered with good quality grease or other suitable compound, and each tube above 50 mm nominal bore shall have a protecting ring affixed to the un socketed screwed end.

Pipe fittings above 75 mm dia. shall be of approved material and specifications as directed / approved by the Engineer.

All exposed GI piping shall have anticorrosive protective coating/ polyethylene tape coating for pipe protection.

3.3.2 Installation

The run and arrangement of all pipes shall be as shown on the Drawings and as directed by the Engineer during installation. All vertical pipes shall be erected plumb and shall be kept parallel to wall and other pipes. All horizontal runs of piping shall be kept close to walls. If required to change the location etc. during the currency of the work, the Contractor will do so at no additional cost. Contractor should follow the Manufacturer's recommendation for installation of the pipe and as directed by the Engineer.

Screwed joints in G.I. pipes shall be made perfectly tight, without the use of any filler except approved jointing compound or tape. Wherever required to make flanged joints, they shall conform to BS 10 Table D.

All pipe passing through floors and walls shall be furnished with sleeves of G.I. sheet, 18 gauge, the inside dia. of which shall be at least 15 mm greater than the outside of the pipe passing through it.

All pipe passing through structural elements (floor slabs, beams, columns etc.) shall be furnished with sleeves of uPVC pipes, conforming to BS 3505 or PS 3051 and BS 4346, Class 'B', the inside dia. of which shall be at least 15 mm greater than the outside of the pipe passing through it.

Sleeves in exterior walls and pits shall have anchor flanges and space between pipe and sleeve shall be caulked and sealed watertight. At waterproof locations, an approved water-proof type pipe sleeve shall be provided.

3.3.3 Pipe work Supports

All supports, clips, steel rods and hangers shall be of mild steel painted with two coats of approved metallic zinc primer.

All clips and brackets shall be equipped with 1/3 mm sectional rubber liners (shore-hardness A 40+50).

Pipe work supports shall be installed in order to allow free movement due to expansions and contraction. Supports shall be arranged adjacent to joints, changes of direction and branches.

Each support shall carry the overall weight of pipe work and water to be borne by it. The intervals between pipe supports shall not exceed as per Manufacturer's recommendation and as directed by the Engineer.

Single pipes hung from floor slabs shall be supported on rod hangers. Where two or more pipes are involved a channel or angle from shall be fitted to the underside of slab by two hangers and the pipes shall be supported from the channel iron by rod hangers and flat iron bands.

All hanger rods shall have double nuts and beveled washers to allow the hanger rod to swing.

Multiple pipe run along walls shall be supported on purpose made substantial angle and channel frames securely fixed to the wall, floor and ceiling as necessary. All pipes shall be arranged to slide on the steel supports and U-bolts shall be provided to form a rigid guide.

Exposed pipe work shall be supported on channel, angle iron or with U-bolts to form a rigid guide.

All U-bolts, except used as anchors, shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide and allowing the pipe to slide axially. U-bolts shall be provided on alternate pipe bracket.

Small pipe work running along skirting shall be supported by standard built-in or screw-on type clips.

Pipes shall be individually supported. Pipes shall not hang from other pipes.

Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

Vertical pipes shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means-of support for the riser.

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Supports for insulated water pipe work shall be arranged such that the supporting steel work does not come into contact with the pipe surface.

Vibration isolators shall be provided with the hangers as approved by the Engineer.

Hangers and supports shall be from Hilti /Fishers or approved equivalent

4 SOIL, WASTE AND VENT PIPES & FITTINGS

4.1 Scope

The work under this section of the specifications consists of providing all plant, equipment, appliances, material and labour for supply and proper installation of soil, waste, and vent pipes and pipe fittings including, clamping, cleaning, painting etc., as shown on the drawings or as specified herein.

4.2 PVC Waste and Vent Pipes & Fittings

4.2.1 Material

The material shall substantially consist of poly (vinyl chloride) (PVC) as per the requirements of aforesaid standard. Pipes and fittings shall be sufficiently stabilized against thermal ageing and ultraviolet (UV) light.

PVC pipes conforming to ASTM D-1785 Schedule 40 & fittings conforming to D-2466 for soil waste and vent shall be served as non-pressure pipes. Fittings and specials compatible to use with PVC pipes and jointing shall be elastomeric (Rubber ring) or solvent cement joint. Clamps hangers and supports shall be as recommended by manufacturer.

4.2.2 Installation

All PVC soil pipes and fittings shall be installed to the lines and grades shown on the drawings or as directed by the Engineer. When required to be installed above ground floor level, suitable and substantial number of hangers and supports of approved type and make shall be provided. No piping shall be hung from the piping of other systems. Clamps shall be provided on not more than 1.5 m centers or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive numbers of fittings are installed, additional clamps will be provided.

All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint.

PVC pipe and fittings installation and jointing should be push-fit/solvent joint as per Manufacturer and as directed by the Engineer.

Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 760 mm above the roof.

4.2.3 Rubber Rings

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The rubber rings may either be synthetic or natural conforming to ASTM Standards or as recommended by the manufacturer. PVC pipes shall be used for domestic installation inside the buildings for soil and waste discharge, ventilation and drainage of rain water.

5 TESTING AND COMMISSIONING

For testing and commissioning refer section 5180.

The Contractor shall furnish and pay for all devices, materials, supplies, labour and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

The Contractor shall also be responsible for the repair of this work & other trades work that may be damaged or disturbed by the tests.

Defects disclosed by the tests shall be repaired. Defective work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory.

6 MEASUREMENT AND PAYMENT

6.1 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment shall be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

- Submission of Samples.
- Factory Tests.
- Site demonstration test
- Transportation
- Cutting, jointing of pipes.
- Rubber rings.
- Providing & fixing of pipe.
- Pipe fittings and accessories
- Cleaning, testing and commissioning of lines.
- Testing and compaction of trench bottoms.
- Water used for testing of pipes.
- Hangers, clips and brackets, steel clamps, tie rods, nuts and bolts, Channels and angle iron, etc.),
- cutting and breaking concrete and then making it good,
- Protective painting, coating, lining and wrapping
- Cleaning, testing, disinfection (for potable water lines), commissioning.
- Marking etc.

6.1.1.1 Measurement

Measurement of acceptable completed work for PP-R, G.I, uPVC pipes & fittings shall be in running meter length and the work to be done shall include earth work, providing and fixing of pipe, pipe fittings, jointing, supports and the measurement will be made for complete work specified herein.

6.1.1.2 Payment

Payment will be made at the unit rate per running meter length of pipe quoted in Bill of Quantities and shall constitute full compensation for all the work related to the item.

7 PLUMBING FIXTURES

7.1 Scope

The work under this section of the specifications consists of providing all material and labour for supply and proper installation of plumbing fixtures such as wash basins, water closets, janitor sink, kitchen sink, shower head with mixer ,shower tray, urinals, baby bath tub and ablution faucet etc. alongwith all their accessories, water inlet connection, waste outlet connection etc. complete in all respect as specified herein or as shown on the Drawings and/or as directed by the Engineer.

7.2 Materials and Installation

7.2.1 General Requirements

Materials shall conform to the latest referenced standard specifications and other provisions stipulated herein and shall be new and unused.

All fixtures shall be imported and of best quality and finish and shall be of approved manufacture, shape and size.

Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval, a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy himself as to the suitability, durability, quality and usefulness of the material to be purchased.

Approval of the schedule shall not be construed as authorizing any deviations from the specifications unless the attention of the Engineer has been invited to the specific changes. If the material or equipment offered under this provision is, in the opinion of the Engineer, equal to or better than specified, it will be given consideration.

Plumbing fixtures shall have smooth impervious surfaces, be free from defects and concealed fouling surface. They shall be true to line, angles, curves and color, etc. All taps and cocks to be installed with plumbing fixtures shall be chrome plated (CP) and shall be of appropriate class to work without damage or leakage on the specified pressure of potable water system.

When any fixture is provided with an overflow, the waste shall be so arranged that the standing water in the fixture cannot rise in the over flow when the stopper is closed or remain in the overflow when the fixture is empty.

Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. The space between the fixture and the wall shall be closely fitted and pointed so that there is no chance for dirt or vermin to collect.

When practical, all pipes from fixtures shall be run to the nearest wall. Where fixture comes in contact with wall and floors, the joint shall be watertight.

Wall hung fixtures shall be rigidly supported by metal supporting members so that no strain is transmitted to the connections. Flush tanks and similar appurtenances shall be secured by approved non-corrosive screws or bolts.

Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet shall be set closer than 380 mm from its centre to any sidewall. No urinal shall be set closer than 300 mm from its centre to any side wall or partition or closer than 600 mm centre to centre.

The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow. All cuttings, making holes etc and making it good shall be included in the work. All fixtures shall be tested for soundness, stability or support and satisfactory operation.

7.2.2 Wash Basins

Wash basin shall be of vitreous China, of counter-top type, counter-sunk (under-counter), or wall-hung, with or without pedestal, of approved manufacture, shape, size, and type, as approved by the Engineer.

The wash basin shall be installed as a **complete unit**, including but not limited to the following:

a) SS or C.P. brass sensor basin mixer or lever-type or double-knob type, as specified in the BOQ item
b) C.P. brass stop cocks / angle valves
c) C.P. brass bottle trap for individual wash basins
d) C.P. brass strainer
e) Approved flexible connection hoses (SS braided type)
f) C.P. brass or steel waste outlet and/or waste pipe
g) Wall / deck escutcheons (rosettes)
h) Heavy-duty cast iron brackets complete with bolts and screws
i) All joints, jointing and sealing materials
j) All other accessories required to complete the work in all respects

7.2.3 Water Closets (European Type)

European type water closet shall be of vitreous China, one-piece unit (pan and low-level flush tank forming a single body), best quality, in the color, size, and type approved by the Engineer.

The flush tank shall be of low-level type, fitted with a double push-button flushing system, comprising one 3-liter (small) button and one 6-liter (large) button. The trap shall be cast integral with the pan.

The seat shall be of smooth, non-combustible, non-absorbent material (e.g., Bakelite), of open-front type, and fixed to the pan with hinges.

The water closet shall be installed as a complete unit, including but not limited to the following:

a) Approved water inlet connection pipe
b) C.P. brass stop cocks / angle valves
c) Nuts, bolts etc.
d) escutcheons (rosettes)
e) Any other accessories required to complete the installation

7.2.4 Water Closets (Asian Type)

Squatting (Asian/Orissa) type water closet shall be of vitreous China, including cistern of vitreous China with dual capacity of 3 and 6 liters, best quality, in the color, size, and type approved by the Engineer.

The flush tank may be of low-level or high-level type, as required,

The water closet shall be installed as a complete unit, with all necessary fittings and accessories, including but not limited to the following:

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a) Approved water inlet connection pipe
b) C.P. brass stop cocks / angle valves
c) Flush tank (low-level or high-level, as required)
d) Interconnecting flush piping
e) Joints, jointing, and sealing materials
f) Any other accessories required for complete installation

7.2.5 Kitchen Sink

Kitchen sink shall be of stainless steel 304, best quality, in the size, finish, and type approved by the Engineer.

The kitchen sink shall be installed as a complete unit, and shall include, but not be limited to, the following:

a) SS or C.P. brass mixer for hot and cold water, as specified in BOQ
b) Single or double deep-bowl type
c) C.P. brass stop cocks / angle valves
d) Approved water inlet connection pipes
e) C.P. brass strainer
f) C.P. brass or steel waste outlet and waste pipe
g) Heavy-duty brackets complete with bolts and screws
h) Joints, jointing, and sealing materials
i) Any other accessories required for complete installation

7.2.6 Bath Tub

Bath tub shall be of vitreous China, of approved manufacture, shape, and size, with smooth, burr-free edges, as approved by the Engineer.

The bath tub shall be installed as a complete unit, and shall include, but not be limited to, the following:

a) SS or C.P. brass mixer or pillar cock, as specified in BOQ
b) C.P. brass stop cocks / angle valves
c) C.P. brass chain complete with 40 mm rubber plug
d) C.P. brass strainer
e) C.P. brass or steel waste outlet and/or waste pipe
f) Heavy-duty cast iron brackets complete with bolts and screws
g) Joints, jointing, and sealing materials
h) Any other accessories required for complete installation

7.2.7 Urinal

Urinal shall be of vitreous China, of approved manufacture, shape, and size, as approved by the Engineer.

The urinal shall be of wall-hung type with external vertical top water inlet. The urinal shall be installed as a complete unit, including but not limited to the following:

a) Exposed C.P. brass wall-mounted self-closing flush valve, push button type, with 2-liter full flush capacity
b) C.P. steel flush pipe
c) C.P. steel waste pipe
d) Integral trap or separate C.P. brass P-trap, as applicable
e) Heavy-duty cast iron brackets complete with bolts and screws
f) Joints, jointing, and sealing materials
g) Any other accessories required for complete installation

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7.2.8 Exposed Shower System / Column

Shower system / column shall be of best quality, of approved manufacture, shape, and size, as approved by the Engineer,

The shower system / column shall be height-adjustable, wall-mounted, exposed type, installed at a suitable height as approved by the Engineer.

The shower system / column shall be installed as a complete unit, including but not limited to the following:

a) Matte or C.P brass shock-proof hand shower (~100mm dia.)

b) Matte or C.P brass shower head of square or round shape (~250mm dia.), with adjustable angle, as approved
c) Wall mounted Matte or C.P brass shower mixer with hot and cold-water taps, either knob or lever, as approved
d) Diverter (to switch between hand shower & head shower)
e) Matte or C.P brass flexible shower hose with suitable length (~1500-1750mm)
f) Matte or C.P brass extension pipe / shower riser with suitable length
g) Gliding element to adjust the height of hand shower
h) Matte or C.P brass shower arm
i) C.P. brass escutcheons (rosettes)
j) Joints, jointing, and sealing materials
k) Any other accessories required for complete installation

7.2.9 Janitor Sink

The janitor sink shall be of white fire clay, of approved manufacture, shape, and size, as approved by the Engineer.

The janitor sink shall be wall-mounted, complete with a with high splash back, and a stainless-steel lift-up bucket grid / grating.

The janitor sink shall be supplied and installed as a complete unit, including, but not limited to, the following:

a) Wall-mounted cold-water C.P. brass bib tap with exposed inlet
b) Overflow provision
c) Screen-type waste fitting, 40 mm diameter, with approximately 20 mm projection
d) C.P. brass P-trap, 50/40 mm diameter, with 75 mm water seal and adjustable inlet pipe
e) Set of built-in heavy-duty cantilever brackets of white-enameled cast iron
f) Joints, jointing, and sealing materials
g) Any other accessories required for complete installation

7.3 Testing and Commissioning

For testing and commissioning refer Section 5180.

7.4 Measurement and Payment

7.4.1 Measurement

Measurement for wash basins, water closets, kitchen sinks, bath tubs, urinals, shower system, and janitor sinks will be made as per actual number acceptably provided and installed. The Contractor's bid against these items shall include supply and installation of complete unit as specified herein, inclusive of all work from inlet connection of water supply to outlet connection with the sanitary system, complete as per Contract Documents and/or as directed by the Engineer.

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7.4.2 Payment

Payment of acceptable completed Measurement for wash basins, water closets, kitchen sinks, bath tubs, urinals, shower system and janitor sinks shall be made at the applicable unit price per number quoted in the Bills of Quantities and shall constitute full compensation for all the work related to that item.

8 MISCELLANEOUS ITEMS

8.1 Scope

The work under this section of the specifications consists of providing all material and labour, equipment, appliances etc., for supply and proper installation of miscellaneous plumbing items of valves, cocks, bottle trap, floor traps, floor drain, cleanouts, mirror, float valve as specified, herein or as shown on the Drawing or as directed by the Engineer. The Contractor shall furnish appropriate catalogues and literature and obtain approval of the Engineer before purchase.

8.2 Material and Installation

8.2.1 Taps and Cocks

All the taps and cocks shall be of brass, gun metal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall be chrome plated. The nominal size specified shall be the nominal bore of the seating. The area of the waterway throughout the body shall be not less than the area of a circle of diameter equal to the nominal size of tap/cock. Washers for cold water cocks shall be of specially selected leather, rubber composition or other equally suitable material. Every tap/cock shall be tested; complete with its component parts, to a hydraulic pressure of at least 1.96 MPa. During test it shall not leak.

