

AROR UNIVERSITY
OF ART, ARCHITECTURE,
DESIGN & HERITAGE,
SUKKUR, SINDH

Volume – I

Establishment of Aror University of Art, Architecture Design and Heritage, Sukkur (ADP NO 819/2025-26)

Volume I

BIDDING DOCUMENTS

FOR

"Construction of Boys Hostel – Remaining Works at Aror University of Art, Architecture Design and Heritage Sukkur"

Lead Consultant
NAQVI & SIDDIQUIE
Inc. Architects - Islamabad
Lower Ground, I&T Centre,
Plot # 61, Street # 14, Sector G-8/1,
Islamabad.
Ph: 92-51-2289407-8
Email: naqvisiddiquie@gmail.com
naqvisiddiquie@yahoo.com

JV Member
M/s Global Engineering Services.
H. No. NE 122/F, St.No.7
Chaman Zar Colony, Rawalpindi
Ph:5765514

Project Director
AROR University of Art, Architecture,
Design and Heritage Sukkur

TABLE OF CONTENTS

Description		Page No.
INVITATION FOR BIDS		
	Form	**5**
INSTRUCTIONS TO BIDDERS		**6**
A.	**General**	**7**
	IB.1 Scope of Bid	**7**
	IB.2 Source of Funds	**7**
	IB.3 Eligible Bidders	**7**
	IB.4 One Bid Per Bidder	**8**
	IB.5 Cost of Bidding	**8**
	IB.6 Site Visit	**8**
B.	**Bidding Documents**	**8**
	IB.7 Contents of Bidding Documents	**8**
	IB.8 Clarification of Bidding Documents	**9**
	IB.9 Amendment of Bidding Documents	**9**
C.	**Preparation of Bids**	**9**
	IB.10. Language of Bid	**9**
	IB.11 Documents Comprising the Bid	**9**
	IB.12 Bid Prices	**10**
	IB.13 Currencies of Bid and Payment	**10**
	IB.14 Bid Validity	**10**
	IB.15 Bid Security	**11**
	IB.16 Alternate Proposals by Bidder	**11**
	IB.17 Pre-Bid Meeting	**11**
	IB.18 Format and Signing of Bid	**11**
D.	**Submission of Bids for Single Stage Single Envelope Bidding Procedure**	**12**
	IB.19 Sealing and Marking of Bids	**12**
	IB.20 Deadline for Submission of Bids	**12**
	IB.21 Late Bids	**12**
	IB.22 Modification, Substitution and Withdrawal of Bids	**13**
E.	**Bid Opening and Evaluation for Single Stage Single Envelope Bidding Procedure**	**13**

IB.23 Bid Opening 13
IB.24 Process to be Confidential 13
IB.25 Clarification of Bids 14
IB.26 Examination of Bids and Determination of Responsiveness 14
IB.27 Correction of Errors 16
IB.28 Evaluation and Comparison of Bids 16

F. **Award of Contract** 17

IB.29 Award 17
IB.30 Employer's Right to Accept any Bid and to Reject any or all Bids 17

IB.31 Notification of Award 17
IB.32 Performance Security 17
IB.33 Signing of Contract Agreement 18
IB.34 General Performance of the bidders 18
IB.35 Integrity Pact 18
IB.36 Instructions not Part of Contract 18
IB.37 Arbitration 18

BIDDING DATA SHEET 19

LETTERS OF TECHNICAL BID/PRICE BID AND APPENDICES TO BID 25

Letter of Technical Bid 26
Letter of Price Bid 28
Appendix-A to Bid : Special Stipulations 30
Appendix-B to Bid : Foreign Currency Requirements 31
Appendix-C to Bid : Price Adjustment Under Clause 70 of Conditions of Contract 32
Appendix-D to Bid : Bill of Quantities 33
Appendix-E to Bid : Proposed Construction Schedule 35
Appendix-F to Bid : Method of Performing the Work 36
Appendix-G to Bid : List of Major Equipment – Related Items 40 37
Appendix-H to Bid Facilities : Construction Camp and Housing 40
Appendix-I to Bid : List of Subcontractors 42
Appendix-J to Bid : Estimated Progress Payments 43
Appendix-K to Bid : Organization Chart of the Supervisory Staff and Labor 44
Appendix-L to Bid : Integrity Pact 45
Appendix- M to Bid : List of approved Manufactures 46

FORMS **48**

BID SECURITY **49**

FORM OF PERFORMANCE SECURITY **51**

FORM OF CONTRACT AGREEMENT **53**

MOBILIZATION ADVANCE GUARANTEE/BOND **55**

INDEMNITY BOND FOR SECURED ADVANCE AGAINST MATERIAL BROUGHT ATSITE **57**

PART-I: GENERAL CONDITIONS OF CONTRACT **60**

PART-II: PARTICULAR CONDITIONS OF CONTRACT **61**

PART A

ADVERTISEMENT
FOR
BIDDERS / CONTRACTORS

NO. PD/AU-SKR/- of 2026
Dated: / /2026

NOTICE INVITING TENDERS

e-Pak Acquisition & Disposal System (EPADs)

Aror University of Art, Architecture, Design & Heritage, Sukkur intends to invite the bids online on EPADS from experienced and technically proficient firms, for the following works, goods and services as detailed below.

#	Tender Title	Estimated Cost	Tender Fee	Completion Period	Pre Bid meeting	Bid Security in Rs	Date of Publish	Date of Submission & Opening
01	**Construction of Boys Hostel (Remaining Works) at Aror University Sukkur**	166.01 million	Rs. 10,000/-	06 Months	21/01/2026 12:00 PM	Rs. 4,150,000.00/-	14/01/2026	Date of Submission: 30-01-2026 upto 02:30 PM Date of Opening: 30-01-2026 at 03:00 PM
02	**Internal Distribution of Water Supply at Aror University Sukkur**	10.813 million	Rs. 5,000/-	03 Months	-	Rs. 270,000.00/-	14/01/2026	Date of Submission: 30-01-2026 upto 02:30 PM Date of Opening: 30-01-2026 at 03:00 PM
03	**81 KW In Grid & 15 KW Off Grid Solar System for Pump Room @ Processing Tanks at Aror University Sukkur**	9.380 million	Rs. 5,000/-	03 Months	-	Rs. 234,500.00/-	14/01/2026	Date of Submission: 30-01-2026 upto 02:30 PM Date of Opening: 30-01-2026 at 03:00 PM

Eligibility: Income Tax- GST, SRB/**Equivalent**, with active NTN number, has/have the valid PEC registration certificate & etc… detailed eligibility and qualification criteria provided in the bidding document)

Method of Procurement:46(2)-Single Stage – Two Envelope (Envelopes **Containing separate** Technical & Financial bids). Bidding Documents can be obtained and shall be submitted through EPADS as per the schedule mentioned below schedule. EPAD web: https://portalsindh.eprocure.gov.pk/#/ and will also be available on Aror University Sukkur website: www.aror.edu.pk. The required Bid Security & Tender **processing** Fee (Non-Refundable) may be submitted in favor of "Aror University of Art, Architecture, Design, and Heritage, Sukkur". Separate bid, along with separate bid security and processing fees, shall be submitted for each tender.