8.2.2 Floor drains

Floor drains shall be of cast iron, uPVC or of other anti-corrosive metal. They shall have minimum water seal of min 50 mm and shall be provided with stainless steel grating and P-trap, removable bucket strainer and cleanout. The traps shall be of self-clearing type. The open area of the strainer shall be at least equal to the cross section area of the drain line to which it connects. Floor drains shall have provision for connection above the water seal. Floor drain shall be well set in position so that there is no leakage at the joint between trap and the floor.

8.2.3 Floor Traps

Floor traps shall be of cast iron, uPVC or of other anti-corrosive metal. They shall have minimum water seal of 50 mm and shall be provided with stainless steel grating and P-trap, removable nickel bronze strainers. The traps shall be of self-cleaning type. The open area of the strainer shall be greater than the cross section area of the drain line to which it connects. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

8.2.4 Cleanouts

Cleanouts of cast iron or uPVC shall be of the same nominal size as that of the pipe on which it is installed with chromium plated (CP) brass cover. Cleanouts shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be flush with the floor by means of finished metal plate secured in position and screwed firmly to the plug.

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Cleanout shall be so installed that there is a clearance of at least 300 mm for pipes less than 75 mm diameter and at least 500 mm for pipes of 75 mm and larger diameter, for the purpose of rodding.

Cast iron pipe used with cleanout shall be measured and paid under cast iron pipe item. All other work of ferrule, plug, concrete work, frame and cover etc. shall be measured and paid under cleanout item.

8.2.5 Vent Cowell

All vent pipe terminating above the building shall be provided with best quality cast iron and a stainless clamp for clamping of water proofing membrane as approved by the Engineer.

8.2.6 Glass Mirror

The glass mirror shall be of best quality and size, as approved by the Engineer, securely fixed on hard board packing and of first-class quality. The mirror shall be fixed on wall as shown on the drawing or as approved / directed by the Engineer.

8.2.7 Towel Rail

The chrome-plated stainless steel towel rail shall be of size as approved by the Engineer and shall be fixed to wall with chrome-plated brackets.

8.2.8 Toilet Paper Holder

The chrome plated stainless steel toilet paper holder (complete in all respects) shall be approved by the Engineer and shall be fixed to the wall with low level chrome plated screws.

8.2.9 Soap Dispenser/ Soap Dish

The chrome plated stainless steel soap dispenser/ soap dish (complete in all respects) shall be approved by the Engineer and shall be fixed to the wall at desired location.

8.2.10 Grab Bars

The Grab Bars for handicaps shall be of size as approved by the Engineer of chrome-plated steel and shall be fixed to wall with chrome-plated brackets.

8.2.11 Hand Drier

The hand drier shall be of best quality as approved by the Engineer with strong metal housing, infrared proximity switch and with easy operation. If required, it shall also be plugged in integrated installation kit for wall mounting.

8.2.12 Gully Traps

Gully traps in RCC / Block masonry chamber as shown on the drawing shall be provided with a P-trap having a 65 mm minimum water seal and a cast iron frame & cover and shall be internally plastered with pudlo shall be provided as per plumbing drawings and details.

8.2.13 Grease Traps

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Grease trap in RCC chamber shall be provided as per plumbing drawings and details. It shall be constructed according to the standards for drainage applications. Contractor should select the size of grease trap as per requirement of the sink connected or as shown in the drawing.

8.2.14 Fiber Glass Water Tank

Fiber glass tank shall be of specified capacity and shall be installed at location shown on drawings or directed by the Engineer.

Fiber glass tank shall be of thermo setting polyester resin reinforced with glass fiber. Resin shall be rapid curing and suitable for tropical climate. It shall conform to BS-3496, type E. The material shall have adequate strength, rigidity and resistance to impact. The tank shall be painted with heat reflecting metallic paint. The tank shall be non-toxic to water. It shall be impervious to water.

The tank shall have the following provisions:

- One manhole opening with cover of not less than 500 mm diameter or square size.
- Outlets for connection of filling overflow drain and supply pipe.
- Outlets for connection of vent pipe with cowel or wise mesh.
- Built-in feet for supporting the tank.

8.2.15 Electric Water Heaters

Water heater shall be of automatic storage type eclectically operated, including all necessary fittings for complete installation & operation. The heater shall be of best quality, as approved by the Engineer.

The working and test pressure of the heater to be of 6 bar and 10 bar respectively and shall deliver water at 150-degree F. It shall be capable to reach the peak demand, storage capacity.

Heater shall be provided with following accessories.

i) Thermostatic control

ii) Temperature & pressure relief valve High limit Control.

Other specifications of Water Heater are as given below:

Inner tank shall be extra heavy gauge anti-rust G.I. sheet metal to hold maximum system water pressure. As insulation, imported glass wool shall be used to maintain the desired temperature .The outer body shall be made of at least 16 gauge M.S. sheet shaped into reinforced circumference. Flow and delivery pipes shall be of high quality G.I. pipes fabricated with heavy gauge anti-rust baffle plate. The thermostat shall be of western European make. Special anti-rust-baked primer-heavy coated stove enamel paint with high gloss automotive shine shall be used on sheet metal.

6.2.18 Gas Water Heaters

Hot water heater shall be automatic, storage type and gas operated including all necessary fittings and accessories for complete installation & operation.

The minimum requirement of material and finish for the inner and outer shells shall be as given in the table below. Thicknesses of the outer and inner shells shall be adequate to withstand the rated pressure, but shall not be less than the thicknesses given in the table below.

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Heater		Inside	Outside	
Capacities	**Shell**	**Material**	**Finish**	**Finish**
Less than 50 Gallons	Inner	* 14 SWG Steel	Galvanized	Galvanized
	Outer	22 SWG Steel	Galvanized	Galvanized and finished with synthetic enamel
50 to 100 Gallons	Inner	12 SWG Steel	Galvanized	Galvanized
	Outer	22 SWG Steel	Galvanized	Galvanized and finished with synthetic enamel
Over 100 Gallons	Inner	10 SWG Steel	Galvanized	Galvanized and lined with at least 1.5mm. thick copper sheet
	Outer	22 SWG Steel	Galvanized	Galvanized and finished with baked enamel

SWG - Standard Wire Gauge

The annular space between outer vessel & inner vessel shall be filled with fibre glass, glass wool or similar insulation material with thermal conductivity of not more than 0.04 W/M-°C.

The working & test pressure of the heater shall be 5 bars and 10 bars respectively. The burner capacity shall be adequate for delivering water at not less than 70oC at rated output capacity.

Heater shall be provided with following accessories:

i. Thermostatic control
ii. Safety pilot
iii. Temperature & pressure relief valve
iv. Burner
v. Drain valve
vi. Auto-shut off in case of failure of pilot lamp

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8.3 Measurement and Payment

8.3.1 Measurement

Measurement of acceptable completed works for payment for valves, taps & cocks, floor drains, floor traps, bottle traps, cleanouts, float valve, vent cowel, towel rails, toilet paper holders, soap dispenser/ soap dish, grab bars, hand drier, gully traps, grease traps, fiber glass water tanks, Electric water heaters and geysers shall be made on the basis of actual number acceptably provided

and installed in position. Measurement of glass mirror shall be made on the basis of square meter.

The Contractor's bid against these items shall include providing and installation complete as specified herein and/or as shown on the Drawings.

8.3.2 Payment

Payment for valves, taps & cocks, floor drains, floor traps, bottle traps, cleanouts, float valve, vent cowel, towel rails, toilet paper holders, soap dispenser/ soap dish, grab bars, hand drier, gully traps, grease traps, fiber glass water tanks, Electric water heaters and geysers shall be made at the applicable unit rate per number quoted in bill of quantities and shall constitute full compensation for all the work related to that item. Payment of glass mirror shall be made on the basis of square meter.

9 ROOF DRAINAGE

9.1 Scope

The work under this section of the specifications consists of providing all plant, equipment, appliances, material and labour for supply and proper installation of rain water pipes and pipe fittings including, clamping, cleaning, painting etc., as shown on the drawings or as specified herein.

9.2 Cast Iron Rain Water Pipes And Fittings

9.2.1 Material

The cast iron pipe shall conform to British Standard 416 for "Cast Iron spigot and socket soil, waste and ventilating pipes and fittings" with socket and spigot or hubless ends. Cast iron pipe below ground shall conform to BS. 437 "cast iron spigot and socket drain pipe and fittings" with socket and spigot ends. The joint shall be lead caulked or elastomeric (Rubber Ring) to BS. 2494.

Cast iron pipes shall be centrifugally (spun) cast.

The quality of material shall be according to B.S.S. No.1452 for Grade 10.

The contractor shall supply coated pipes and fittings. The coating composition shall be of tar basis or a mixture of natural bitumen with a suitable hardener and natural asphalt. The coatings shall be smooth, tenacious, sufficiently hard, not to flow when exposed to a temperature of 63°C and not so brittle at zero degree centigrade that it chips soft when scribed lightly with the point of a pen knife.

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Every pipe shall be tested at the manufacturer's work to a hydraulic test pressure of 0.07 MPa. Every pipe and fitting shall ring clearly when tested for soundness by being struck all over with a light hammer.

9.2.2 Installation

All rain water pipes and fittings shall be installed to the lines and grades shown on the drawings or as directed by the Engineer. When required to be installed above ground floor level, suitable and substantial number of hangers and supports of approved type and make shall be provided. No piping shall be hung from the piping of other systems. Clamps shall be provided on not more than 1500 mm centers or a minimum of one hanger per each length of pipe whichever is smaller. Where excessive numbers of fittings are installed, additional clamps will be provided.

All steel clamps, hangers and support etc. shall be given one coat of red oxide primer and two coats of synthetic enamel paint. All exposed C.I. soil/vent pipes shall be given two coats of synthetic enamel paint. Materials for painting shall be high quality product of well-known manufacturer and will be approved by the Engineer before using. The instructions of the manufacturer regarding all painting work shall strictly be adhered to.

Caulked joints for cast iron bell-and-spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 25 mm deep and not to extend more than 1/8 inches below the rim of the hub. Rubber ring joints shall also be allowed. No paint, varnish, or other coatings shall be permitted on the jointing material until after the joint has been tested and approved.

Pipes passing through walls, floors, etc. shall be provided with sleeves of approved design. All vent pipes to be installed in the system shall be provided with approved cowl and will rise at least 750 mm above the roof.

The entire system of drains, waste, and vent piping inside the building shall be tested by the Contractor under a water test. Every portion of the system shall be tested to a hydrostatic pressure equivalent to at least 10 feet head of water. After filling this Contractor shall shut off water supply and shall allow it to stand two hours, under test during which time there shall be no loss or leakage.

The Contractor shall furnish and pay for all devices, materials, supplies, labour and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

The Contractor shall also be responsible for the repair of this work & other trades work that may be damaged or disturbed by the tests.

Defects disclosed by the tests shall be repaired. Defective work shall be replaced with new work without extra cost to the Employer. Tests shall be repeated as directed, until all work is proven satisfactory.

All fixtures shall be tested for soundness, stability or support and satisfactory operation.

9.2.3 Measurement and Payment

9.2.4 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment will be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

- Submission of Samples.
- Factory Tests.
- Site demonstration test
- Cutting, jointing of pipes.
- Rubber rings.
- Providing & fixing of pipe.
- Cleaning, testing and commissioning of lines.
- Testing and compaction of trench bottoms.
- Water used for testing of pipes.
- Hangers, clips and brackets,
- steel clamps, tie rods,nuts and bolts, Channels and angle iron, etc.),

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- Cutting and breaking of concrete and then making it good,
- Applying protective painting,
- Cleaning, testing, disinfection (for potable water lines), commissioning.
- Marking

9.2.5 Measurement

Measurement for C.I. pipes, pipes shall be in running meter length and the measurement will be made for complete work specified herein.

9.2.6 Payment

Payment will be made at the unit rate of bid per running meter length of pipe. The amount bid shall be full payment for the work specified herein.

*** End of Section 5100 ***

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SECTION - 5180

TESTING AND COMMISSIONING

1.0 SCOPE OF WORK

The work under this section of specifications includes furnishing all plant, labour, equipment, appliances and materials and performing all operations required in connection with testing and commissioning of all water line, drainage system and fixture etc. in parts and as a whole as specified herein or as shown in the Contract Documents or as directed by the Engineer.

2.0 GENERAL

The testing shall include a complete visual inspection of the whole plumbing and fire fighting system and verification or performance as stipulated in the material specification and of correct functioning of the electrical and control systems.

All supply documents, operating instructions, acceptance documentation and maintenance regulations shall be checked to ensure that they correspond with equipment described and also all certificates such as that of the inspection authorities, test certificates and data about quality, temperature and pressure shall be submitted.

3.0 FIXTURES AND FITTINGS

3.1 Test Programme

The type and the catalogue number of the sanitary fixtures shall be checked.

All equipment in general including the accessories shall be checked for service ability, correct operation and freedom from damage.

The flow and water capacity shall be checked on the full connection of lavatories, showers, water closets, etc. and also the draining capacity shall be measured at the same time.

4.0 POTABLE WATER SUPPLY SYSTEMS (HOT & COLD)

4.1 Test Programme

The method of laying and sealing the water connections lines to the buildings and through walls shall be checked.

Visual inspections shall be made of the entire network for the water systems with regard to laying, fixing, suspension of pipes and fixtures, particularly the arrangements of the fixed points and the separation of the individual connections in the various parts of the system.

The satisfactory function of all valves, air relief valve, check-valves, pressure reducers, thermostats, pumps, etc, shall be checked. The test programme shall also cover:

- Checking of type, thickness and professional laying of the piping insulation.
- Checking number, form and inscription of the equipment labeling.
- Checking of all pipes and flanged connections to devices, water-heaters, air conditioning devices, drainages and vents for symmetry and lack of strain.

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- Checking of the setting of pressure reducing valve with reference to the pressure conditions specified with or pressure gauge.

- Performance of pressure test for the entire network, including fixtures.

4.2 Hydraulic Pressure Test

On completion of the pipe work installation or sections thereof as required, pressure test shall be made before the application of insulation. The pressure tests shall be taken by sectors. All equipment and accessories shall be provided and the Engineer shall be given notice that the work is ready for testing. Tests shall be made by pumping up the system to the required pressure then closing the valves between the pump and the section under test. The valve shall remain closed for the duration of the test and the pump shall be disconnected. Test pressure, as detailed below shall be applied as detailed for a period two hours or longer, at the discretion of the Engineer. If, at the end of period, there is no drop in pressure and no evidence of leak or other faults, the test will be considered satisfactory.

Should any fault be revealed by the test, leaks are to be recorded. Faults shall be made good and the pipe work retested as many times as necessary until satisfactory results are obtained. No additional charges shall be allowed for retesting of any section of the works found at fault.

After all the pipes and fixtures have been properly laid and tested, they shall be flushed clean with water and then disinfected with water solution of chlorine of at least 50 ppm strength for a contact period 6 hours. The system will be finally flushed with clean water.

4.3 Test Pressure and Procedure

Fill pipes slowly with potable water to exclude all air. Apply test pressure of 5.5 bar i.e 1.5 times the maximum working pressure or as approved by the Engineer.

There must be no measurable loss of pressure for at least 30 minutes holding period.

5.0 DRAINAGE SYSTEMS

5.1 Test Programme

- Check the piping by means of the separation system, in relation to the specified capacity.

- Check each connection for dimension and draining capacity.

- Check the drain line for laying, fixing, compliance with specification.

- Check the practical arrangement of the fixtures, fixing points, suspensions, cleaning openings, vents, pit covers and ground inlets.

- Check all the covers and openings, paying special attention to the separation system for waste/sewage and the storm water.

- Provide clean water and apparatus for testing.

5.2 Test Methods

5.2.1 Water Testing

All the openings in the piping system shall be tightly closed by inserting testing plug. The highest point will be left open to supply water and may be raised if necessary by temporary jointing, develop a minimum static head of 0.5 bar for of water at each section of the system. Water is filled to the point of overflow and any drop in the level of water will indicate a leak that will be found by inspection. The water level will be checked for no drop for at least 15 to

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30 minutes. Higher stacks will be tested in sections, starting from the top section and then connecting top section to next lower section.

5.2.2 Timing

Testing shall be carried out as soon as practicable after completion of each drainage stack. All concealed work shall be tested before being finally enclosed.

6.0 FIRE FIGHTING SYSTEMS

6.1 Stand Pipe System

6.1.1 Test Programme

Visual inspections shall be made of the entire network for the standpipe system with regard to laying, fixing, and suspension of pipes, particularly the arrangements of the fixed points and the separation of the individual connections in the various parts of the system.

The satisfactory function of all valves, air relief valve, check valves, pressure gauges, shall be checked.

The test programme shall also cover:

- Checking number, form and inscription of the labeling.
- Performance of pressure test for the entire network.

6.2 Hydraulic Pressure Test

As described for potable water supply system.

6.3 Test Pressure and Procedure

As described for potable water supply system.

7.0 COMMISSIONING

After successful testing of selected isolated pipe lengths for potable water (hot & cold),Sanitary drainage and firefighting system, the Contractor shall clean all the lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

8.0 MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specification unless otherwise specifically stated in the Bills of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other item of the Bills of Quantities.

*** End of Section 5180 ***

SECTION - 5213

POLYETHYLENE (PE) PIPES AND FITTINGS

1. GENERAL

1.1. SCOPE

The work under this section of the specifications includes furnishing all plant, labor, equipment, appliances, materials and in performing all operations required in connection with providing and laying of Polyethylene Pipes and Pipe fittings, in accordance with the Contract or as directed by the Engineer and the manufacturer's recommendations.

1.2. GENERAL REQUIREMENTS

1.2.1 Pipes and fittings shall be new and unused.

1.2.2 All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.2.3 Where manufacturers of pipes and fittings are specified, they shall be of the same manufacturers unless otherwise approved by the Engineer.

1.2.4 Where more than one similar item of pipes and fittings are specified, they shall be of the same manufacturer.

1.2.5 The Contractor shall submit to the Engineer for approval the following information regarding the specified/proposed items of pipes and fittings.

i. Name and address of the manufacturers
ii. Country of origin, make and model
iii. Pressure rating, SDR ratio, wall thicknesses of pipes and fittings.
iv. MTC - mill test certificate from the manufacturers
v. Method of jointing, testing and commissioning
vi. Manufacturer has the following Accreditations:
    a. ISO 9001 and 14001
    b. Manufacturer's Submittal of QA/QC Document.

1.2.6 Approval by the Engineer shall not be construed as authorizing any deviation(s) from the specifications unless they are specifically brought to notice of the Engineer.

1.2.7 Approval by the Engineer shall not relieve the Contractor from any of his contractual responsibility regarding satisfactory performance and other requirements of the works

1.3. SPECIAL REQUIREMENTS

1.3.1 Pipes and fittings shall be suitable for the intended use.

1.3.2 Every pipe shall be tested at the manufacturer's works to specified hydraulic test pressure. The test pressure shall be maintained for sufficiently long time for proof and inspection.

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1.3.3 Each pipe and fitting shall be permanently marked or engraved giving the following information,

i. Manufacturers Name or Trademark
ii. Manufacturing date
iii. Manufacturing number
iv. Nominal diameter in mm
v. Class or pressure rating
vi. Manufacturers Inspection mark
vii. Standards according to which the pipes and fittings have been manufactured.
viii. Heat number should be embossed on all pipes, fittings and flanges

1.3.4 Unless otherwise specified, diameters of pipes and fittings shall be external with mention of SDR ratio & pipe thickness. Actual inside diameters and tolerances in diameters of pipes and fittings shall be according to the specified standards.

1.3.5 Unless otherwise specified, service ratings of pipes and fittings shall not be less than 1.5 times of maximum working pressure to which they will be subjected to.

1.3.6 Unless otherwise specified, wall thicknesses of the pipes shall be according to the class of the pipes. The wall thicknesses shall be measured at locations excluding the jointing ends. The tolerances in wall thicknesses shall be according to the specified standards. Wall thicknesses of fittings shall not be less than those of corresponding pipes to which they are joined together.

1.3.7 Pipes and fittings ends shall be matching and compatible with each other and with the ends of valves and appurtenances to which they are joined.

1.3.8 Unless otherwise approved by the Engineer, pipes and fittings, jointing materials etc. shall be of the same manufacturers as those of the pipes and fittings.

2. MATERIALS

2.1. GENERAL

Materials shall conform to the latest referenced specifications and/or other provisions specified herein. Materials shall be new and unused. In cases where manufacturers are specified, materials shall be of the same manufacturers. In all other cases, the Contractor shall submit the names of the manufacturer from whom he intends to buy. Other information such as diagrams, drawings and descriptive data, shall be supplied, as desired by the Engineer. Approval of materials under this provision shall not be construed as authorizing any deviations from specifications.

2.2. MANUFACTURING

The material from which the pipe is produced shall consist substantially of polyethylene, to which may be added only those additives that are needed to facilitate the manufacture of the polymer, and production of sound, durable pipe of good surface finish, mechanical strength. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard, or to impair the fabrication of welding properties of the pipe, or to impair its chemical and physical properties.

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2.3. PIPE

Pipes shall conform to International Standards Organization (ISO) recommendations, I.S.O-4427-2019 or DIN 8074 and shall be of appropriate class capable of withstanding the specified pressure rating of PN-8 to PN-32 as specified in the Bill of Quantities and test pressure of 1.5 times the working pressure.

2.4. QUALITY

The pipe shall not have any detrimental effect on composition of the water flowing through them. The quantities of any toxic substances extracted from the internal wall, of the pipes shall not exceed the values specified in ISO 4427.

2.5. FITTINGS

Compatible fittings and specials for use with polyethylene Pressure Pipes shall be of the appropriate class and shall conform to ISO-4427-3:2019, 3458, 3459, 3501, 3503 or BS 5114.

3. HANDLING AND STORAGE

3.1. GENERAL

The Contractor shall be responsible for proper handling as per manufacturer's recommendations of pipes and pipe fittings, etc. All the material shall be stacked in accordance with the manufacturer's recommendations at approved places as directed by the Engineer.

3.2. TRANSPORT

Transportation of pipes shall be done in such a way that they are secure and that no more than an absolute minimum of movement can take place on the vehicle during transit. The same care is needed if pipes are to be transferred from one vehicle to another, how short the final journey may be. The manufacturer's recommendation with respect to UV/ sunlight/ heat protection be followed during transportation.

3.3. OFF-LOADING

Cranes shall be used for off-loading. Whole sequence of operations shall be carried out smoothly and without snatch. Rope or nylon slings, lifting beams with flattened hooks or scissor-dog shall be used. Hooks and dogs shall be well padded to prevent the pipe being damaged and shall be fitted with locking device. Steadying ropes are essential.

3.4. STORAGE

Pipes, and fittings damaged during handling, transporting or lowering shall be rejected and replaced at the contractor's expense. Storage shall be under shade so that all polyethylene pipes & fittings are not exposed to sunlight and extreme heat.

3.5. STRINGING AND INSPECTION

3.5.1 Stringing, consists of placing pipes on the ground in line ready for laying. Care is again needed to prevent damage during this operation.

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3.5.2 The turned ends of all pipes shall be inspected to ensure that they are free from any local irregularities which could affect the water tightness of the joint. All pipes shall also be visually inspected for evidence of impact damage. When such damage is detected, a thorough examination of internal surface in region of the pipe ends shall be made for sign of hair cracks. Damaged pipes, joints, and fittings shall be rejected and replaced at the expense of the Contractor.

4. JOINTING

4.1. BUTT FUSION JOINT

4.1.1 The pipe shall be joined with butt, heat fusion joints conform to ISO 4427 and the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

4.1.2 Pipes with diameters smaller than or equal to 75mm shall be joined together with compression fittings. All other pipes greater than 75mm shall be joined with butt fusion method.

4.1.3 All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints.

4.1.4 Lengths of pipe shall be assembled into suitable installation lengths by the butt- fusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier.

4.2. MECHANICAL JOINT

4.2.1 The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.5 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307.Allboltsshallbe tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation, apply a bituminous coating to bolts and nuts.

4.2.2 Flange connections shall be provided with a full-face neoprene gasket.

5. INSTALLATION

High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the instruction of the manufacturer, as shown on the Drawings and as specified herein. A factory qualified joining technician as designated by the pipe manufacturer shall perform all heat fusion joints.

Care shall be taken in loading, transporting and unloading to prevent damage to the pipe. Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the contractor, at his own expense.

Under no circumstances shall the pipe or accessories be dropped into the trench or forced through a directional bore upon "pull-back".

Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill.

When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means.

Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps and tanks shall be through flanged connections.

All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

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If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Employer. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.

5.1. OPEN TRENCH INSTALLATION

5.1.1 The centerline of the pipe shall not deviate from straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

5.1.2 Good alignment shall be preserved during installation. Deflection of the pipe shall occur only at those places on design drawings and as approved by the Engineer. Fittings, in addition to those shown on the Drawings, shall be used only if necessary or required by the Engineer.

5.1.3 Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".

5.1.4 Precautions shall be taken to prevent flotation of the pipe in the trench.

5.1.5 When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and

moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be compacted to provide uniform side support for the pipe.

5.1.6 Restrained joints shall be installed where shown on the Drawings or as directed by the Engineer.

6. CLEANING/ FLUSHING/ DISINFECTION

At the conclusion of the work, thoroughly clean all of the new pipe lines to remove all dirt, stones, and pieces of wood or other material which may have entered during the construction period by forcing a cleaning swab through all pipes. Flushing velocities shall be a minimum of 2.5 feet per second. All flushing shall be done after coordination with Inspector. Debris cleaned from the lines shall be removed from the job site.

Only potable water lines and system shall be disinfected. Final disinfection shall be accomplished by chlorination. A chlorine and water mixture shall be applied by means of a solution feed chlorination device. The dosage applied to the water entering the pipe shall be at least 50 mg/liter of chlorine. The mixture of chlorine and water shall be retained for at least 24 hours. The chlorine residual at pipe extremities shall be at least 25 mg/liter at the end of the period. Following the complete disinfection of the pipe line, all treated water shall be thoroughly flushed out, until the chlorine residual is less than 1 mg/liter.

7. COMMISSIONING

After successful completion of testing the pipeline shall be commissioned by filling water and bringing the pipeline to full operating pressure. All temporary arrangements made for testing shall be removed.

8. HYDROSTATIC PRESSURE TEST

The completed pipeline or each completed section as convenient to the Contractor or as necessary in Engineer's opinion due to differences in elevation shall be subjected to specified hydrostatic test pressure. All fittings, specials, valves, etc. shall also be subjected to hydrostatic testing while installed in the pipeline.

After filling, the pipeline shall be left under lower pressure for a period of 2 days in order to achieve conditions as stable as possible for testing. More water shall be pumped in until the test pressure, which shall not be less than 1.5 times of maximum working pressure, is reached and then the section shall be completely closed off. The test pressure shall be applied and maintained for at least 2 hours.

If the pressure measurements are not made at the lowest point of the section, an allowance shall be made for the static head between the lowest point and the point of measurement to ensure that the specified works test pressure is not exceeded at the lowest point. If a drop in pressure occurs, the quantity of water added in order to re-establish the test pressure shall be carefully measured.

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If any abnormal movement, distortion, squirm, or leakage is detected, the test pressure shall be dropped immediately, and cause of such abnormal behaviors shall be investigated and rectified, in consultation with the approval of the Engineer.

The test will be considered as satisfactory if achieves the required test pressure.

The Contractor must submit his plan for testing to the Engineer for review at least 10 days before starting the test and shall notify Inspector a minimum of 48 hours prior to test.

Before testing, the pipeline shall be cleaned as specified in British Standard CP 2010: Part-1. Before starting of the test, the whole of the pipeline shall be inspected.

9. MEASUREMENT AND PAYMENT

8.1. GENERAL

Except otherwise specified herein or elsewhere in the Contract Documents no separate measurement and payment will be made for the under mentioned works related to the relevant items of the Bills of Quantities but shall not be limited to the following. The cost thereof shall be deemed to have been including in the quoted unit rate of the respective items of Bills of Quantities.

8.1.1 Submission of sample/ Test reports
8.1.2 Transportation
8.1.3 Stacking and stringing
8.1.4 Jointing/welding
8.1.5 Cutting, turning and jointing of pipes
8.1.6 Pipe fitting (tees, bends, flanges, flange adapters, blank flanges, etc.), markers for route, thrust blocks, etc.
8.1.7 Cleaning, Flushing, Testing, Disinfection and Commissioning of pipe line

8.2. MEASUREMENT OF POLYETHYLENE PIPE

Measurement of acceptable completed works of supply, erection and installation of pipes including fittings will be made on basis of actual length in running meter of pipes provided and installed in position as shown on the drawings or as directed by the Engineer.

8.3. PAYMENT

Payment will be made for acceptable measured quantity of supply, erection and installation of polyethylene pipes including fittings on the basis of unit rate per running meter quoted in the bills of quantities and shall constitute full compensation for all the works related to the item.

***** END OF 5213 *****

SECTION - 5214

STEEL PIPES & FITTINGS

1. GENERAL

1.1. SCOPE

The works under this section of the specifications include furnishing all plant, labor, equipment, appliances and materials and in performing all operations required in connection with the supply, installation, testing, disinfection (only in case of potable water system) flushing and commissioning of black steel pipes and pipe fittings, U-turn vent pipes and overflow funnels as specified herein, in bill of quantities, as shown on the drawings, and/or as directed by the Engineer.

1.2. APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the following applicable codes and standards. When the requirements of these specifications or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

ASTM A-53 : "Steel pipes and tubes for pressure purposes."

ASTM A-234: "Carbon and Alloy Steel Pipe Fittings."

ANSI B16.5: "Steel Pipe Flanges and Flanged Fittings"

B.S.4504 : Flanges and Bolting for Pipes, Valves and Fittings." (part1)

B.S.534 : "Steel Pipe Fittings and Specials for Water, Gas and Sewage."

B.S. 1965 : "Butt Welded Pipe Fittings for Pressure purposes, Part 1 : Carbon Steel."

B.S.3601 : "Steel Pipes and Tubes for pressure purposes, Carbon steel: Ordinary Duties."

B.S.3063 : "Dimensions of Gaskets for Pipe flanges".

B.S.4147 : "Hot applied bitumen based coatings for ferrous products."

B.S.4161 : "Coat tar based hot applied coating materials for protecting Iron and Steel products".

B.S.4515 : "Field welding of carbon steel pipe lines".

ISO 898 : "Mechanical Properties of Fasteners, Bolts, Screws and Studs."

C.P.2010 : "Pipelines Part 2: Design and Construction of Steel Pipelines in Land"

Other authoritative codes and standards which ensure equal or higher quality than those references may also be acceptable subject to satisfaction and approval of the Engineer.

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Any conflict between the requirements of this specification and those on the figures herein or in the codes, standards and specifications referred to herein shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

1.3. GENERAL REQUIREMENTS

1.3.1 Pipes and fittings shall be new and unused.

1.3.2 Where manufacturers of pipes and fittings are specified, they shall be of the same manufacturers unless otherwise approved by the Engineer.

1.3.3 Where more than one similar item of pipes and fittings are specified, they shall be of the same manufacturer.

1.3.4 The Contractor shall submit to the Engineer for approval of the following information regarding the specified/proposed items of pipes and fittings.

i. Name and address of the manufacturers
ii. Country of origin, make and model
iii. Dimensions and wall thicknesses of pipes and fittings
iv. Material and thicknesses of coating and lining
v. MTC - Mill Test Certificate from the manufacturers
vi. Warranty as provided by the manufacturers
vii. Method of jointing, testing and commissioning

1.3.5 Approval by the Engineer shall not be construed as authorizing any deviation(s) from the specifications unless they are specifically brought to notice of the Engineer.

1.3.6 Approval by the Engineer shall not relieve the Contractor from any of his contractual responsibility regarding satisfactory performance and other requirements of the pipes and fittings.

1.4. SPECIAL REQUIREMENTS

1.4.1 Pipes and fittings shall be suitable for the intended use.

1.4.2 Every pipe shall be tested at the manufacturer's works to specified hydraulic test pressure. The test pressure shall be maintained for at least 2 hours for proof and inspection.