Under the following conditions Bid will be rejected:

- Technical Bid not accompanied by bid security & non-refundable tender processing fee.
- Bid received without Signature & Stamp
- Bid is only accepted online on SPPRA EPAD portal.
- Bid submitted without required documents as per qualification criteria.

All other terms & conditions are mentioned in the bidding documents. The procuring agency reserves the right to reject all or any bids subject to the relevant provision of Sindh Public Procurements Rules 2010 (Amended till to date). In case of any Govt. Holiday or unforeseen situation, the bids shall be opened on the next working day or an other day as per schedule. Tenders will be opened at Aror University of Art, Architecture, Design, and Heritage, Sukkur",

Project Director
The Aror University of Art, Architecture,
Design and Heritage, RCW Rohri Bypass, Sukkur, Sindh.
Tel: +92 71 5651900 – Ext: 904/961
Email: pd@aror.edu.pk

INSTRUCTIONS
TO
BIDDERS

INSTRUCTIONS TO BIDDERS

(Note: These Instructions to Bidders along with Bidding Data Sheet 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 Employer as defined in the Bidding Data Sheet hereinafter called "the Employer" wishes to receive bids for the construction and completion of works as described in these Bidding Documents, and summarized in the **Bidding Data Sheet** hereinafter referred to as the "Works".

1.2 The successful bidder will be expected to complete the Works within the time specified in **Bidding Data**.

IB.2 Source of Funds

2.1 The employer had got approved scheme under title "Establishment of Aror University of Art, Architecture, Design and Heritage Sukkur" by Govt: of Sindh and had allocated sufficient funds for CFY 2025-2026 under ADP No. 819/2025-26 and intends to spend proportions of cost for execution of this work.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all Pre-qualified Contractors/bidders meeting the following requirements:

I. Valid licensed by the Pakistan Engineering Council (PEC) in the category C-2 or above with Specialized code CE-09, CE-10, CE-11(i), EE-04, EE-06, EE-10 & EE -11(vi) or as mentioned pre-qualification notice.

II. The valid professional tax certificate issued by the Government of Sindh.

III. Valid registration with FBR & SRB along with status of active taxpayer.

IV. "Certificate of satisfactory performance for the works completed and those under execution same nature during the financial year 2024-25.

V. "The Annual audited Financial Statement for the year 2024-25.

VI. Bidders must have average annual turnover as per (FBR tax returns) on the basis of last financial 2024-25 years or less years that should be more than or equal to the estimated cost of the work.

VII. Affidavit on (non-judicial stamp paper) of no litigation history, non- black listing, never include in any corrupt, fraudulent and collusive practices, also undertaking that the information and documents provided are correct. The template is available in tender documents.

VIII. Bidder must not have forfeited CDR/or bid security with procurement agency (AUAADH).

IX. "Any contractor who was prequalified but later found not to meet the criteria specified in the prequalification notice shall be re-notified by Aror University Sukkur regarding their prequalification status.".

IB.4 One Bid per Bidder

4.1 Each bidder shall submit only one bid either by himself. A bidder who participates in more than one bid (other than alternatives pursuant to Clause IB.16) 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 Employer 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 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 Employer 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 Employer, 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

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. **Instructions to Bidders.**
2. **Bidding Data Sheet.**
3. **General Conditions of Contract, Part-I (GCC).**
4. **Particular Conditions of Contract, Part-II (PCC).**
5. **Specifications – Special Provisions.**
6. **Specifications – Technical Provisions.**
7. **Form of Bid & Appendices to Bid.**
8. **Bill of Quantities (Appendix-D to Bid).**
9. **Form of Bid Security.**
10. **Form of Contract Agreement.**
11. **Forms of Performance Security and Mobilization Advance Guarantee/Bond andForm of Indemnity Bond for Secured Advance.**
12. **Drawings.**

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

8.1 Any prospective bidder requiring any clarification (s) in respect of the Bidding Documents may notify the Employer in writing at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification which he receives earlier than 28 days prior to the deadline for submission of bids.
Copies of the Employer's response will be forwarded to all purchasers of the Bidding Documents, including a description of the enquiry 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 Employer may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective bidder, modify the Bidding Documents by issuing addendum.

9.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to IB 7.1 hereof and shall be communicated in writing to all purchasers of the Bidding Documents. Prospective bidders shall acknowledge receipt of each addendum in writing to the Employer.

9.3 To afford prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer 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 Employer shall be in the bid language stipulated in the **Bidding Data** Sheet and Particular 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 Comprising the Bid through EPADS:

11.1 Each bidder shall:

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

b) update the information indicated and listed in the **Bidding Data.**
And

c) furnish a technical proposal 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 JV (this clause is Not applicable)**.

11.3 The Bidder shall furnish, as part of the Technical Bid, a Technical Proposal including a statement of work methods, equipment, personnel, schedules and any other information as stipulated Bidding Forms, in sufficient detail to demonstrate the adequacy of the Bidders" proposal to meet the work requirements and the completion time referred to in Sub-Clause hereof.

Not Applicable

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 IB 1.1 hereof, based on the unit rates and / or prices submitted by the bidder.

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 Employer when executed and shall be deemed covered by rates and prices for other items in the Bill of Quantities.

12.3 All duties, taxes and other levies payable by the Contractor under the Contract, or for any other cause, as on the date 28 days prior to the deadline for submission of bids shall be included in the rates and prices and the total Bid Price submitted by a bidder. Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 70.2 of the General Conditions of Contract Part-I.

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.

IB.14 Bid Validity

14.1 Bids shall remain valid for the period stipulated in the Bidding Data Sheet 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 Employer 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 Sheet in Pak Rupees or an equivalent amount in a freely convertible currency.

15.2 The Bid Security shall be, at the option of the bidder, in the form of Call Deposit issued by Scheduled Bank in Pakistan in favor of the Employer valid for a period 28 days or beyond the Bid Validity date.