1.4.3 Each pipe and fitting shall be permanently marked or engraved giving the following information.

i. Make and Nominal diameter
ii. Class, Duty or Service (Pressure) Rating
iii. Standards according to which the pipes and fittings have been manufactured.
iv. Heat number to be embossed on all pipes, fittings and flanges.

1.4.4 Unless otherwise specified diameters of pipes and fittings shall be nominal. Actual inside and outside diameters and tolerances in diameters of pipes and fittings shall be according to the specified standards.

1.4.5 Pipes and fittings shall be seamless or welded as specified herein or in bill of quantities, as shown on the drawings and/or as directed by the Engineer. If the Contractor so

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desires, seamless pipes and fittings may be substituted for welded pipes and fittings at no risk or cost to the Employer. Where neither seamless nor welded pipes nor fittings are specified, pipes and fittings shall be seamless unless otherwise approved by the Engineer.

1.4.6 Unless otherwise specified, service ratings of pipes and fittings shall not be less than the maximum pressure to which they will be subjected to.

1.4.7 Unless otherwise specified, wall thicknesses of the pipes shall be according to the class, schedule or duty of the pipes. The wall thicknesses shall be measured at locations excluding the jointing ends. The tolerances in wall thicknesses shall be according to the specified standards. Wall thicknesses of fittings shall not be less than those of corresponding pipes to which they are joined together.

1.4.8 Pipes and fittings ends shall be matching and compatible with each other and with the ends of valves and appurtenances to which they are joined.

1.4.9 Unless otherwise approved by the Engineer, pipes and fittings, jointing materials such as rubber rings, gaskets, nuts & bolts and jointing compound etc. shall be of the same manufacturers as those of the pipes and fittings.

2. MATERIAL

2.1. PIPE

Black Steel grade 'B' seamless/ spirally welded pipe of schedule 40 or wall thickness as mentioned in Bill of Quantities conforming to ASTM-A53.

2.2. FITTINGS

All black steel pipe fittings shall conform to ASTM A-234 or ANSI B16.5.

2.3. JOINTS

Black steel pipes and fittings shall be joined by welding or by flange, except for joining of valves and appurtenances and at locations as shown on the drawings and /or as directed by the Engineer. Welded joint shall conform to B.S. 4515. Black steel pipe flanges shall conform to specified or appropriate Table of B.S. 10. Nuts and bolts for flanges shall be of hexagon shape and shall conform to ISO 898. Gaskets shall be of flat shape and shall conform to B.S. 3063.

2.4. EXTERNAL COATING

All pipes shall be FBE (Fusion Bounded Epoxy) coated of at least 200 microns, or as mentioned in Bill of Quantities.

2.5. INTERNAL COATING

The internal coating of black steel pipes shall be anti-corrosive epoxy coated or as mentioned in Bill of Quantities.

3. INSTALLATION

3.1. TRANSPORTATION, HANDLING AND STORAGE

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3.1.1 The Contractor shall be responsible for proper transportation, handling (loading and unloading) and storage of pipes and fittings as per the manufacturer's recommendations and direction of the Engineer.

3.1.2 Crane, rope or nylon slings, lifting beams with flattened hooks or scissor-dog shall be used for loading and unloading of pipes and fittings. Hooks and dogs shall be well padded to prevent the pipe being damaged and shall be fitted with locking device. Steadying ropes are essential.

3.1.3 Pipes and fittings damaged during transportation, handling or storage or lowering shall be rejected and replaced at the Contractor's expense. Storage of gaskets and jointing compound shall be under shade to prevent damage by sunlight and extreme heat.

3.2. INSPECTION

Pipes and fittings shall be visually inspected for any evidence of damage or hair cracks. The turned ends of pipes and fittings shall be inspected for any local irregularities which could affect the water tightness of the joint. Damaged pipes and fittings shall be rejected and replaced at the Contractor's expense.

3.3. LAYING AND JOINTING

3.3.1 ABOVE GROUND (UNBURIED)

Before installation, the interior of pipes and fittings shall be thoroughly cleaned of all rust, dirt and foreign materials.

Pipe and fittings shall be installed to lines and grades as shown on the drawings and/or as directed by the Engineer.

Pipe joints shall be welded unless otherwise specified and/or directed by the Engineer except for jointing valves and appurtenances and where welding is not possible. Welding shall be done by qualified and licensed welders using electric arc welding process. The welding shall develop full strength of the adjoining steel. Defective joints and joints not developing full strength shall be rejected at the risk and cost of the Contractor.

Pipes and fittings shall be properly supported by galvanized steel clamps, brackets and hangers, etc. Supports shall permit unrestrained expansion and contraction. Clamps, brackets and hangers etc. shall be designed to take the weight of pipe, weight of water, seismic and wind loads.

Thrust anchors shall be provided at all changes in the pipe diameters and directions and at all branches and dead ends.

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Thrust anchors shall be designed to resist maximum thrust forces resulting from the worst possible combination of working/static/test pressures, transient/water hammer pressure, and thermal expansion/contraction, seismic and wind loads.

The Contractor shall submit to the Engineer for approval shop drawings of the pipe supports and thrust anchors. The supports and anchors shall be used only after approval by the Engineer.

Approval by the Engineer shall however, not relieve the Contractor from any of his contractual responsibility regarding safety requirements of the supports and anchors.

Pipes passing through floors, ceilings, roof, walls and columns in non-water retaining structures above ground or water table shall be encased in black steel pipe sleeve conforming to ASTM A-53.The annular space between the pipes and the pipe sleeves shall not be less than one inch. The annular space shall be filled with approved packing material and sealed at both ends with approved sealant.

Pipes passing through water retaining structures above or below ground and non-water retaining structures below water table shall be provided with leak proof puddle flange. The flange diameter shall be larger than the outside diameter of the pipe by at least 100mm for pipe diameters 150mm and smaller and by at least 150mm for pipe diameters larger than 150mm.

After installation, all exposed surface of pipe or any sort of fittings left with bared surface or gets damaged in jointing or welding shall be epoxy coated at site as per the satisfaction of the Engineer.

3.3.2 BELOW GROUND (BURIED)

Before installation, the interior of pipes and fittings shall be thoroughly cleaned of all rust, dirt and foreign materials.

Laying of pipes and fittings shall be carried out according to the British Standard practice CP2010: Part 4.

Pipes and fittings shall be laid to alignments and grades as shown on the drawings and/or as directed by the Engineer.

Pipes and fittings shall be lowered into the trench in a manner approved by the Engineer. All care shall be taken to avoid abrasion of the pipes and fittings.

The pipes shall be laid on specified bedding material. Before laying bedding material shall be approved by the Engineer. Recesses shall be excavated in the bottom and sides of the trench to accommodate joints, fittings and specials. After laying of pipe and fittings, the recesses shall be filled with specified bedding material and thoroughly compacted manually.

Pipes and fitting's alignments, that have the grades or joints disturbed or dislocated after laying shall be removed and re-laid to the entire satisfaction of the Engineer.

Backfilling shall be carried out with the specified materials and in the specified sequence. Backfill shall be laid in layers and compacted to 95 percent of AASHTO modified density.

The thickness of each compacted layer shall not exceed 150 mm. Hand tools shall be used for compaction of backfill/bedding material around the pipe and fittings. Mechanized methods may be used for compaction of backfill 300 mm over/above crown of the pipeline.

When laying is not in progress, the open ends of the pipeline shall be closed with a temporary plug as approved by the Engineer.

Small changes in direction may be made by deflecting the last laid pipe after the joint has been made. If the alignment requires deflection in excess of the manufacturer's recommended limits, bends shall be used.

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Concrete thrust blocks shall be provided at all changes in the pipe diameters and directions and at all branches and dead ends as shown on the drawings.

After installation, all exposed surface of pipe or any sort of fittings left with bared surface or gets damaged in jointing or welding shall be epoxy coated at site as per the satisfaction of the Engineer.

4. TESTING

After laying each section of pipeline as convenient to the contractor or as necessary in the Engineer's opinion, shall be tested for hydrostatic pressure. Field hydrostatic test pressure shall not be less than 1.5 times the maximum pressure to which the system will be subjected to.

Before testing, pipe section shall be cleaned and their ends shall be closed with blank flanges, plugs or caps. The closed ends shall be anchored against thrust forces. Valved air vent outlet shall be installed at the upper end of the pipe section and valved water inlet fitting shall be installed at the lower end of the section. Pressure gauge certified from any approved laboratory shall be installed at both lower and upper ends of the pipe section. An isolating ball valve shall be fitted between the pipe section and the gauges.

Sufficient backfill material shall be placed over the center section of each pipe (leaving the joints exposed) to allow inspection of the pipe joints under the test pressure. All permanent anchors shall be in positions and shall have developed adequate strength before the testing begins. The pipe section under test shall be filled with water from the inlet fitting, taking care that all air is displaced through the vent outlet.

After filling, the pipeline shall be left under small pressure for 24 hours as directed by the Engineer in order to wet the pipe and the pipe joints. After the wetting period, additional water shall be introduced into the pipe section until the test pressure (which should not be less than 1.5 times of the maximum working pressure) is achieved when the pipe section shall be closed.

The test pressure shall be maintained for at least two hours or for a period as directed by the Engineer. Pressure gauges shall be read at maximum intervals of 15 minutes during the test period.

If the pressure measurements are not made at the lowest point of the section, an allowance shall be made for the static head between the lowest point and the point of measurement to ensure that the specified works test pressure is not exceeded at the lowest point.

If a drop in pressure occurs, additional quantity of water shall be introduced into the pipe section in order to re-establish the test pressure. The additional quantity of water introduced into the pipe section shall be accurately measured.

During the test period all joints shall be inspected. If any abnormal movement, distortion, squirm or leakage is detected, the test pressure shall be relieved immediately and the defects shall be rectified in consultation and with the approval of the Engineer.

After rectification of the defects, the pipe section shall be re-tested.

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The test will be considered to have passed, if no leakage or drop in pressure is observed after.

5. FLUSHING

After installation and testing pipelines shall be flushed with clean water until all dust, dirt, scales and extraneous matters are removed from the inside of the pipeline. During flushing all valves and appurtenances shall be closed and opened several times.

6. COMMISSIONING

After successful completion of testing and flushing duly approved by the Engineer, pipelines shall be commissioned. All valves and appurtenances shall be set at proper openings and all parameters shall be set at specified or manufacturers' recommended values.

7. OVER FLOW FUNNEL

Overflow funnel shall be fabricated from mild steel of heavy gauge as shown on the drawing and welded to M.S. pipe flange on the side.

8. PIPEWORK SUPPORTS

All pipe work supports shall be of mild steel rolled sections and shall be epoxy coated. Straps, rods and hangers shall be of mild steel.

Straps shall be provided on all pipe supports. Straps shall have a pair of nut and washers on each leg with the supporting steel flange clamped tight between the pair of nuts to form a rigid guide allowing the pipe to slide axially.

Horizontal pipe work along walls shall be supported on channel frames securely fixed to the column. All pipes shall be arranged to slide on the pipe supports and straps shall be provided to form a rigid guide.

Vertical pipe work shall be supported at the base or at anchor points to withstand the total weight of the riser. Brackets from risers shall not be used as a means of support for the riser.

Pipe work supports shall be so designed and installed as to allow free movement due to expansion and contraction. Supports shall be anchored to steel or reinforced concrete column, wall, beam or slab. Each support shall be able to carry independently it's all the operational loads of pipe work and water.

All pipes shall be individually supported. Pipes shall not hang from other pipes. Points at which pipes pass through walls, floors, connections to plant, equipment and heat emitters, etc. do not constitute points of supports for the pipes.

9. MEASUREMENT AND PAYMENT (STEEL PIPES & FITTINGS)

9.1. GENERAL

Except otherwise specified herein or elsewhere in the Tender/Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have

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been included in the quoted unit rate of the respective items of the Bill of Quantities related to the section.

i. Cutting, welding, jointing and laying including jointing materials such as rubber rings, gaskets, nuts and bolts, jointing compounds, welding electrodes etc.
ii. Protective painting, coating, lining and wrapping
iii. Testing, flushing and commissioning.
iv. Pipe work supports such as clamps, brackets, hangers etc.
v. Cutting and breaking of concrete and then making it good.
vi. Pipe fittings and accessories.
vii. Thrust blocks

9.2. **MEASUREMENT**

Measurement of acceptable completed works of steel pipes including fittings and flanges etc. will be made on the basis of actual length in meters of pipes provided, installed in positions, tested, flushed, and commissioned as specified herein, in bill of quantities, as shown on the drawings and/or as directed by the Engineer.

9.3. **PAYMENT**

Payment for acceptable measured quantity of steel pipes including fittings and flanges will be made on the basis of unit rate per meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the items.

10. MEASUREMENT AND PAYMENT (M.S. U-TURN VENT PIPE, OVERFLOW FUNNEL)

10.1. **MEASUREMENT**

Measurement of acceptable completed works of U-turn vent pipes and overflow funnel will be made on the basis of actual numbers of item provided, installed in position with flanges and sleeves, as specified herein, in bill of quantities, as shown on the drawings and/or as directed by the Engineer.

10.2. **PAYMENT**

Payment for acceptable measured quantity of U-turn vent pipes, overflow funnel will be made on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the items.

***** END OF SECTION *****

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SECTION - 5218

UNPLASTICISED POLYVINYL CHLORIDE (uPVC) PIPES AND PIPE FITTINGS (SEWER/GRAVITY)

1.0 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all uPVC pipes, plant, labor, equipment, appliances and materials and in performing all operations required for installing and testing of sewer pipes in strict accordance with the specifications of this section and applicable drawings and subject to the terms and conditions of the contract.

2.0 APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the following applicable codes and standards. When the requirements of this specification or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

Number	Title
B.S. 3505	"Unplasticised PVC Pipe for Cold Water Services"
P.S. 3051	"Unplasticised PVC Pipe for Potable Water Services"
B.S. 4346	"Joints and Fittings with Unplasticised PVC Pressure Pipes"

Other authoritative codes and standards which ensure equal or higher quality then those references may also be acceptable subject to satisfaction and approval of the Engineer.

Any conflict between the requirements of this specification and those on the figures herein or in the codes, standards and specifications referred to herein shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 Pipes shall be new and unused.

3.2 Where manufacturers of pipes are specified, they shall be of the same manufacturers unless otherwise approved by the Engineer.

3.3 Where more than one similar item of pipes are specified, they shall be of the same manufacturer.

3.4 The Contractor shall submit to the Engineer for approval the following information regarding the specified/proposed items of pipes and fittings.

(i) Name and address of the manufacturers
(ii) Country of origin, make and model
(iii) Dimensions and wall thicknesses of pipes
(iv) MTC - mill test certificate from the manufacturers
(v) Method of jointing, testing and commissioning

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3.5 Approval by the Engineer shall not be construed as authorizing any deviation(s) from the specifications unless they are specifically brought to notice of the Engineer.

3.6 Approval by the Engineer shall not relieve the Contractor from any of his contractual responsibility regarding satisfactory performance and other requirements of the works.

4.0 SPECIAL REQUIREMENTS

4.1 Pipes shall be suitable for the intended use.

4.2 Every pipe shall be tested at the manufacturer's works to specified hydraulic test pressure. The test pressure shall be maintained for sufficiently long time for proof and inspection.

4.3 Each pipe shall be permanently marked or engraved giving the following information:-

i Manufacturers Name or Trademark
ii Manufacturing date
iii Manufacturing number
iv Nominal diameter in mm
v Class or pressure rating
vi Manufacturers Inspection mark
vii Standards according to which the pipes and fittings have been manufactured.
viii Heat number should be embossed on all pipes, fittings and flanges

4.4 Unless otherwise specified, diameters of pipes and fittings shall be nominal. Actual inside and outside diameters and tolerances in diameters of pipes and fittings shall be according to the specified standards.

4.5 Unless otherwise specified, service ratings of pipes and fittings shall not be less than the maximum pressure to which they will be subjected to.

4.6 Unless otherwise specified, wall thicknesses of the pipes shall be according to the class, schedule or duty of the pipes. The wall thicknesses shall be measured at locations excluding the jointing ends. The tolerances in wall thicknesses shall be according to the specified standards.

Wall thicknesses of fittings shall not be less than those of corresponding pipes to which they are joined together.

4.7 Pipes and fittings ends shall match and compatible with each other and with the ends of valves and appurtenances to which they are joined.

4.8 Unless otherwise approved by the Engineer, pipes and fittings, jointing materials such as rubber rings, gaskets, nuts & bolts etc. shall be of the same manufacturers as those of the pipes and fittings.

5.0 MATERIALS

5.1 General

Materials shall conform to the latest referred standard specifications and other provisions stipulated herein and shall be new and unused. Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy him as to the suitability, durability, quality and usefulness of the material intended to be purchased.

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5.2 Pipes

uPVC Sewerage Pipes shall conform to specified or appropriate class of B.S. 3505 or P.S 3051.

5.3 Material

The material from which the pipe is produced shall consist substantially of polyvinyl chloride, to which may be added only those additives that are needed to facilitate the manufacture of the polymer, and production of sound, durable pipe of good surface finish, mechanical strength and opacity. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard or to impair the fabrication of welding properties of the pipe or to impair its chemical and physical properties.

The pipe material shall not have any detrimental effect on composition of the water flowing through them. The quantities of lead, dialectal tin C4 and higher homologues and any other toxic substances extracted from the internal wall of the pipes shall not exceed the values specified in B.S 3505.

5.4 Joints

uPVC Sewerage pipes and fittings shall be joined with solvent cement of best quality as specified herein, in bill of quantities, as shown on the drawings and/or as directed by the Engineer and shall conform to B.S. 4346.

6.0 PIPE TESTS

6.1 Factory Tests

The Contractor shall inform the Engineer the schedule of pipe manufacturing in the factory for this particular project. The Engineer may visit pipe factory to inspect the pipe manufacturing process. The Engineer may assign his representative to supervise the manufacturing and testing of pipes.

The Contractor shall assign his representative at factory to supervise the pipe manufacturing and quality control.

The Contractor shall arrange the following tests at factory in the presence of Engineer or his representative on selected pipe samples.

i. Dimension measurements (Wall thickness, Diameter, Length)
ii. Visual Inspection

All the manufacturing pipes shall be individually checked for cracks and other defects before transportation to the site.

All pipes shall be properly marked at factory by embossing that number to identify the project consignment.

MTC – Mill Test Certificates for the above shall be submitted by the manufacturer.

6.2 Site Demonstration Test

6.2.1 The Contractor shall arrange the site visits of the pipe manufacturer or his representative to explain and demonstrate the pipe jointing, laying and hydraulic pressure testing procedure for all the pipe sizes, in the presence of Engineer before actual laying of uPVC pipes in the trenches.

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Separate demonstration test will be required for each uPVC pipe size to be installed. Requirements of standard hydraulic pressure test specified in the later part of this section shall be applicable to this demonstration test.

Pipe joints and pipe surfaces shall be inspected during this demonstration. If the pipe joint are found leaking and the leakage is more than the allowable limits, the demonstration will be rejected and the Contractor will be required to remove the defective material either pipes or rubber rings whichever is applicable.

The pipes and rubber rings shall be selected at random by the Engineer from the stock lot brought at site by the Contractor. The Contractor must ensure delivery of quality material at site. The whole stock/lot shall be rejected if the pipes do not pass the demonstration test.

7.0 HANDLING AND STORAGE

7.1 General

The Contractor shall be responsible for proper handling, as per manufacturer's recommendations, of pipes and pipe fittings etc. All the material shall be stacked in accordance with the manufacturer's recommendations at approved places as directed by the Engineer.

7.2 Transportation

Transportation of pipes shall be done in such a way that they are secure and that no more than an absolute minimum of movement can take place on the vehicle during transit. The same care is needed if pipes are to be transferred from one vehicle to another, how short the final journey may be.

7.3 Off-loading

Cranes shall be used for off-loading. Whole sequence of operations shall be carried out smoothly and without snatch. Rope or nylon slings, lifting beams with flattened hooks or scissor-dog shall be used. Hooks and dogs shall be well padded to prevent the pipe being damaged and shall be fitted with locking device. Steadying ropes are essential.

7.4 Storage

Pipes should be carefully stored to prevent damage, pipes should not rest directly on ground. Solid timbers base should be set on ground for pipe stacking. Pipes should not be stacked so high as to over load the bottom. (The height of stack shall be further limited by the head room available for any fitting gear used on site). Pipe sockets should not normally rest on other pipes in the stack. The end pipes in the bottom row should be securely locked, wedges should be firmly anchored to prevent collapse of the stack. Pipes, and fittings damaged during handling, transporting or lowering shall be rejected and replaced at the contractor's expense. Storage shall be under shade so that all uPVC pipes & fittings are not exposed to sunlight and extreme heat.

8.0 LAYING AND INSTALLATION

8.1 Trenching

Pipe trenches shall be excavated up to required depth as indicated in the drawing. The excavated soil should be placed on one side of the trench leaving the other side clear for equipment and pipe handling. The bottom shall be carefully levelled. In-situ field density of trench bottom shall be determined. The bottom shall be compacted if in situ density is less than 60% of relative density as determined by ASTM D 2043. The test shall

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generally be carried out at spacing of 200 meters. If in some portion soft clayey material or loose material is encountered 300 mm of this material shall be replaced by specified bedding material in that reach. If excavation is carried below required depth, the excess excavated part shall be refilled with bedding material at no extra cost to the owner. (No bedding material shall be placed nor any permanent work commenced until the trench has been inspected by the Engineer and his permission to proceed to the work is given).

8.2 Stringing and Inspection

Stringing, consists of placing pipes on the ground in line ready for laying. Care is again needed to prevent damage during this operation.

The turned ends of all pipes shall be inspected to ensure that they are free from any local irregularities which could affect the water tightness of the joint. All pipe shall also be visually inspected for evidence of impact damage. When such damage is detected, a thorough examination of internal surface in region of the pipe ends shall be made for sign of hair cracks. Damaged pipes, joints, and fittings shall be rejected and replaced at the expense of the Contractor.

8.3 Bedding Material

Bedding material for pipe shall be sand, well graded with portion passing through sieve #200 shall not be more than 10%, free from boulders, clay, cinder, ashes and rubbish etc.

8.4 Laying

Laying shall start at the lowest point in the area in which work is being done, pipe sections shall be laid with socket upstream.

Each length of uPVC Pipes between manholes shall be in a straight line and to the true alignment, position, gradient, and the inverts as shown on the Drawings, unless otherwise directed in writing and set out by the Engineer. The Contractor shall check and satisfy himself as to the correctness of the final gradient, position, and slope of the complete sewer trenches before commencing the laying operation.

At all times when the work of laying the sewer is not in progress, all openings into the pipe and the ends of the pipe in trenches shall be kept tightly closed to prevent entrance of ground water, animals and foreign materials. The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, and shall assume full responsibility for any damage due to this cause and shall, at his own expense, restore and replace the pipe to its specified position and grade if it is displaced due to floating.

The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean condition until the work is completed and approved by the Engineer.

Pipe and accessories shall be carefully lowered into the trench by means of derricks, ropes, belt slings, or other suitable methods. Under no circumstances shall any of the pipe and other materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe.

The full length of each section of pipe shall rest solidly up on the prepared bed of trench. Pipes that have the alignment, grades or joints disturbed after laying, shall be removed and re-laid by the Contractor at his own cost. Pipe shall not be laid in water or when trench conditions are unsuitable for the work.

8.5 Jointing

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Except where otherwise detailed on the drawings, all pipes and joints shall be of solvent cement type.

All joints shall be capable of withstanding the various tests specified for the appropriate class of pipe. Joints shall withstand while maintaining the specified test pressure at a deflection of not less than the values specified in the relevant specification.

The jointing surfaces of pipes shall be dry, clean and free from oil, grease, tar, mud or sand particles.

In placing the pipe and making the joints, care shall be taken to avoid disturbance of bedding underneath the pipe barrel. If the joints cannot be made manually, mechanical pulling devices shall be used.

9.0 TESTING

9.1 General

After the joints are properly fixed and before backfilling the trenches, sewers shall be tested for infiltration or ex-filtration as specified. The Contractor shall test all sewers and their branches in such lengths and time selected at or approved by the Engineer. Sections of the completed sewer shall be isolated and measurement of the infiltration or ex-filtration shall be made by approved methods used for testing of sewer lines shall be absolutely free from insoluble impurities of any kind.

No chemical or adhesive shall be used for water tightening and repairing of pipes. Test reach in no case shall exceed 500 meter.

All joints shall be kept exposed or remain excavated during the testing to witness any leakage in the joints.

9.2 Infiltration

Sewer line shall be tested for infiltration test when the crown of the pipe is below the ground water table. The pipe length under test shall be completely emptied before starting infiltration test. The ends should be effectively closed.

One hour after completely emptying the pipes, depth of water shall be measured at both ends of the pipe. Estimated quantity of water infiltrated shall not exceed the specified allowable limits.

9.3 Ex-filtration

The sewers which are constructed with ground water level below the crown of the pipe shall be tested for ex-filtration.

A section of sewer shall be isolated between manholes by means of expanding stoppers or other approved methods. The length to be tested should be subjected to an internal pressure test of 1.20 meters head of water above the crown of pipe at the high end but not more than 6.0 meters at the low end.

Quantity of water required to achieve the starting level in the test reach after 1 hour shall be measured which shall not exceed the specified allowable limit.

9.4 Allowable Infiltration or Ex-filtration Limits

The calculated amount of infiltration or ex-filtration over a 24 hour period shall not exceed 6 liters per millimeter dia. per kilometer of sewer which rate shall be applied to

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the actual sewer size and length tested to determine the allowable infiltration or ex-filtration over the 24 hour period.

If the measured infiltration or ex-filtration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permissible maximum stated above.

9.5 Commissioning

After successful infiltration/ex-filtration testing of selected isolated pipe lengths, the contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

10.0 MEASUREMENT AND PAYMENT

10.1 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment will be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

10.1.1 Submission of Samples.
10.1.2 Factory Tests.
10.1.3 Site demonstration test
10.1.4 Cutting, jointing of sewer pipes.
10.1.5 Rubber rings.
10.1.6 Providing & fixing of uPVC pipe.
10.1.7 Cleaning, testing and commissioning of sewer lines.
10.1.8 Testing and compaction of trench bottoms.
10.1.9 Water used for testing of sewers.
10.1.10 Route markers

10.2 Measurement

Measurement of acceptably completed works of providing, laying, cutting and jointing of uPVC pipes with rubber rings/ cement solvent including cleaning and testing of sewer lines will be made on the basis of actual length in running meter of sewer pipes as per drawing or as directed by the Engineer.

10.3 Payment

Payment will be made for acceptable measured quantity of providing, jointing, laying, cutting and jointing of sewer pipes fittings with rubber rings including cleaning and testing of sewer lines on the basis of unit rate per running meter quoted in the bills of quantities and shall constitute full compensation for all the works related to the item.

***** End of Section 5218 *****

SECTION - 5220

VALVES & APPURTENANCES

1. GENERAL

1.1. SCOPE

The work to be done under this section of the specifications includes furnishing all plant, labor, equipment, appliances, materials and performing all operations required in connection with supply, installation, testing and commissioning of valves and appurtenances as specified herein, as shown on the drawings and as directed by the Engineer.

1.2. GENERAL REQUIREMENTS

1.2.1 Valves and appurtenances shall be of renowned manufacturers.

1.2.2 Valves and appurtenances shall be new and unused.

1.2.3 Valves and appurtenances intended for firefighting network/ system shall be UL listed and FM approved. All necessary documents shall be provided by the Contractor to confirm the required certification before installation of the valves and appurtenances.

1.2.4 Material of valves and appurtenances shall be suitable for installation on pipelines and must be similar to that of pipeline.

1.2.5 Service ratings of the valves and appurtenances shall be as specified herein, on the drawings or in the contract document but shall not be less than 10 bars.

1.2.6 Valve ends shall be of appropriate class, material and type of the pipe/fittings to which they are to be joined.

1.2.7 Valves and appurtenances shall be installed in positions as shown on the drawings or as directed by the Engineer.

1.2.8 Before installation the interior of valves and appurtenances shall be cleaned of all foreign materials and greased. Damaged paints shall be retouched.

1.2.9 Before installation and after commissioning valves and appurtenances shall be subjected to test pressure which shall be not less than 1-1/2 times the working pressure or the service pressure of the valves and appurtenances, whichever is higher and that no leakage shall be permitted during the test.

1.2.10 Valves and appurtenances shall be adequately supported and labeled.

1.2.11 Manufacturer's literature and operation manual for valves and appurtenances shall be provided.

1.2.12 Specifications are only general guidelines and by no means cover details of each equipment. These only spell out the intent of the requirement. The details have to be provided by the Bidders along with details of performance, construction and technical literature with the tender. The specifications are to be read in conjunction with the drawings.

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2. MATERIALS AND PRODUCTS

2.1. CAST IRON GATE VALVES

Cast iron gate valves shall have flanged ends and wheel handle and shall conform to B.S.5150 "Specifications for Cast Iron Gate Valves". Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of 10 bars to 25 bars as specified in the Bill of Quantities. Valves shall close in clockwise direction.

The valve parts shall be of the following materials.

i. Valve body shall be of cast iron.
ii. Flanges shall be of cast iron.
iii. Shaft shall be of stainless steel.
iv. Disc shall be of stainless steel with bronze trim.
v. Seat shall be of cast iron with bronze trim.

Valve parts in contact with water shall be of corrosion resistant material, free from toxic substances and shall not foster microbiological growth or impart taste, odour, turbidity or color to the water.

Inside surfaces of valves shall be enameled and outside surfaces shall be epoxy coated.

2.2. CAST IRON CHECK VALVES

Cast iron check valves shall be of non-slam, swing type with flanged ends and shall conform to B.S. 5153, "Specifications for Cast Iron Check Valves for General Purposes". Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of 10 bars to 25 bars as specified in the Bill of Quantities. The direction of flow shall be permanently marked on the body of the valve.

The valve parts shall be of the following materials.

I. Valve body shall be of cast iron.
II. Flanges shall be of cast iron.
III. Shaft and spring shall be of stainless steel.
IV. Disc and seat shall be of stainless steel with bronze trim.
V. Disc and shaft seal shall be of rubber (O-ring type).
VI. Wheel handle shall be of cast iron.

Valve parts in contact with water shall be of corrosion resistant material, free from toxic substances and shall not foster microbiological growth or impart taste, odor, turbidity or color to the water.

Inside surfaces of valves shall be enameled and outside surfaces shall be epoxy coated.

2.3. DUCTILE IRON GATE VALVES

Ductile Iron Gate valves shall have flanged ends and wheel handle and shall conform to B.S.5150 "Specifications for Ductile Iron Gate Valves" or EN1171. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of 16- bars to 25 bars as specified in the Bill of Quantities. Valves shall close in clockwise direction.

The valve parts shall be of the following materials.

i. Valve body, bonnet and wedge shall be of ductile iron.
ii. Wedge seat shall be of bronze.
iii. Stem shall be of stainless steel.
iv. Hand wheel shall be of ductile iron.
v. Body seat shall be of bronze.

Valve parts in contact with water shall be of corrosion resistant material, free from toxic substances and shall not foster microbiological growth or impart taste, odour, turbidity or color to the water. Inside surfaces of valves shall be enameled and outside surfaces shall be epoxy coated.

2.4. BRONZE GATE VALVES

Bronze gate valves and shall conform to B.S. 5154, "Specifications for Copper Alloy Globe, Globe Stop, Check and Gate Valves for General Purposes". Valves shall be rated for a working pressure of 10 bars to 25 bars. Valve ends shall be flanged as shown on the drawings. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall close in clockwise direction. Open and shut indicators shall be marked on the wheel handle.

The hose bibs shall be provided with concrete pedestal as shown on the drawings or as approved by the Engineer.

8.2.1 Bronze Valves (Gate Valves)

All valves of 75 mm diameter and smaller shall be of bronze unless otherwise specified conforming to BS 5154 and shall be of PN-16 pressure rating. All valves shall be so located that they become accessible with ladder. Open and shut indicators shall be marked on the handle. The ends may be screwed or flanged. All valves shall be of renowned manufacturer.