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

15.4 The bid securities of unsuccessful bidders will be returned as promptly as possible, but not later than 28 days after the expiration of the period of Bid Validity.

15.5 The Bid Security may be forfeited:

(a) If the bidder withdraws his bid except as provided in IB 22.1;

(b) If the bidder does not accept the correction of his Bid Price pursuant to IB 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;

(ii) Sign the Contract Agreement within 7 days of the receipt of letter of acceptance.

IB.16 Alternate Proposals by Bidder. (This clause is Not Applicable)

IB.17 Pre-Bid Meeting

17.1 The Employer may, on his own motion or at the request of any prospective 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, is as stipulated in the **Bidding Data** Sheet. All prospective bidders or their authorized representatives shall be invited to attend such a pre-bid meeting.

17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Employer not later than seven (7) days before the 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 IB 7.1 hereof, which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause IB.9 and not 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 Letter of Price 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 No alteration is to be made in the Letters of Price and Technical Bids 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.

18.4 The Bidder shall prepare one original of the Technical Bid and one original of the Price Bid comprising the Bid as described in Bidding Data Sheet against IB 11 and clearly mark it "ORIGINAL - TECHNICAL BID" and "ORIGINAL - PRICE BID". In addition, the Bidder shall submit two (2) copies of the Bid and clearly mark each of them "COPY."In the event of any discrepancy between the original and the copies, the original shall prevail.

18.5 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the Bidding Data Sheet and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Bid, except for unamended printed literature, shall be signed or initialed by the person signing the bid.

18.6 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.

18.7 Bidders shall indicate in the space provided in the Letter of Technical and Price Bids, 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 FOR SINGLE STAGE TWO ENVELOPE BIDDING PROCEDURE

IB.19 Sealing and Marking of Bids

(a) bid shall comprise a single package containing two separate envelopes. Each envelope shall contain

separately the financial proposal and the technical proposal.

(b) envelopes shall be marked as "FINANCIAL PROPOSAL" and "TECHNICAL PROPOSAL" in bold and legible letters to avoid confusion.

(c) initially, only the envelope marked "TECHNICAL PROPOSAL" shall be opened.

(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.

IB.20 Deadline for Submission of Bids

20.1 (a) Bids must be received by the Employer at the address specified no later than thetime and date stipulated in the Bidding Data Sheet.

(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 Employer 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 Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

IB.21 Late Bids

21. (a) Any bid received by the Employer 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 determine the manner in which timely delivery of his bid will be accomplished either in person, by messenger or by mail.

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 Employer 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 IB 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.

E BID OPENING AND EVALUATION FOR SINGLE STAGE SINGLE ENVELOPEBIDDING PROCEDURE

IB. 23 Bid Opening

23.1 The Employer will open the bids, 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 bidder's representatives who are present shall sign a register evidencing their attendance.

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 The bidder's name, total Bid Price and price of any Alternate Proposal(s), any discounts, bid modifications, substitution and withdrawals, the presence or absence of Bid Security, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening of bids.

23.4 Employer shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with the Sub-Clause 23.3.

IB.24 Process to be Confidential

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 which shall be done at least ten 07 days prior to issue of Letter of Acceptance. 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 Employer'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 not later than fifteen (15) days after the announcement of the bid evaluation report. However mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification of Bids

25.1 To assist in the examination, evaluation and comparison of bids, the Employer may, at his discretion, ask any bidder for clarification of his 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 Employer in the evaluation of the bids in accordance with Clause IB.28.

25.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its bid may be rejected.

IB.26 Examination of Bids and Determination of Responsiveness

26.1 Prior to the detailed evaluation of bids, the Employer will determine whether each bid is

substantially responsive to the requirements of the Bidding Documents.

26.2 A substantially responsive bid is one which (i) meets the eligibility criteria; (ii) has been properly signed; (iii) is accompanied by the required Bid Security; (iv) Includes signed Integrity Pact where required as per clause IB.35 and (v) conforms to all the terms, conditions 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 Employer's rights or the bidders obligations under the Contract; (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids. Only substantially responsive bid shall be considered for further evaluation.

Technical Evaluation Criteria

ELIGIBILITY CRITERIA FOR SELECTION OF TECHNICAL BID

Evaluation Criteria For Construction of Boys Hostel (Remaining Work) ADP No. 819/2025-26				
Mandatory Requirement for Qualification				
#	**Criteria**	**Requirement**		
A	**Valid registration with PEC Category (C2 or Above)**	**Valid documentary Evidence**		
B	**FBR Registration with Active NTN**	**Valid documentary Evidence**		
C	**Valid SRB Registration showing Active Status**	**Valid documentary Evidence**		
D	**Affidavit Showing No Litigation and No Blacklisting**	**Valid documentary Evidence on stamp paper**		
E	**Financial Soundness/Turnover (at least 3 times Estimated Cost) in last three years (2022-25)**	**Valid Audited Accounts**		
#	**Criteria**	**Maximum Marks**	**Sub-Division**	**Requirement**
1	**Type of organization**	**7**		**Valid Documentary Evidence**
1.1	Proprietorship		3	
1.2	Partnership		5	
1.3	Private Limited		7	
2	**Financial Status:**	**8**	**-**	**Valid Documentary Evidence**
2.1	Bank Certificate & Statement for Last 3 Years	-	4	
2.2	Net Income Tax paid for the last 3 years		4	
3	**Capabilities & Experience:**	**25**	**-**	**Valid Documentary Evidence**
3.1	**Similar Works Completed**	**-**	**10**	
3.1.1	2 marks on each completed project (equivalent or more than estimated cost)- max 10 marks.	-	10	
3.2	**Similar Works in Hand**	**-**	**10**	**Valid Documentary Evidence**
3.2.1.	2 marks on each in-hand project (Equivalent or more than Estimated Cost)- max 10 marks.	-	10	
3.3	**No. of Years of Establishment**	**-**	**5**	**Valid Documentary Evidence**
3.3.1	15 or More than 15 years	-	5	
3.3.2	8 or More than 8 years	-	3	
3.3.3	3 or More than 3 years	-	1	
4	**Information of Key Personnel having at least 5 years experience**	**20**	**-**	**Valid Documentary Evidence**
4.1	**Project Manager/Project Director**		**5**	
4.1.1	3 or More than 3		**5**	
4.1.2	2		**3**	
4.1.3	1		**2**	
4.2	**Civil Engineer**	**-**	**5**	