2.5. BRONZE CHECK VALVES

Bronze check valves shall conform to B.S. 5154, "Specifications for Copper Alloy Globe, Globe Stop, Check and Gate Valves for General Purposes". Valves shall be rated for a working pressure of 10 bars to 25 bars. Valve ends shall be flanged as shown on the drawings. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. The direction of flow shall be permanently marked on the valve body.

2.6. BUTTERFLY VALVES

Butterfly valves shall conform to B.S. 5155, "Specifications for Butterfly Valves" and shall be rated for a working pressure of 10 bars to 25 bars. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. The direction of flow shall be permanently marked on the valve body. Valves shall be double flanged or wafer type as mentioned in Bill of Quantities.

- Valve body shall be of cast iron/ductile iron as per BOQ.
- Seat Ring shall be Ethylene Propylene Diene Monomer (EPDM).
- Disc shall be stainless steel with bronze trim.
- Stem (Shaft) shall be S.S Cr.13
- Lever or gear shall be cast iron/ductile iron.
- Stem O ring shall be EPDM.

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Wherever mentioned in Bill of Quantities, butterfly valves shall be provided with lever/wheel, worm gear and with extended stem as shown on the drawings or as specified herein.

2.7. SURGE RELIEF VALVES

Surge relief valves shall be spring operated globe type for continuous services conforming to ISO Standard or Equivalent. Valves body shall be of cast iron with stainless steel rim. Spring shall be of stainless or high tensile steel. Flanges shall be drilled to B.S. 4504 Part 1 or EN1092-1. Valves shall be rated for a working pressure of minimum 16 bars. Valves shall relieve pressure when the surge pressure in the system exceeds the pre-set value. The pressure will be adjustable.

2.8. DUCTILE IRON DOUBLE ACTING AIR VALVE

The automatic air release valves shall include a small orifice and a large orifice, consisting of: One resilient seated large orifice for release and admission of air when filling and emptying one small nipple orifice for release of air accumulated under normal working conditions. It shall be designed to operate under the pressures shown in the BOQ. The air valves shall have incorporated isolated valve. All air valves shall have integrated flanged inlet drilled according to ISO 7005-2 and EN 1092-2 complying with the pressures mentioned above and shall be fitted with lifting eyes for handling. The dimensions of the flanges shall be suit to tight with the flanges of the gate valves flanges mentioned above. Air valves should have orifice(s) sized for the operating conditions. Air Valves should comply with EN 1074-4. Valves should be suitable for water service and where required should combine the operating features of air release and air re-entry into the system to prevent vacuum and allow system drainage. The air release portion should automatically exhaust entrained air that accumulates in system. Ductile iron body, cover and flange, Stainless steel ball floats for large and small orifice and trim should be provided to meet the operating conditions. Valve body should be coated with Epoxy powder Coating of minimum thickness 300 micron. The valve should automatically operate in order to:

a) Positively open under internal pressure lower than the atmospheric pressure, to admit air in bulk during pipeline draining,

b) Exhaust air in bulk during pipeline filling and positively close when water fills the body of the valve,

c) Exhaust accumulated air under pressure when the pipeline is in operation

The valve body and bonnet should be made of ductile iron. The ball floats should be made of stainless steel or rubber coated steel. The nozzle (small orifice of the valve) should be made of brass. The valve should be flanged. The flange should comply with ISO 7005-2, EN 1092-2 or equivalent from other standards. For pipes 150 mm and larger, automatic air vacuum and air release valves shall be supplied with double orifice air valves with both, small and large orifices. Valves shall be of the flanged type and of pressure class PN 16 or PN 25 as mentioned in the BoQ. The following types and minimum sizes of air valves (nominal diameter) shall be used:

Pipeline = 150-300 mm - double air valve DN 50

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Air release valve shall be provided at all high points to ensure adequate venting of the piping system.

In addition to above, the air release valves provided in firefighting system/ network shall be UL listed and FM approved as mentioned in the BoQ.

2.9. FLOAT VALVES

Float valve shall be copper alloy piston type and conform to BS 1212. Float shall be of copper conforming to BS 1968.

2.10. PRESSURE REDUCING VALVE

Pressure reducing valve shall consist of screwed pressure reducing valve, body and screws of brass, spring, bonnet and regulation handle of high quality synthetic material, valve insert of corrosion resisting synthetic material (completely interchangeable), mesh strainer of corrosion resisting synthetic material with fine mesh of stainless steel, mesh width 0.16 mm diameter, strainer chamber of standard construction of shock-proof transparent synthetic material, ¼" connection for pressure gauge on both sides of valve body, 2 pressure gauges, casing of synthetic material, diameter 63 mm, ¼" connection. At bar calibrated scale 0-16 bars. One double socket wrench for loosening of spring and strainer chambers, including all necessary sealing, and fixing material.

2.10 ABOVE GROUND FIRE HYDRANTS

Above ground fire hydrants shall conform to AWWA C502-80 and shall be of Ductile Iron body. The pressure rating shall be of at least PN 16 and test pressure of 1.5 times the working pressure. The lower part shall consist of ductile iron with drain opening. The upper part shall be of ductile iron with one 100mm (4") outlet and two 65mm (2½") outlets. The connection between upper and lower parts shall be constructed as a security break device with ductile iron ring and hexagonal screws.

The 100mm (4") outlet coupling shall be screwed according to BS 750, round threaded, the two 65mm (2½") couplings shall be of brass quick release/ instantaneous type with brass covers and shall be suitable with the . The spindle and other equipment shall be stainless steel or other corrosion resistant material.

The inside coating shall be either pure enamel or epoxy resin based paint. The outside shall be painted bright red (fire red according to RAL 3000) with epoxy resin based paint.

2.11 BELOW GROUND FIRE HYDRANTS

Fire hydrants below ground shall be of type shown on drawing and shall be fixed vertical on ductile iron tee. It shall conform to EN 14339:2005 and BS 750. It shall be of Ductile Iron body and shall be securely anchored as shown on the drawings. The pressure rating shall be of at least PN 16 and test pressure of 1.5 times the working pressure.

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All exterior surfaces of buried metal components of fire protection system shall be coated with a minimum of two coats of black bituminous enamel. The hydrant shall be installed in water tight chamber as shown on the drawings. Letter "F" or word "FIRE" shall be inscribed on the cover. The cover shall be water tight for the below ground fire hydrant chambers.

3. INSTALLATION OF VALVES

Valves shall be installed either in chambers with water tight covers or above grade on line as shown on the drawings and/or as directed by the Engineer. Before installation, the interior surfaces of valves shall be cleaned of all foreign matters, inspected to ensure that all components are sound and in working condition and tested to 1-1/2 times the working pressure and internally and externally coated. After installation, valves shall be securely anchored; tested, retouched where paints have been damaged and labeled.

4. MEASUREMENT AND PAYMENT

4.1. GENERAL

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost therefore shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

i. Jointing arrangement of pipe on both ends of valves, including gaskets, nuts, bolts etc.
ii. Valves and appurtenances supports and anchors
iii. Keys for operation of valves
iv. Steel embedded parts and label plates
v. Valve boxes
vi. Manufacturer's literature and operation manual for valves and appurtenances
vii. Painting of valves appurtenances

4.2. MEASUREMENT

Measurement of acceptably completed works of valves and fire hydrants will be made on the basis of actual number of valves and fire hydrants provided and installed in position as shown on the drawings, and as directed by the Engineer.

4.3. PAYMENT

Payment for the acceptable measured quantity of valves and fire hydrants will be made on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

***** END OF 5220 *****

SECTION - 5225

MANHOLES AND VALVE CHAMBERS

1.0 SCOPE

The work to be done under this section of specifications includes all plant, labour, equipment, appliances, materials and in performing all operations required in connection with construction, manholes/valve chambers including providing and fixing C.I/D.I or RCC cover and frame, ladder rungs, etc. complete as specified herein as shown on the drawings, or as directed by the Engineer.

2.0 APPLICABLE SECTIONS OF SPECIFICATION

The following specification sections except for sub-sections regarding measurement and payment shall be followed for carrying-out civil works associated with this section:-

S.No.	Description	Section No.
1.	Earth Work	1100
2.	Form Work	2100
3.	Reinforcement	2200
4.	Plain and Reinforced Concrete	2300
5.	Block Masonry	4100
6.	Cast Iron Covers with Frames and ladder rungs	5233

3.0 CONSTRUCTION

Manholes and valve chambers shall be of reinforced cement concrete top, walls and base slab shall be of R.C.C. of the sizes, thickness, height and class of concrete as shown on relevant drawings. The work of excavation, backfilling, disposal of surplus/rejected earth, plain and reinforced cement concrete, formwork, reinforcement C.I/ D.I or RCC cover and suitable frame, ladder rungs, benching, etc. are to be done under this section and shall be executed in accordance with the specifications as stated above. The C.I. frame and ladder rungs and other fittings/accessories as shown in drawings, shall be well set in place at the time of pouring of concrete.

4.0 MEASUREMENT AND PAYMENT

4.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

a) Earth work, formwork plain and reinforced concrete reinforcement, reinforcement steel embedded parts, steel pipe sleeves with packing and sealant, PCC valve supports concrete benching etc.

b) Provision and installation of C.I. cover with frame, gratings and ladder rungs.

4.2 **Measurement**

Measurement of acceptably completed works of manhole/valve chambers will be made on the basis of actual number of manholes/valve chambers provide as shown on the drawings and or as directed by the Engineer.

4.3 **Payment**

Payment will be made for acceptable measured quantity of manhole/valve chambers on the basis of unit rate as quoted in the Bills of Quantities & shall constitute full compensation for all the works related to the item.

***** End of Section 5225 *****

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SECTION 5233

CAST IRON/ DUCTILE IRON COVERS WITH FRAMES

1.0 SCOPE OF WORK

The work to be done under this section of the specifications consists of furnishing all plant, labor, equipment, appliances, materials and performing all operations required in connection with the installation of Cast Iron/ Ductile Iron Cover with Frame, Gratings and ladder rungs, complete as specified herein, as shown on the drawings and or as directed by the Engineer.

2.0 APPLICABLE CODES AND STANDARDS

All works and materials under this section shall conform to the latest edition of the following applicable codes and standards. When the requirements of this specification or the drawings exceed the code requirements, the Contractor shall be bound by the specifications and/or drawings for those requirements.

Number	Title
BS EN 124	"Gully Tops and Manhole Tops for Vehicular and Pedestrian Areas"

Other authoritative codes and standards which ensure equal or higher quality then those references may also be acceptable subject to satisfaction and approval of the Engineer.

Any conflict between the requirements of this specification and those on the figures herein or in the codes, standards and specifications referred to herein shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

3.0 CAST IRON/ DUCTILE IRON COVERS WITH FRAME

Cast iron/ ductile iron cover and frame shall be of the sizes and duty as specified on the drawings. The specified size means the clear opening. The cover shall be complete with frame. Top of cover shall be roughened, name/ logo of the Employer marked with the letters representing system for which manholes are constructed duly approved by the Engineer. Locking and lifting arrangement shall also be provided. The frame shall be well set in place at the time of pouring of concrete. The cover shall tightly fit in the frame. The class and test load for cover and frame shall be as follows:

Class/Duty of Cover and Frame	Peak or Test Load
A 15	15 KN
B 125	125 KN
C 250	250 KN
D 400	400 KN
E 600	600 KN
F 900	900 KN

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The Contractor shall ensure that the manhole is rated for above mentioned test load irrespective of the weight.

4.0 CAST IRON/ DUCTILE IRON GRATING AND FRAME

All cast Iron/ ductile iron grating and frame shall be of the sizes and duty as specified on the drawings. The class and test load for grating and frame shall be same as provided in the above table. The specified size means the clear opening. Cast iron grating shall be complete with frame. The casting shall be sound and free from all defects. The frame shall be set in place at the time of pouring of concrete. Opening in gratings shall be in an approved pattern.

5.0 LADDER RUNGS

Galvanized steel ladder rungs with epoxy coating shall be fabricated to the size specified on the drawings or as directed by the Engineer. The galvanized mild steel ladder rungs with epoxy coating shall be embedded in the concrete of manholes or chambers at locations shown on the drawings or as directed by the Engineer.

6.0 MEASUREMENT AND PAYMENT

Measurement

Measurement of acceptably work of cast iron cover & frame, ladder rung will be made on the basis of actual number provided and installed in position as shown on the drawing and as directed by the Engineer.

Payment

The payment for the acceptable measured quantity will be made on the basis of unit rate per number quoted in the bill of quantities and shall constitute full compensation for all the works related to the item.

*** End of Section 5233 ***

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SECTION – 5240

PUMPING MACHINERY

1. GENERAL

1.1 SCOPE

The Work under this Section shall include all labor, materials, and equipment required to furnish and install the pumps and triturator along with motors and all other accessories in the location and quantities as shown on the drawings and or as specified in this section.

1.2 REFERENCES

1.2.1 ASTM - American Society of Testing and Materials

ASTM A 36	Structural Steel.
ASTM A 48	Gray Iron Castings.
ASTM A 53	Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated (Galvanized), Welded and Seamless.
ASTM A 108	Steel Bars, Carbon, Cold Finished, Standard Quality.
ASTM A 276	Stainless Steel Bars and Shapes.
ASTM A 297	Steel Castings, Iron-Chromium, Iron-Chromium-Nickel, Heat-Resistant, for General Applications.
ASTM A 536	Ductile Iron Castings.

1.3 MATERIALS AND PRODUCTS

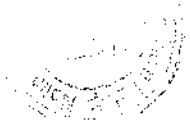
Materials and machinery shall conform to the latest referenced specifications and other provisions specified herein and shall be new and unused. In case where manufacturers are specified, materials and equipment will be of the same manufacturers. In all other cases the Contractor shall ensure that all components and accessories shall be product of single manufacturer and submit the names and addresses of the Manufacturers and trade names of the materials and equipment that he intends to provide. Contractor shall also provide the information such as diagram, drawing and descriptive data. Approval of materials and all the machinery under this provision shall not be construed as authorizing any deviations from the specifications. The Engineer will review all submittals and all technical data to ensure compliance with the requirement of design drawings and specifications.

1.4 SPECIAL REQUIREMENTS

1.4.1 The Contractor shall furnish with each pump/triturator properly identified characteristic curves prepared and certified by the manufacturer showing capacity, head, efficiency and brake horsepower throughout the entire range of the pump.

1.4.2 The pumps/triturator shall have stable throttling curves and be suitable for unrestricted parallel operation.

1.4.3 All pumps/triturator shall be electric driven or as mentioned in bill of Quantities.



1.4.4 The pumps/triturator and their drives shall not overload or trip when operating against zero pressure.

1.4.5 The design, construction and materials shall be such that the damage as a result of cavitation is completely eliminated.

1.4.6 Pumps/triturator shall have bearings and be suitable for continuous as well as intermittent operation without external sealing or cooling water. The pumps shall be such that they shall come into operation at once after a prolonged shutdown period without having to take special measures. Pumps shall be capable of delivering specified quantity of water at the specified pressure.

1.4.7 Pumps/triturator shall be tested at factory for FAT (Factory Acceptance Test) in the presence of Employer and Engineer or his representative before dispatching to the site.

1.4.8 Pumps/triturator shall be installed at positions shown on the Drawings and/or as directed by the Engineer.

1.4.9 Pumps/triturator and their drives shall be in perfect alignment when installed in position.

1.4.10 Pump/triturator set shall be provided with reducer/enlarger if necessary on pump discharge pipe, and suction piece on the suction end.

1.5 SUBMITTALS

1.5.1 Product Data: Submit manufacturer's pumps/triturator specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

1.5.2 Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

1.5.3 Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to plumbing of pumps/triturator. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.5.4 Certificate of Compliance.

1.5.5 Maintenance Data: Submit maintenance data for each type of pumps/triturator, control, and accessory; including "trouble-shooting" maintenance guide.

1.6 TRANSPORTATION, HANDLING AND STORAGE

1.6.1 Deliver pumps/triturator, hardware and accessories in manufacturer's original new, protective packing.

1.6.2 Handle pumps/triturator and components carefully to prevent damage, breaking, denting and scoring. Contractor shall not install damaged pumps or components delivered at site and shall replace if any with new/ unused.

1.6.3 Store pumps/triturator and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

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1.6.4 Comply with manufacturer's written rigging and installation instructions for unloading, plumbing pumps/triturator, and moving them to final location.

1.7 WARRANTY

All pumping assemblies and components including pumps/triturator, motors, controls, etc. shall be guaranteed by the system manufacturer in writing for a period of minimum 1 year after satisfactory installation, testing, commission and acceptance by the Client and from date of substantial completion against defective materials and workmanship, including motor burn-out.

Water pressure booster system as a whole shall be also guaranteed in writing by the manufacturer for a period of 1 year after satisfactory installation, testing, commission and acceptance by the Client and from the date of substantial completion against any defects in design, materials, construction or workmanship.

1.8 QUALITY ASSURANCE

1.8.1 Manufacturer's Qualifications: Firms regularly engaged in manufacture of pumps/triturator with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years, and shall be subject to approval of the Engineer.

1.8.2 Provide pumps whose performance, under indicated operating conditions, are certified by the pump manufacturer.

1.8.3 Single Source Responsibility: All the components and accessories shall be product of single manufacturer.

1.9 PRODUCT HANDLING

Deliver all hardware in manufacturer original protective packing.

2. PRODUCTS

2.1 GENERAL

Materials and machinery shall conform to the latest referenced specifications and other provisions specified herein and shall be new and unused. In case where manufacturers are specified, materials and equipment will be of the same manufacturers. In all other cases the Contractor shall ensure that all components and accessories shall be product of single manufacturer and submit the names and addresses of the Manufacturers and trade names of the materials and equipment that he intends to provide. Contractor shall also provide the information such as diagram, drawing and descriptive data.

2.1.1 Statistically and dynamically balance rotating parts.

2.1.2 Construction shall permit complete servicing without breaking piping or motor connections.

2.1.3 Pumps/triturator connections shall be flanged.

2.1.4 Pumps/triturator shall be selected to operate with non-overloading characteristics.

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2.1.5 The characteristic curve of a centrifugal pump shall be stable; the head shall increase with decrease in delivery until maximum head reached at zero flow which shall not exceed the discharge pressure at rated duty by more than 25%.

2.2 HORIZONTAL CENTRIFUGAL PUMPS & MOTOR (FOR POTABLE WATER)

2.2.1 The pump sets will consist of horizontal centrifugal pump and motor of specified capacity and head and shall be horizontal, totally enclosed, fan cooled, squirrel cage induction motors of specified power.

2.2.2 Pump materials shall be as under:

Body	:	Cast iron
Impeller	:	Bronze or Stainless Steel
Pump Shaft	:	Stainless Steel
Shaft Sleeve	:	Stainless steel

2.2.3 Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for at least 1.5 times the working pressures.

2.2.4 The efficiency of the pumps should not be less than 60%.

2.2.5 Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for minimum pressure of 16 bars.

2.2.6 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.3 POTABLE WATER BOOSTER PUMP SET

Potable water booster pump set shall be provided with the following accessories:

One number PVC / polypropylene / rubber / epoxy lined steel hydro-pneumatic pressure tank of specified capacity with neoprene rubber diaphragm between the water and air sections. The tank shall be complete skid mounted boosting system with automatic motor control unit for dry run protection and auto operation system shall be provided with stainless steel piping. The unit shall be furnished ready for installation L/C flexible pipe gate valve, non-return value, pressure switch & pressure gauge and shall be ready for operation when connected to the piping & electricity supply. The tank shall be rated for a working pressure of 6 kg/cm^2 and test pressure of 9 kg/cm^2 and shall comply with all the relevant clauses of "ASME Code for Pressure Vessel".

Pump sleeve, intermediate chamber/guide vanes, impeller, suction inter-connector spline shaft cover plates etc. shall be of stainless steel with mechanical seal of approved material. Base plate shall be painted steel.

Pressure gauge, pressure switch, gate and check valve on pump discharge pipe. Pressure switch will be adjustable between 4.0 to 3.0 kg/cm^2 and shall be wired to motor

control panel.

- ✓ Gate valve and check valve on pump discharge pipe.
- ✓ Gate valve and foot valve on pump suction pipe.

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- ✓ Minimum run timer adjustable from 0-6 minutes.
- ✓ Low water level cut-off switch.
- ✓ Reducer/enlarger, if necessary on pump discharge and suction pipe.

2.4 SUBMERSIBLE BOREHOLE PUMP & MOTOR (FOR TUBEWELL)

The pump shall be suitable for the intended use and shall have specified capacity and head. Pump shall be made of Stainless Steel 304 or above.

2.4.1 The materials of pump shall be as follows:

Pump Casing	-	Stainless Steel
Impeller	-	Stainless Steel
Shaft	-	Stainless Steel
Wear Ring	-	Rubber
Diffuser	-	Stainless Steel

2.4.2 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.4.3 Pumps shall be provided with all necessary accessories for operation.

2.4.4 Contractor shall work out the actual flow and head of the pump based on the exploratory bore and site conditions and shall propose the pump accordingly.

2.4.5 The size of the pump shall be with respect to the size of the bore casing.

2.5 HORIZONTAL CENTRIFUGAL SEWAGE PUMPS & MOTOR (FOR WASTEWATER)

2.5.1 The pump sets will consist of horizontal centrifugal non clogging sewage pump and motor of specified capacity and head and shall be horizontal, totally enclosed, fan cooled, squirrel cage induction motors of specified power.

2.5.2 Pump materials shall be as under:

Body	:	Cast iron
Impeller	:	Stainless Steel or as suggested by the Manufacturer
Pump Shaft	:	Stainless Steel
Shaft Sleeve	:	Stainless steel

2.5.3 All wetted materials of pumps shall be suitable to withstand any chemical attack from municipal sewage water & blue wastewater (from Aircraft).

2.5.4 Pumps shall have mechanical seal. The suction and discharge flanges shall be rated for at least 1.5 times the working pressures.

2.5.5 The efficiency of the pumps should not be less than 55%.

2.5.6 Non-Clog impeller shall be designed to allow sizable spherical solids to pass the flow passage easily without clogging.

2.5.7 All pumps shall operate through level switches installed in wet pit as per the schedule provided in the drawings.

2.5.8 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.6 SUBMERSIBLE PUMP & MOTOR (FOR WASTEWATER)

The pump shall consist of submersible sewage non-clogging pump and motor of the specified capacity and head and shall be integral sealed unit with strainer. The pump should be capable to handle the drainage water / waste water.

Pump material shall be as under:

Body	:	Cast Iron
Impeller	:	Stainless Steel or as suggested by the Manufacturer
Shaft	:	Stainless Steel
Bearing	:	Pre-lubricated bearing
Motor	:	Air filled water tight

2.6.1 The pumps shall be installed inside the pit as shown on drawing. The discharge flange shall be threaded to BS 21 and shall be rated for working pressure of 10 kg/cm^2.

2.6.2 The motor shall have a built-in over load protection, low voltage, over-heating and phase failure.

2.6.3 The operation shall be automatic according to the levels in the wet pit.

2.6.4 Pump suction and discharge flanges shall be of steel drilled to B.S 4504 or B.S 10 and shall be rated for the working pressure of 10 bars.

2.6.5 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.7 TRITURATOR / MACERATOR (FOR BLUE WATER DISPOSAL)

2.7.1 The blue water disposal system shall consist of non-clogging triturator / macerator with motor complete in all respects for minimum flow rate of 100 m^3/hrs and shall be capable of at least continuous operation for 08 hrs./day.

2.7.2 Triturator materials shall be as under:

Cutterhead casing - Material	:	Gray Cast Iron (EN-JL 1040)
Cutterhead casing - Connection inlet	:	DN 150 PN 16 DIN EN 1092 (DIN2501)
Cutterhead casing - Connection outlet	:	DN 150 PN 16 DIN EN 1092 (DIN2501)
Shear plate - Material	:	Molybdenum high speed steel (1.3343 / AISI M2 hardened)
Drive shaft	:	Unalloyed Structural Steel / 1.0070 (st. 70-2)
Mechanical seal - Material	:	Stationary seat silicon carbide
Mechanical seal - Material slip ring	:	Silicon carbide
Mechanical seal - Material elastomer	:	FPM
Mechanical seal - Material components	:	Austenitic chromium-nickel-stainless steel (1.4571 / AISI 316Ti)

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Headstock - Material	:	Unalloyed structural steel / 1.0570 (st. 52-3)
Headstock - Cutter material	:	Hard metal AISI 1045
Bearing housing - Material	:	Gray Cast Iron (EN-JL 1040)

2.7.3 All wetted parts of triturator shall be suitable to withstand any chemical attack from municipal sewage & blue water from Aircraft.

2.7.4 Triturator shall have mechanical seal. The suction and discharge flanges shall be rated for at least 1.5 times the working pressures.

2.7.5 The triturator shall operate through level switches installed in wet pit or manually.

2.7.6 Motor shall run on 3-phase, 415/380 volts, 50 c/s A.C. Power. Motor shall be protected against low voltage, overheating and phase failure.

2.8 PUMP ACCESSORIES

Pumps/triturator shall be provided inclusive of the following accessories:

2.8.1 Pressure switches, pressure transducers, level switches, etc.

2.8.2 Reducer/enlarger is necessary if the pumps/triturator discharge size is different from discharge piping.

2.9 MOTOR PROTECTION

Motors of 3kw or less power shall be started direct on line. Larger motors shall be started by star-delta starter.

Motor shall be protected against under voltage over voltage, overload, over-heating and phase failure.

Motor shall be rated for normal operation against a voltage fluctuation of + 10% and frequency fluctuation of + 2Hz.

2.10 CONTROL

(a) Potable Water Supply Pumps

- Operation of pumps shall be manual and automatically controlled by level switched installed in Overhead Water Tank.

(b) Wastewater Pumps and motors

- Operation of pumps shall be manual and controlled by level switches installed inside the wet sump pit of Sewage Lift Station.

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(c) Triturator / Macerator

- The triturator shall operate through level switches installed in wet pit or manually.

2.11 PRESSURE GAUGES

2.11.1 Pressure gauges shall be of copper alloy, bourdon tube type with 100mm diameter dial face. The dial shall be engraved in black on white background from zero to 16 bars or 1.5 times the working pressure whichever is larger.

2.11.2 Gauge shall be installed to socket welded to the pipeline with an isolating plug/ball valve. If the pipeline installation is such that the above requirement cannot be met pressure gauge of remote reading type shall be installed.

2.12 WATER LEVEL INDICATOR

2.12.1 The water level indicator for high and low water level cut off shall operate on 230 Volt AC, 50 Hz and supplied complete with float, float chains, counter-weights, chain clamps steel mounting brackets, chain guide roller and any other equipment and material necessary for installation and satisfactory operation.

2.12.2 The level indicator shall have at least 5 switch-contacts or as required for sensing the required water levels within the specified range.

2.12.3 The level indicator shall be suitable to match with the specific gravity of the fluid in which it is intended to be installed.

2.13 LEVEL SWITCHES

The level indicator shall have at least 3 switch-contacts or as required for sensing the required water levels within the specified range. The level indicator shall be suitable to match with the specific gravity of the fluid in which it is intended to be installed. All operational, constructional and installation details shall be furnished by Contractor for approval.

2.14 FOOT VALVE FOR PUMPS

Foot valves shall be installed on the suction Line of the pumps where required or indicated on the drawing. Foot valve shall be of brass or as specified in bill of quantities, and shall be provided with integral strainer. Foot valve shall be provided with a spring loaded vertical check disc with gasket for tight shut-off.

2.15 BELL MOUTH SUCTION FITTING

Shall be installed on the suction Line of the pumps where required or indicated on the drawing. Bell mouth shall be of same material as of suction pipe or as specified in bill of quantities. The size of bell mouth intake and connection end shall be as per drawings or as specified in the bill of quantities.

2.16 CHAIN AND PULLEY BLOCK ARRANGEMENT

2.16.1 Manually driven chain and pulley block arrangement shall be installed in Pump Room. The chain and pulley block arrangement shall be capable to lift the specified load and shall be provided and installed as shown in drawings, to serve as lifting arrangement for pumps and accessories.

2.16.2 The I-Beam shall be a standard AISI girder of required size and specific weight. The travel wheels of the pulley block shall be made of dia-forged steel and supported on ball or roller bearings. The bolts wherever used shall be of high tensile steel. Rubber buffers

shall be provided at the end of travel of pulley block in either direction.

2.16.3 The chain block shall be capable to provide a standard clearance/lift.

2.16.4 After installation, the lifting arrangement shall be subject to no load and full load tests for satisfactory operation. Before putting into operation, the arrangement shall be properly cleaned, greased and painted.

2.17 BAR RACK/ SCREEN

2.17.1 The manually cleaned screens shall be furnished and installed as shown in the drawings and as specified herein.

2.17.2 All materials used shall be Mild Steel suitable for service in a moist, corrosive environment as encountered in Wastewater treatment plants. Bar Screen shall be made of rectangular bars of size 12mm x 50mm and length as per drawings. Screen shall be installed at 50mm c/c.

2.17.3 Bolts, anchor bolts, and washers which are submerged or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel, with bronze nuts or cap screws of copper-silicon alloy. Wherever stainless steel bolts and nuts are specified, it shall refer to the above material combination, unless specifically excluded.

2.17.4 Unless otherwise shown, all anchors shall be stainless steel.

2.17.5 All protective coating for the ferrous metals and all materials exposed to the corrosive environment in the head works or submerged in wastewater shall be epoxy coated of at least 200 microns or selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free.

2.18 MAINTENANCE MANUALS AND TOOLS

2.18.1 A comprehensive manual containing the complete information in connection with the assembly, operation, lubrication, adjustment and repair of the pumping equipment, electric motor, together with detailed parts list with drawings or photographs shall be furnished in duplicate.

2.18.2 For the pump room, special tools necessary for maintenance and repair of the pumps and electric motors including tools kits, grease guns etc. with accessories shall be furnished.

2.18.3 The manufacturer's recommended list of spare parts shall be submitted by the Contractor to the Engineer for approval. Such spare parts will also be furnished by the Contractor.

All the maintenance manuals, tools, spare parts etc., shall be supplied by the Contractor at no cost and all cost shall be deemed to be included by the Contractor in his bid against item of pumping set.

3. EXECUTION

3.1 INSTALLATION

3.1.1 Examine area and conditions under which pumps are to be installed. Do not proceed with the work until unsatisfactory conditions have corrected in manner acceptable to the Engineer.

3.1.2 Provide access around the pumps for service as shown in the drawings, but in no case less than that recommended by the manufacturer.

3.1.3 Unless indicated otherwise, install pumps on minimum of 100 mm high concrete base or as mentioned in the drawings with anchor bolts poured in place.

3.1.4 The submersible drainage non clogging pumps shall be installed in the sum pits at the locations shown on the drawings.

3.2 SHOP TESTING

3.2.1 Pump performance tests shall be conducted in accordance with Hydraulic Institute test codes as described in HI E35.01, E37.01 and E39.01. In addition, each pump shall be tested at five points of operation from shut-off head to run-out condition, including the guaranteed pump's performance point.

3.2.2 All pumps shall be hydrostatically tested for leaks at 1.5 times the design pressure. There shall be no leakage during the one hour test period.

3.2.3 The Contractor shall submit manufacturer's test certificates, including test data to show that pump meets specifications.

3.3 FIELD TESTING

3.3.1 Field performance test of all pumps shall be witnessed by the Engineer.

3.3.2 All tests shall be subject to approval of the Engineer.

3.4 ADJUSTING AND CLEANING

3.4.1 Check alignment, and where necessary, realign shafts or motors and pumps within recommended tolerances by manufacturer.

3.4.2 Start-Up: Lubricate pumps before start-up. Start-up in accordance with manufacturer's written instructions.

3.4.3 Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

4. MEASUREMENT AND PAYMENT

4.1 PUMPING MACHINERY

4.1.1 Measurement

Measurement for payment of pumping machinery shall be the actual number acceptably provided, installed, tested and commissioned in position; the Contractor's bid against these item shall include cost of providing, installing, testing and commissioning the pumping machinery including the pumps, triturator, electric motors, all accessories, level switches, pressure switches, pressure gauges, manuals, tools, spare parts, etc., as shown on the Drawings, as specified herein or as directed by the Engineer.

Measurement for payment of bar screen shall be the weight in kilograms acceptably provided and installed in position.