4.2.1	3 or More than 3	-	5	
4.2.2	2		**3**	
4.2.3	1	-	**2**	
4.3	**MEP Engineer**	**-**	**3**	**Valid Documentary Evidence**
4.3.1	3 or More than 3	-	3	
4.3.2	1 or 2	-	2	
4.4	**Electrical Engineer**	**-**	**2**	
4.4.1	3 or More than 3	-	3	
4.4.2	1 or 2	-	2	
4.5	**Supervisor**	**-**	**3**	
4.5.1	3 or More than 3	-	3	
4.5.2	1 or 2	-	2	
4.6	**Surveyor**	**-**	**2**	
4.6.1	3 or More than 3	-	3	
4.6.2	1 or 2	-	2	**Valid Documentary Evidence**
5	**Tools & Equipment:**	**20**	**-**	
5.1	**Form work (Plywood or Steel Shuttering) with Skyfolding Pipes**	**-**	**5**	
5.1.1	20,000 sft or More then 20,000 sft.	-	5	
5.1.2	Below 20,000 sft & above 5000 sft		3	
5.2	**Surveying Equipment**	**-**	**5**	
5.2.1	3 or More than 03 Sets of Total Station and Level Machine	-	5	
5.2.2	1 or 02 Set of Total Station and Level Machine	-	3	
5.3	**Mixture Machines with Hoists**	**-**	**5**	
5.3.1	3 or More than 3 or bach plant	-	5	
5.3.2	2		3	
5.3.3	1	-	2	
5.4	**Excavator**	**-**	**5**	
5.4.1	3 or More than 03	-	5	
5.4.2	2		3	
5.4.3	1	-	2	
6	**Performance**	**20**	**-**	**Valid Documentary Evidence**
6.1	**Similar Work Completion/ Satisfactory Certificate (s)**	**-**	**20**	
6.1.1	4 marks on each satifactory or completion certificate- max 20 marks.	-	20	
	TOTAL	**100**		

NOTES:

- *Only bidders scoring **70 or above** in the technical evaluation will qualify for the financial bid opening.*
- *Incomplete or missing documents may lead to disqualification.*
- *The Procurement/evaluation committee reserves the right to verify the submitted documents and information.*

26.3 If a bid is not substantially responsive, it may not subsequently be made responsive by correction or withdrawal of the non-conforming material deviation or reservation. The Employer may, however, seek confirmation/ clarification in writing which shall be responded in writing.

IB.27 Correction of Errors

27.1 Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer 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 Employer 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 Letter of Price Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and with the concurrence of the bidder, 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 IB.15.6 (b) hereof.

IB.28 Evaluation and Comparison of Bids

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

28.1 In evaluating the Bids, the Employer 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 Day work; and
(c) Making an appropriate adjustment for any other acceptable variation or deviation.

28.2 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.

28.3 If the Bid of the successful bidder is seriously unbalanced in relation to the Employer's estimate of the cost of work to be performed under the Contract, the Employer 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 Employer 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 Employer against financial loss in the event of default of the successful bidder under the Contract.

F. AWARD OF CONTRACT

IB.29 Award

29.1 Subject to Clauses IB.30 and IB.34, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price, provided that such bidder has been determined to be eligible in accordance with the provisions of Clause IB.3 and qualify pursuant to IB 29.2.

The Employer, at any stage of the bid evaluation, having credible reasons for or prima facie evidence of any defect in bidder's capacities, may require the bidders to provide information concerning their professional, technical, financial, legal or managerial competence.
Provided that such qualification shall only be laid down after recording reasons in writing. They shall form part of the records of that bid evaluation report.

IB.30 Employer's Right to Accept any Bid and to Reject any or all Bids

30.1 Notwithstanding Clause IB.29, the Employer reserves the right to accept or reject any Bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidders or any obligation except that the grounds for rejection of all bids shall upon request be communicated to any bidder who submitted a bid, without justification of grounds. Rejection of all bids shall be notified to all bidders promptly.

IB.31 Notification of Award

31.1 Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder in writing ("Letter of Acceptance") that his Bid has been accepted. This letter shall name the sum which the Employer will pay 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.

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

31.4 Upon furnishing by the successful bidder of a Performance Security, the Employer will promptly notify the other bidders that their Bids have been unsuccessful and return their bid securities.

IB.32 Performance Security

32.1 The successful bidder shall furnish to the Employer a Performance Security in the form and the amount stipulated in the Bidding Data Sheet and the Conditions of Contract within a period of 28 days after the receipt of Letter of Acceptance.

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

IB.33 Signing of Contract Agreement

33.1 Within 03 days from the date of furnishing of acceptable Performance Security under the Conditions of Contract, the Employer 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 Employer and the successful bidder shall be executed within 14 days of the receipt of the Contract Agreement by the successful bidder from the Employer.

33.3 The formal Agreement between the Employer and the successful bidder shall be duly stamped at rate of 0.35% of bid price (updated from time to time) stated in Letter of Acceptance.

IB. 34 General Performance of the Bidders

The Employer reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts/works. The Employer may in case of consistent poor performance of any Bidder as reported by the employers of the previously awarded contracts, interalia, reject his bid and/or refer the case to the Pakistan EngineeringCouncil (PEC). Upon such reference, PEC in accordance with its rules, procedures and relevant laws of the land take such action as may be deemed appropriate under the circumstances of the case including black listing of such Bidder and debarring him from participation in future bidding for similar works.

IB.35 Integrity Pact

The Bidder shall sign and stamp the Integrity Pact provided at Appendix-L to Bid in the Bidding Documents for all Federal 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

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.

BIDDING DATA SHEET

BIDDING DATA

The following specific data for the Works to be bidder shall complement, amend, or supplement the provisions in the Instruction to Bidders. Wherever there is a conflict, the Provisions herein shall prevail over those in the Instructions to Bidders

Instructions to Bidders Clause Reference	
Clause IB.1	**Scope of Bid**
Sub Clause 1.1	**Name and address of the Employer:**
	The Employer is: **Establishment of Aror University of Art, Architecture, Design & Heritage Sukkur (Hereinafter Called the "Employer" Which expression shall include the successors, legal representatives and permitted assignee's).**
	The Employer's Representative:
	Project Director/Nominee **Establishment of AROR University of Art, Architecture, Design and Heritage Sukkur** **Rohri Bypass Sukkur, Sindh** **Pakistan**
	Name of the Project & Summary of the Works
	The name of the Project is:
	Construction of **Construction of Boys Hostel – Remaining Works at Aror University of Art, Architecture Design and Heritage Sukkur** **The Summary of the Works:**
	Establishment of Aror University of Art, Architecture, Design and Heritage, Sukkur intends to complete construction of boys hostel – remaining works
	The works comprise of RCC frame structure building works lying within the lines, boundaries and limits shown in the Drawings and any such additional areas adjacent thereto as may be designated by the Employer/Engineer from time to time for the construction to be Performed under the Contract. All such areas and additional areas shall be comprised within the Site of Works.
Clause IB.2 **Sub Clause 2.1**	**Source of Funds** The Employer has received funding under ADP Govt: of Sindh and has sufficient funds to cover the Cost of the entire Project for which these Bidding Documents are issued.
Clause IB.3 **Sub Clause 3.1**	**As per Clause IB.3 (3.1)**

Clause IB.7 **Documents Comprising the Bid**

The Bidding Documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause IB.9.

7.1.1 **Volume – I**

- Instruction to Bidders
- Bidding Data
- Form of Bid & Appendices to Bid
- Forms of Bid Security, Performance Security, Contract Agreement, Mobilization Advance against Bank Guarantee and Indemnity Bond for secured advance against Material Brought at Site.
- Part-I - General Conditions of Contract
- Part-II – Particular Conditions of Contract
- Special Provisions

7.1.2 **Volume-II**

- BOQ for
    1. Civil Works
    2. Electrical Works
    3. Plumbing & Firefighting Works

7.1.3 **Volume-III**

- Technical Specifications for
    1. Civil Works
    2. Electrical Works
    3. Plumbing & Firefighting Works
    4. Health & Safety

7.1.4 **Volume-IV**

- Drawings for
    1. Architectural Works
    2. Structural Works
    3. Electrical Works
    4. Plumbing & Firefighting Works

Clause IB.8 **Clarification of Bidding Documents**

Sub-Clause 8.1 Any prospective bidder requiring any clarification (s) in respect of Bidding Documents including any explanation/clarification of the items of works or their description as provided in the Invitation for Bids may notify the Employer's Representative in writing not later than fifteen (15) days prior to the date fixed for submission of bids. The Employer's'' response will be made not later than ten (10) days prior to the date fixed for submission of Bid.

Clause IB.10 **Language of Bid**

Sub-Clause 10.1 English

Clause IB 11 **Documents Accompanying the Bid**

Sub-Clause 11.1 (b) Latest status of access to financial resources and commitments for the duration of Construction Period (including the current year).

Sub-Clause 11.3 The Bidder shall also submit along with the Bid the entire original document issued to him comprising Volume-I to Volume-II.

Clause IB.12 **Bid Price**

Sub-Clause 12.3

The Bidder shall obtain all information as to Pakistan Income Tax, Sales Tax, Company Taxes, Municipal Octroys, Levies and any other taxes imposed by the Government of Pakistan/Provincial Governments/local bodies, export and import duties and necessary permits and conform the requirements thereof at his own responsibility and include the same in his quoted unit rates and Bid Price. The quoted unit rates and Bid Price shall also include the cost of accepting the general risks/liabilities and obligations set forth or implied in the Contract. No claim at any later stage on this account will be entertained.

Sub-Clause 12.4 In line three (03) after the Word "Contract" delete the rest of the text of the Sub Clause.

Clause IB.13 **Currencies of Bid and Payment**

Sub-Clause 13.1 The unit rates and the prices shall be quoted by the Bidder entirely in Pakistani Rupee. All the payments to the Contractor for the works done shall be made in Pakistani Rupees. No foreign currency payment is admissible under this Contract.

Sub-Clause 13.2 The Sub-Clause is deleted in its entirety.

Clause IB.14 **Bid Validity**

Sub-Clause 14.1 Ninety (90) days

Clause IB.15 **Bid Security**

The Bid Security shall be **Rs. 4,150,000/- (Rupees Four million one hundred fifty thousand only.)** (Equivalent to 2.5 % of the value of work.)

Sub-Clause 15.2 In shape of Pay Order or Demand Draft" "or bid security issued by a scheduled bank".

Clause IB.17 **Pre-Bid Meeting**

Sub-Clause 17.1 **Venue, time and date of the Pre-Bid Meeting**

Date 21/1/2026 at 12:00 PM. In the office of Project Director, Establishment of Aror University of Art, Architecture Design and Heritage Sukkur. (asper tender notice)

Clause IB.18 **Format and Signing of Bid**

Sub-Clause 18.4

The Bidder shall prepare and submit the original documents comprising the Bid as described in Clause 7 of these Instructions to Bidders, bound with the volume containing the Form of Bid, and clearly marked "**ORIGINAL"** along with Two (02) copies.

Sub-Clause 18.5 One (01) copy of Power of Attorney must be attached to the Bid submitted to the Employer if this Bid is signed / executed by a person other than the President, Partner or Owner of the Bidder's Company.

Clause IB.19 **Sealing and Marking of Bids**

Sub-Clause 19.1 ***Each Bidder shall submit his Bid through EPADS as well as Through courier, Technical and Financial proposals shall be uploaded separately.*** Copy of scanned Bid security must be attached with technical proposal. Process for hard format is as under:

(a) **ORIGINAL BID** comprising of Technical and Financial shall be put in a separate envelope, sealed and marked as "**Original**". The **copy** of the Bid shall be put in a separate envelope, sealed and marked as "**Copy**".

(b) Bid Security shall be put in separate envelope. The envelopes containing the **Bid Security, Original Bid, the Copy and other Bid Documents** shall be put in a larger envelope, which will be properly sealed and returned by the fix date and time.

(c) Provide the following text on the larger outer envelope.

Sub-Clause 19.2 Employer's address for the purpose of Bid submission is as follows:

Project Director
Establishment of AROR University Sukkur
Rohri Bypass Sukkur, Sindh
Pakistan

Name & identification number of the Contract is as follows:

Name: Construction of Boys Hostel – Remaining Works at Aror University of Art, Architecture Design and Heritage Sukkur

Time and date of pre-bid meeting, bid opening shall be as per the data provided in the Bidding data sheet.

Clause IB.20 **Deadline for Submission of Bids**
Sub-Clause 20.1(a) **30/1/2026 02:30 pm,**

Clause 23.1 **Bid Opening**.

Sub-Clause 23.1 **Venue, time, and date of Bid opening:**
On the date of 30 January 2026 at 03:00 PM
Project Director, Establishment of AROR University Sukkur time tender
Evaluation and Comparison of Bids

Clause IB-28
Sub-Clause 28.1

In evaluating the Bids the Employer shall also examine whether the bid is balanced and the method of Performing the work Appendix-F and Proposed Construction Schedule Appendix-E submitted by the Bidder to confirm that all the requirements of staff to be deputed at site and Construction plant and equipment (Appendices -K &G) have been met without any deviation or reservations and that the proposed resources to be deputed by the Bidders' are adequate to Construct and Complete the Works in the proposed time period. Furthermore, the Contractors ability to mobilize and harness additional resources when required shall also be considered.