4.1.2 Payment

Payment will be made for acceptable measured quantity of pumping machinery, pressure switches, pressure gauges, etc on the basis of unit rate per number quoted in the Bill of Quantities. The amount bid shall be full payment for the work specified.

Payment of bar screen will be made for acceptable measured quantity on the basis of weight in kilograms quoted in the Bill of Quantities. The amount bid shall be full payment for the work specified.

***** END OF SECTION *****

SECTION - 5280

FLUSHING, TESTING, DISINFECTION AND COMMISSIONING OF PIPELINE

1. SCOPE OF WORK

The work under this section of specifications includes furnishing all plant, labor, equipment, appliances, materials and water and performing all operations required in connection with flushing, testing, disinfection and commissioning of all water lines and system in parts and as a whole as specified herein or as shown in the Contract Documents or as directed by the Engineer.

2. WATER FOR FLUSHING AND TESTING

The contractor shall arrange the required quantity of water for flushing & testing. No separate payment shall be made for the supply of water for flushing and testing.

3. FLUSHING

The Contractor shall provide facilities for flushing of water lines. Flushing shall be done section by section. A length of 500 meters will be considered to be a normal length of the section. Flushing shall be continued until clean water starts flowing through the other end. The flushing velocity shall be at least 2.5 feet per second. Flushed water will be disposed of as directed by the Engineer.

4. PRESSURE AND LEAKAGE TEST

Flushing of pipe line shall be followed by a pressure and leakage test as specified in the relevant specifications for various types of pipes and fittings.

During the test, all exposed pipes, fittings, valves, hydrants, and couplings shall be carefully examined.

The Contractor shall locate and repair the defective joints and/or pipes at his own expense until the specified leakage test is satisfactorily performed. The pipe connection and all necessary apparatus including gauges shall be furnished by the Contractor.

5. DISINFECTION

Only potable water lines and system shall be disinfected. Final disinfection shall be accomplished by chlorination. A chlorine and water mixture shall be applied by means of a solution feed chlorination device. The dosage applied to the water entering the pipe shall be at least 50 mg/liter of chlorine. The mixture of chlorine and water shall be retained for at least 24 hours. The chlorine residual at pipe extremities shall be at least 25 mg/liter at the end of the period. Following the complete disinfection of the pipe line, all treated water shall be thoroughly flushed out, until the chlorine residual is less than 1 mg/liter.

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6. COMMISSIONING

After successful completion of testing, the pipeline shall be commissioned by filling water and bringing the pipeline to full operating pressure. All temporary arrangements made for testing shall be removed.

7. TESTING OF FIREFIGHTING SYSTEM/ NETWORK

In addition to above, the Contractor shall test the firefighting system/ network as per NFPA standards and shall provide the Testing Protocol and Procedure for approval of the Engineer before carrying out the testing of the firefighting network/ system. The testing assembly required for testing the firefighting network/ system shall be arranged by the Contractor before the testing of the system. No payment shall be made for the testing assembly required to conduct the testing of the network/ system as per approved Testing Protocol.

8. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specification unless otherwise specifically stated in the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

***** END OF 5280 *****

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SECTION - 8460

NATURAL GAS PIPING

1 SCOPE OF WORK

The Contractor shall furnish all plant, labour, materials, equipment, tools, appurtenances, services, temporary work and storage and perform all operations necessary for the supply and installation of the gas supply piping alongwith necessary fittings in perfect operating condition in accordance with these specifications and Drawings and/or as directed by the Engineer.

The Contractor shall be responsible for the supply and installation of gas piping work (low pressure) within the building and outside up to the gas regulator. Gas regulator, meter, control valves and piping work (high / medium pressure) will be supplied and installed by SSGC.

The Contractor shall execute all gas piping work through SSGC approved sub-contractor.

2 GENERAL

The Contractor shall design, provide and install gas piping to supply gas up to designated places mentioned in drawings. Operating pressure in gas pipeline shall be 8 inches of water column.

The layout of gas supply pipelines is tentative and for tender purposes only. Final layout of the gas supply pipelines shall be made by the Contractor after coordination with other services in accordance to the equipment layout. The final piping layout as prepared by the Contractor shall be submitted to the Engineer for approval prior to start of installation.

3 CODES AND STANDARDS

The Codes and Standards applicable to only a portion of the specified works are referred in the relevant parts or clauses.

Codes and Standards which are generally applicable to the works and services of this section are listed herein:

Latest editions shall be considered and applicable for all standards referred in this section.

National Fire Protection Association Standard	NFPA 54
ASA Standard	ASA Z 21.30
ISO - International Organization for Standardization	ISO 23551-5
American National Standards Institutes	ANSI Z 223.1
American Society of Mechanical Engineers (ASME)	ASME 16.44
International Fuel Gas Code (IFGC)	

Other authoritative codes and standards which ensure equal or higher quality than those referred above may also be acceptable subject to satisfaction and approval of the Engineer.

Any conflict between the requirements of this specification and those on the figures herein or in codes and standards referred shall be brought to the attention of the Engineer for resolution whose decision will be final and binding.

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4 EQUIPMENT AND MATERIALS

4.1 PIPE

All internal gas piping (low pressure piping) shall be Galvanized Steel and conform to BS 1387 Medium grade or equivalent. All piping connections shall be screwed.

4.2 PIPE FITTINGS

Fittings shall be of Malleable Cast Iron in accordance with BS EN 10242. Fittings shall be galvanised and screwed.

4.3 BALL VALVES

The ball valves shall be of Brass / Bronze body and shall provide quick cut off and shall meet the requirements of BS 6755.

The valve shall require one-quarter turn from the full closed position to the full open position, or from the full open position to the full closed position.

The valve shall be provided with tapered pipe threads.

The valve construction should be such that the operator can visually determine that the valve is in open or closed position. When the valve is in closed position, the operating lever or flow indicator shall be perpendicular to the longitudinal axis of the valve.

4.4 PLUG VALVES

The Contractor shall supply and install where shown on the drawings, area isolation plug valves and service plug valves of taper plug type with provision for greasing which should withstand a test pressure of not less than 3.5 bar in closed position.

The plug valves shall be of steel body of 150 class pressure rating and shall be of locking type so that the gas supply can be locked off, if desired. All plug valves shall conform to API-615.

5 TRANSPORTATION, DELIVERY AND STORAGE

All transport handling, uncrating, unpacking, cleaning, degreasing, protective covering, inspection, etc., shall be included in the scope of work. Due diligence and care shall be exercised to prevent distortion and damage when unloading and moving the material to its location for installation.

6 INSTALLATION AND WORKMANSHIP

6.1 GENERAL

Installation work shall include all handling, assembling, aligning, supporting, setting, excavation and back filling, etc. necessary to install gas piping in locations shown on tender drawings. Special attention shall be paid to all installation notes on the drawings.

The supply and installation work shall be carried out in accordance with schedule to be submitted by the Contractor to the Engineer for approval, keeping in view the conditions and other works in the vicinity.

Each part of the piping systems shall be complete in all details and provided with all fittings, control valves and accessories necessary for satisfactory operation.

Reduction in sizes shall be with reduction tees, elbows or reducers. All changes in direction shall be made with the use of fittings and pipe shall not be bent.

6.2 PROTECTION

Keep pipe and other openings closed to prevent entry of foreign matter. Cover all fixtures, equipment and apparatus and protect against dirt, water, chemical or mechanical damage, before and during the construction period. Restore to the original condition, any fixtures, apparatus or equipment damaged prior to obtaining completion of maintenance period certificate, including damaged shop coats of paint.

6.3 CUTTING, PATCHING AND REPAIRING

Masonry work, concrete work, carpentry work, cutting, patching, painting, repainting etc. as required for proper installation and completion of work shall be performed by skilled craftsmen in respective trades at expense of the Contractor. Cut construction only after obtaining written permission from the Engineer. No payment shall be made for such works and their cost shall be included in tendered cost.

6.4 UNDERGROUND / BURIED PIPING

6.4.1 CLEARANCES

Underground gas piping shall be installed with enough clearance from any other underground structure to avoid contact therewith, to allow proper maintenance and to protect against damage that might result from proximity to other structures.

All underground gas piping shall be located in a manner so as to be at least 12 inches away from other services.

6.4.2 PROTECTION AGAINST DAMAGE

Underground piping systems shall be installed with atleast 18 inches of cover. The cover may be reduced to 12 inches if external damage to the pipe is not likely to result. If a minimum of 12 inches of cover can not be maintained, the pipe shall be installed in conduit or bridged (shielded).

6.4.3 PROTECTION AGAINST CORROSION

Gas piping in contact with earth or other material which may corrode the piping, shall be protected against corrosion in an approved manner as per Engineers' instructions. The piping shall be properly prepared i.e. scraped or wire brushed to remove mill scale, rust and cleaned with solvent to remove dirt, oil and grease before using bitumen and hessian cloth, fiber glass mat or PVC tapes as approved by the Engineer.

6.5 PIPING THROUGH FOUNDATION WALL

Underground gas piping, when installed below grade through the outer foundation or basement wall of a building shall be encased in a sleeve. The annular space between the gas piping and the sleeve shall be sealed at the foundation or basement wall to prevent entry of gas or water.

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6.6 CONCEALED PIPING IN BUILDING

6.6.1 MINIMUM SIZE

No gas pipe smaller than standard ½ inch dia pipe shall be used in any concealed location.

6.6.2 PIPING IN PARTITIONS

Concealed gas piping shall not be located in solid partitions.

6.6.3 PIPING IN FLOORS

Gas piping in solid floors such as concrete shall be laid in channels in the floor suitably covered to permit access to the piping with minimum damage to the building. When piping in floor channels may be exposed to excessive moisture or corrosive substances, it shall be suitably protected.

Gas piping may be embedded in concrete floors and passages with a minimum cover of 2 inches.

6.6.4 CONNECTIONS IN CONCEALED LOCATIONS

When installing gas piping which is to be concealed, unions, running threads, right and left couplings, bushings, and swing joints made by combination of fittings shall not be used.

6.7 BRANCH PIPE CONNECTION

All branch outlet pipes shall be taken from the top or sides of horizontal lines and not from the bottom.

6.8 PIPE THREADS

6.8.1 SPECIFICATIONS FOR PIPE THREADS

Metallic pipe and fitting threads shall be taper pipe threads complying with the Standard for Pipe Threads BS 21.

6.8.2 DAMAGED THREADS

Pipe with threads which are stripped, chipped, corroded, or otherwise damaged shall not be used.

6.8.3 NUMBER OF THREADS

Pipe shall be threaded in accordance with following table.

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Nominal Pipe Size (inch)	Approximate Length threaded portion (inch)	Approximate No. Threads to be Cut
½	¾	10
¾	¾	10
1	⅜	10
1¼	1	11
1½	1	11
2	1	11
2½	1½	12
3	1½	12

6.9 PIPE HANGERS, SUPPORTS AND ANCHORS

Pipe hangers and supports shall conform to the requirements of Standard Practice for Pipe Hangers and Supports-Materials Design and Manufacture, ANSI/MSS SP-58.

All supports for steel piping shall be ferrous. Brackets or supports shall be set out so that they do not obstruct the access to valves, flanges or other fittings requiring maintenance.

All pipework shall be supported by means of approved clips or hangers at centres. In the event of two or more pipes being carried by a single support the spacing shall be for the shorter interval.

All vertical drops shall be supported so as to prevent sagging or swinging. Unless otherwise indicated, pipe supports are to be spaced as follows:

Nominal Pipe Size (inch)	Max. Spacing of Supports (feet)
½	6.0
¾ to 1	8.0
1 ¼ or large (horizontal)	10.0
1 ¼ or large (vertical)	Every floor level

Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment, valves and control valves. Piping shall be supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed.

All channels, angles, plates, clamps etc. necessary for the fastening hangers shall be furnished and fitted by the Contractor. All hangers shall be properly sized for the pipe to be supported. Oversized hangers shall not be permitted without Engineer's approval.

Details of hangers and supports to be used by the Contractor shall be submitted to the Engineer for approval before fitting. All hangers shall be provided with lock nuts and have provision for vertical adjustment of pipes.

Individual horizontal piping shall be supported by hangers consisting of malleable split rings with malleable iron sockets, or steel clevis type hangers, or roller hangers as directed by the Engineer.

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Vertical piping shall have heavy wrought iron or steel clamps securely bolted on the piping with the end extensions bearing on the structure of the building.

6.10 UNIONS

Unions shall be installed at suitable locations and at all valves for easy dismantling of the piping system.

7 FINISHING

7.1 PAINTING

All hangers, brackets and other surfaces exposed to air shall be painted. All surfaces to be painted shall be prepared properly to receive prime coat of paint. Surfaces shall be scraped or wire brushed to remove mill scale, rust and cleaned with solvent to remove dirt, oil and grease. All surfaces shall be thoroughly dried before application of paint. Prime coat shall be suitable for subsequently applied finish coats. For prime coat, lead paint of an approved manufacturer shall be used.

Before finish coat is applied, all prime coated surfaces shall be properly touched up. The equipment and piping shall not be finish painted until they have been tested and approved. All succeeding coats shall be applied only when the undercoats are thoroughly dried. All exposed metal surfaces of pipework, hangers, brackets, valves, etc. must be painted one under coat and two finishing coats of enamel paint of approved colour.

8 TESTING AND COMMISSIONING

8.1 GENERAL

At each stage of the work, the Contractor shall have the installation subjected to various tests, checks and detection techniques, as mentioned in NFPA-54, and obtain the approval of the Engineer. Any imperfections, defects, non-compliance with the specifications and above code, etc. shall be made good to the satisfaction of the Engineer at no extra cost.

In addition to the tests and checks specified earlier, the piping shall be subjected to pressure tests and operational test as specified herein.

8.2 PRESSURE TESTS

Prior to initial operation, piping shall be pneumatically tested to a pressure of not less than 3 psig for internal (low pressure) pipelines. Test pressure shall be measured with a manometer or with a pressure measuring device designed and calibrated to read, record or indicate a pressure loss due to leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made.

If repairs or additions are made following the pressure test, the affected piping shall be retested, except that in the case of minor repairs or additions, the Engineer may waive retest requirements. The pressure test shall be maintained for a sufficient time not less than one hour to determine if there are any leaks. Equipment which is not to be included in the test shall be either disconnected from the piping or isolated by the use of valves or blanks.

The Contractor shall inform the Engineer in writing of his readiness to carry out the pressure tests, atleast 4 days prior to the date the test is to be held, and shall perform the test in his presence. Records shall be made of the tests, including the test fluid, test pressure and shall bear the approval of the Engineer.

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8.3 COMMISSIONING

After the piping system has been tested and determined to be free of leakage, all piping shall be fully purged in accordance with NFPA-54. Care shall be taken to ensure that under no circumstances the piping be purged into the combustion chamber of an appliance. After the piping has been sufficiently purged, all appliances shall be purged and pilots, if any, ignited.

Each burner shall be adjusted to its proper gas rate in accordance with the manufacturer's instructions. Over rating of the burners is prohibited. The burner gas rate can be checked with test hand on the meter. The gas rate shall be adjusted to the required rate by changing a fixed orifice. The primary air shall be adjusted for proper flame characteristics.

All protective devices furnished with the appliances shall be checked to ensure proper operation. When an automatic pilot is provided, it shall be checked for proper operation and adjustment in accordance with the manufacturers' instructions. At the time of commissioning new installations or extensions of gas piping work, consumer shall be instructed by demonstrations as to how to operate the appliance safely.

9 SUBMITTALS

9.1 MANUFACTURER'S DATA

The Contractor shall submit manufacturer's data for all material and equipment for approval of Engineer before the order is placed. Orders for material submitted for approval must be accompanied by relevant drawings, curves, technical data, catalogues and samples.

10 RECOMMENDED BRANDS AND MANUFACTURERS

Sr.	Item	Recommended Brand / Manufacturer
1.	G. I. Pipes	- International Industries Limited (IIL) - Jamal Pipe Industries
2.	Seamless Pipes	- Huffaz seamless Pipes, Pakistan - Peoples Steel Mills - Lontrin
3.	Pipe Fittings	- NEFIT - Crane - Protek or approved equivalent
4.	Valves	- Protek - Scon - Kitz or approved equivalent
5.	Industrial Coatings	- Jotun Paints - Akzo Nobel - ICI Paints - Nippon Paints - Berger Paints - 3M or approved equivalent