Conditional Bids shall be rejected notwithstanding the fact that those conditions are withdrawn by the Bidder subsequent to opening of the Bids.

Sub-Clause IB.29.2
Clause IB.30 **Employer's Right to Accept any Bid and to Reject any or all Bids**

Employer reserves the Right to Accept any Bid and to Reject any or all Bids as per PPRA Rule 33(1).

Sub-Clause 30.2. The Employer may withhold a reasonable amount in 5-10%age from the executed items to balance out the amount of lower/non workable items and the withheld amount will be released progressively in proportion to these items after execution.

Clause IB.31
Sub-Clause 31.1 Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder in writing ("Letter of Acceptance") that his Bid has been accepted. This letter shall name the sum which the Employer will pay 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").

Sub-Clause 31.2 No Negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted, however, Employer may have clarification meetings to get clarify any item in the bid evaluation report.

Sub-Clause 31.3 The notification of award and its acceptance by the bidder will constitute the formation of the Contract, binding the Employer and the bidder till signing of the formal Contract Agreement.

Sub-Clause 31.4 Upon furnishing by the successful bidder of a Performance Security, the Employer will promptly notify the other bidders that their Bids have been unsuccessful and return their bid securities.

Clause IB.32 **Performance Security**

Sub-Clause 32.1 The successful Bidder shall furnish to the Employer a Performance Security in the form of an unconditional and irrevocable Bank Guarantee from a Schedule Bank in Pakistan in an amount of 5% (five percent) of the Contract Price stated in the Letter of Acceptance in accordance with the Conditions of Contract within a period of twenty-eight (28) days after the receipt of Letter of Acceptance.

Clause IB 33 **Signing of Contract Agreement**
Sub-Clause 33.1

"The successful Bidder shall submit along with the Performance Security/Bond a draft copy of Agreement as per the Form of Agreement provided in the Bidding Documents, incorporating all agreements between the parties."

Sub-Clause 33.2 "The formal Agreement between the Employer and the successful Bidder shall be executed within seven (07) days of the receipt of Letter of Acceptance by the successful Bidder from the Employer but not before the submission by the Bidder and acceptance by the Employer of the Performance Security as per Sub-Clause 32.1 hereof."

Clause IB.37 **Service at Site**
Sub-Clause 37.1 It shall be the sole responsibility of the Contractor to provide, operate and maintain in working condition all temporary utilities and services such as water supply, Electricity (university provides as per actual consume units & cost) , Telephone connections, sewerage disposal, etc. required for the proper execution of works under this Contract. Contractor shall also be responsible for payment of installations / re-installation /enhancement as well consumption charges, directly to the concerned agencies or any other charges or royalties levied by the concerned authority or local governing agency or any other municipal body. Bidder's attention is specially directed to sub-clause 15.3 of Special Provision attached to these Bid Document where by the successful bidder is required to make all necessary arrangements for a temporary electricity service, at site during the whole of the Construction period.

Clause IB.38 **Contractor's Camp / Temporary Areas, Offices and Engineer's /Owner's Site Office**

The Contractor shall make on his own, arrangements for his own camp, workshops, yards, storage areas, offices, areas for erection of equipment and offices for the Engineer and the Employer closed to the site area and permissions, approvals required in this regard from the concerned agencies / authorities for all such facilities and costs thereof shall be the sole responsibility of the Contractor. P.S. labour residential camp will not be allowed inside the university campus.

Letters of Technical Bid/ Price Bid,
And Appendices to Bid

Letter of Technical Bid

Date: .....

Bid Reference No: .....

(Name of Contract/Works)

To: .....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB) 9;

(b) We offer to execute and complete in conformity with the Bidding Documents the following Works:

(c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of …… days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) As security for due performance of the under takings and obligations of our bid, we submit here with a Bid security, in the amount specified in Bidding Data Sheet, which is valid (at least) 28 days beyond validity of Bid itself.

(e) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process, other than alternative offers submitted in accordance with IB16 (as applicable).

LTB-2

(f) We agree to permit Employer or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors. This permission is extended for verification of any information provided in our Technical Bid which comprises all documents enclosed herewith in accordance with IB.11.1 of the Bidding Data Sheet.

Name .....

In the capacity of .....

Signed .....

.....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

.....

Address……..

LPB-1

Letter of Price Bid

Date: .....

Bid Reference No: .....

(Name of Contract/Works)

To: .....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (IB)9;

(b) The total price of our Bid, excluding any discounts offered in item (c) below is:

(c) The discounts offered and the methodology for their application are:

(d) Our Bid shall be valid for a period of …….. days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(e) If our Bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

LPB-2

(f) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed and we do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other bidder for the Works.

(g) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

(h) We agree to permit Employer or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors. This permission is extended for verification of any information provided in our Technical Bid which comprises all documents enclosed herewith in accordance with IB.11.1 of the Bidding Data Sheet.

(i) If awarded the contract, the person named below shall act as Contractor's Representative.

Name .....

In the capacity of .....

Signed .....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

Address……..

BA-1

Appendix-A to Bid

SPECIAL STIPULATIONS
Clause
Conditions of Contract

1.	Employer's name and address	1.1.2.2 & 1.3	Office of The Project Director, Aror University Sukkur Rohri Bypass Sukkur, Sindh
2	Engineer's name and address	1.1.2.4 & 1.3	The project Director Establishment of Aror University Sukkur
3.	Law applicable	5.1(b)	The law to be applied is the law of Islamic Republic of Pakistan
4.	Amount of Performance Security	10.1	5% of Contract Price stated in the Letter of Acceptance in the form of bank guarantee.
5	Time for Furnishing Program	14.1	Within 07 days from the date of receipt of Letter of Acceptance.
6.	Time for Commencement	41.1	Within 07 days from the date of receiptof Engineer's Notice to Commence which shall be issued within fourteen Next days after signing of Contract Agreement.
7.	Time for Completion	43.1, 48.2	06 months from the date of receipt of Engineer's Notice to Commence and extendable with full justifications.
	a) Amount of Liquidated Damages	47.1	Rs.0.1% for each day of delay in completion of the works subject to a maximum of 10% of the Contract Price stated in Letter of Acceptance.
	b) Amount of Bonus	47.3	N/A
8.	Defects Liability Period	49.1	12 months (365 days) Days from the effective date of Taking Over Certificate.
9.	Percentage of Retention Money	60.3	8 % of the amount of interim Payment Certificate.
10	Limit of Retention Money	60.3	10% of Contract Price stated in the Letter Of Acceptance.
11.	Minimum amount of Interim Payment Certificate (Running Bills)	60.2	Rs.10 million
12	Minimum amount of Running Account Bills	60.2	As per actual progress of work
13.	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Employer	60.10	20 days in case of local currency.
14.	Mobilization Advance	60.12	10% of Contract Price as stated in the Letter of Acceptance. Mobilization advance shall be interest free and be based on bank guarantee.

BB-1
Appendix-B to Bid

FOREIGN CURRENCY REQUIREMENTS
(If required and only in case of International Bidding)

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

BC-1

Appendix-C to Bid

COST ESCALATION-DIFFERENCE OF COST UNDER CLAUSE 70 OF CONDITIONS OF CONTRACT

The source of prices and the weightages for use in the adjustment formula under clause 70 shall be as follows:

Cost Element	Description	Weightages	Applicable Price
1	2	3	4
(a)	Fixed Portion	0.30	
(b)	Local Labor (un-skilled labor per day shall be taken as representative of all types of Labor (skilled and un-skilled) of all trades)	0.10	Government of Pakistan, Pakistan Statistical Bulletin
(c)	Cement – in bags	0.15	Government of Pakistan, Pakistan Statistical Bulletin
(d)	Reinforcing Steel – per Ton Grade-60 Grade-40	0.20	Government of Pakistan, Pakistan Statistical Bulletin
(e)	Bricks	0.10	Government of Pakistan, Pakistan Statistical Bulletin
(f)	High Speed Diesel (HSD)	0.15	Pakistan State Oil (PSO)
	Total	1.00	

Not Applicable

Notes:

1) Price for "(b) (c) (d) and (e)" shall be taken from the Government of Pakistan, Pakistan Statistical Bulletin and price for (f) shall be as announced by Pakistan State Oil (PSO). The base prices shall be fixed and current prices shall be those applying 28 days prior to the **last day of the monthly statement period**.

2) The Price for the cost element of "(b) (c) (d) and (e)" shall be used for the City where the Site is located. In-case the Site is not listed in the monthly Pakistan Statistical Bulletin, the prices for the nearest City listed in the Bulletin shall be used.

3) Any fluctuation in the prices of materials other than those given above shall not be subject to adjustment of the Contract Price and shall be deemed to be included in the rates and prices quoted by the Bidders.

4) The weightage is calculated on the basis of estimated quantities and cost. In the initial stage of execution, the price adjustment will be made on the basis of weightage given in above table. However the final price adjustment will be paid on the basis of weightage worked out on quantities and cost at completion of work.

Authorized Signature and official Seal: _____

Name:_____

Date: _____

D-1

Appendix-D to Bid

BILL OF QUANTITIES

A. 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 in accordance with provisions of the Contract.

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 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 28 days prior to deadline for submission of Bids, 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.

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 summarized 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 58.2 of Part I, General Conditions of Contract.

BILL OF QUANTITIES

B. Work Items

1. As per attached Bill of Quantities

BE-1

Appendix-E to Bid

PROPOSED CONSTRUCTION SCHEDULE

Pursuant to Sub-Clause 43.1 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) showing the sequence of work items and the period of time during which he proposes to completeeach work item in such a manner that his proposed programme for completion of the whole of the Works and parts of the Works may meet Employer's completion targets in days noted below and counted from the date of receipt of Engineer's Notice to Commence (Attach sheets as required forthe specified form of Construction Schedule):

Description		**Time for Completion**
a)	Whole Works	_____days
b)	Part-A	_____days (If applicable)
c)	Part-B	_____days (If applicable)
d)	_____	_____days
e)	_____	_____days

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. Thenarrative 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 in Pakistan, 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.

4. Quality control / Quality assurance measures to be adopted including procedures to be followed for carrying out all tests required under specifications.

Not Applicable

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.

Following is a list of Minimum Equipment Requirement to be brought /installed/ erected at site by the Contractor:

a)	Batching Plant (30 cubic meter per hour capacity) ***Contractor shall also commit and submit details of a stand-by arrangement of a Batching Plant in case the above-mentioned plant becomes un-operative.*** (***Optional)***	1 No.
b)	Concrete Pump with sufficient capacity to deliver/place concrete to the highest place of the building (Stationary type) (***Optional)***	1 No.
c)	Crane (Mobile) (25-ton capacity) (***Optional)***	1 Nos.
d)	Crane (Tower) (***Optional)*** (30-meter boom length with 15 ton normal and 1.5-ton capacity at tip of the boom). The height of the Crane shall be sufficient to cover the entire height of the building plus 50 feet.	1 No.
e)	Shovel/Loader/Backhoe (***Optional)***	1 No.
h)	Concrete Transit Mixers (5-6 cubic meter capacity) (***Optional)***	3 Nos.
i)	Cabin Hoist (1500 Kg capacity) (***Optional)***	1 Nos.
j)	Air Compressor (15 hp capacity)	1 No.
k)	Formwork	30,000 Sft.
l)	Scaffolding Pipes with all necessary accessories	50,000 Rft.
l)	Safety netting all around the building	20,000 sft.
m)	Water Bowser	1 No.
n)	Diesel Gen. Set 10 kVA	1 No.

Note:
The Bidder while preparing his methodology for performing and executing the works and listing out Major Equipment (required to complete the works in the specified Time Schedule) in this Appendix shall consider the above-mentioned minimum requirement of Construction Equipment to be brought/installed/erected at site.

Authorized Signature and official Seal: _____

Name:_____

BG-1

Appendix-G to Bid

The Bidder will provide 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.

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						

BG-2

Appendix-G to Bid

Equipment:

The Bidder must demonstrate that it has the key equipment listed hereafter:

No.	PLANT/EQUIPMENT				
	Equipment Type and Characteristics	**Total Nos. available**	**Under Utilization on other projects, if applicable**	**Nos. waiting to be shifted to new project(s)**	**Min. Number Required for this Project**
1					
2					
3					
4					
5					
6					

CONSTRUCTION CAMP AND HOUSING FACILITIES

The Contractor in accordance with Clause 34 of the Conditions of Contract shall provide description of his construction camp's facilities and staff housing requirements.

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.). The Contractor should mention here what are his proposed environmental measures for the project as per EPA rules like treatment of wastewater and water quality etc. The Contractor shall submit a detailed EMP (Environmental Management Plan) to describe how materials are removed from site and disposed off at a safe location, prevention for the contamination of ground and surface water in neighboring areas etc. including remedial measures for adoption.

6. Detail of testing Lab with testing equipment etc.

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

Not Applicable

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	**Amounts (1,000 Rs.)**
1	**2**
Ist Quarter	
2nd Quarter	
3rd Quarter	
4th Quarter	
…….	
…….	
…….	
…….	
…….	
Bid Price	

BK-1

Appendix-K to Bid

ORGANIZATION CHART
FOR THE
SUPERVISORY STAFF AND LABOUR

(to be filled and signed by the Bidder)

Following is a list of Minimum Staff Requirement to be deployed at site immediately by the Contractor upon commencement of works:

Designation	**Nos.**	**Minimum Qualification**	**Min. Relevant Working Experience**
Project Manager	01	B.Sc. Civil Engr. with valid PEC Regd.	15 Years
Site Engineer	01	B.Sc. Civil Engr. with valid PEC Regd. OR BS Civil Technology	5 Years/ 10-15 Years
Quantity Surveyor Civil	01	Diploma in Civil	8-10 Years
Mechanical Engineer	01	Diploma in Mech.	8-10 Years
Surveyor/Draftsman	01	Diploma in Civil/Survey	8-10 Years
Civil Foreman	01	Intermediate	10 Years
Mechanic	01	Matric	10 Years

Note: If contractor could not deploy required staff at site then for each relevant personnel a deduction will be made from contractor's IPCs on the basis of prevailing market rate as assessed by the Engineer In-charge.

Authorized Signature and official Seal: _____

Name:_____

Date: _____

Appendix-L to Bid

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS. 10.00 MILLION OR MORE

Contract No._____Dated_____
Contract Value: _____
Contract Title: _____

…… [Name of Supplier] 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 Pakistan (GoP) or any administrative subdivision or agency thereof or any other entity owned or controlled by GoP through any corrupt business practice.

Without limiting the generality of the foregoing, [name of Supplier] 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 orotherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[Name of Supplier] certifies 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 GoP and has not taken any action or will not take any action to circumvent the above declaration, representation or warranty.

[Name of Supplier] 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 GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [name of Supplier] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [name of Supplier] 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 GoP.

Name of Employer: ……
Signature: ……..
[Seal]

Name of Contractor: ……
Signature: ……
[Seal]

(LIST OF APPROVED MANUFACTURERS) Appendix-M to Bid

(To be signed by the Bidder)

The Contractor should note that only material from those manufacturers specified in the list of approved manufacturers shall be allowed to be used on this Project. The Contractor shall submit literature/catalogue/samples etc. of all the items from each of the specified manufacturer to the Engineer / Employer who shall then decide and approve the sample and the manufacturer. Where the item involves any finishes such as paints, external coatings, etc. the Contractor shall erect mock-up samples of the specified manufacturers for the selection and approval of the Engineer/Employer.

Onus lies with the Contractor for establishing the genuineness of any material/product item for its make and origin as specified below: -

GENERAL SOURCE OF SUPPLY OF MATERIAL/ GENERAL NOTES

Civil Work:

	Items		Make
1.	Hill Sand	=	Bulari/Jamshoro
2.	Cement	=	DJ/Lucky
3.	Steel	=	Amreli/Mughal/Razak
4.	Bricks	=	Gomal
5.	Crush	=	Koat Bungalow
6.	Aluminum 2mm	=	Lucky/Prime
7.	Door Frame	=	G.I with 16 gauge
8.	Door	=	Solid wood
9.	Weather Sheild	=	ICI/Burger
10.	Matt Finishing	=	ICI/Burger
11.	Marble	=	Ziarat White or equivalent
12.	Granite	=	Granite as per approved Sample
13.	Bathroom Tile	=	Master/Shabir/Foreign within Base rate Approved Sample

Plumbing Items

1.	Ceramic Fixtures	=	Faisal/I.F.O/ACL (Pak)/Porta
2.	Kitchen Sink With Mixture	=	Asia/Local Make (Best Quality)
3.	Bath Room Accessories with Mirror	=	Master/Local Make (Best Quality)
4.	Faucets and Trims	=	Faisal/Master (Pak)
5.	Polypropylene Pipe (PPR)	=	WSI/Vesbo/Dadex/Pak Saudi
6.	uPVC Pipe	=	WSI/Vesbo/Dadex/Pak Saudi
7.	Natural Gas Pipe and Fittings (G.I)	=	IIL/Asia (Pak)
8.	Anchor/ Fasteners	=	Local Make (Best Quality)
9.	Valves and Fittings	=	KITZ / RUB or (Equivalent)
10.	Teflon Tap	=	Imported
11.	Hot Water Gas Heater With all fittings	=	NasGas / Canon or (Equivalent)
12.	Floor Drain Gratins (S.S)	=	Local Make (Best Quality)
13.	Water Transfer Pump with Motor & Allied Fittings	=	KSB / ESPA or Equivalent)
14.	Manhole and Gully Trap Cover with frame (C.I)	=	GPM / Local Make (Best Quality)

Electrical Work

1.	Substation MV/LV Panels	=	Green T&D Or Equivalent
2.	Submain & Main Distribution Board/DB	=	Electrech/Libra Engineering/equivalent
3.	Circuit Breaker	=	MG/ABB
4.	Witches & Receptacles	=	Clipsal/Mk
5.	Cables And Conductors	=	Pakistan/Pioneer /Fast & Copper Gat Cables
6.	Public Address Honeywell USA	=	Toa Japan/Gent
7.	Nurse Calling System	=	C-Tec UK or Equivalent
8.	Light Fitting And Fixtures	=	Brittle/Opple/Philips
9.	Telephone/Io's/Switches	=	Clipsal/Mk
10.	Fire Alarm System	=	Gent Honeywell (USA)
11.	Closed Circuit TV	=	Samsung/LG
12.	Data Communication	=	Giga/SISCO/Amp/3m

I/c following Materials

1. Bricks in Pacca brick works used is sub structure will be from Rahim Yar Khan (A-I Quality, approved by Client)
2. Bricks in face brickwork will be from Lahore. (A-I Quality, approved by Client).
3. Fine aggregate (Hill sand) will be from Bholari quarry.
4. Coarse aggregate (Crush stone, Ballast) will be from Koat Bunglow/Ubhan Shah.
5. Deformed Steel from Karachi (60 grade steel by Amerli/Razaque) will be used, no any rust will be allowed, at site steel must be covered with plastic covers to save it from humidity/moisture.
6. DG cement (Manufactured at Dera Ghazi Khan) will be used in all construction work. Proper and adequate steps must be taken for curing.
7. New Steel/marine ply shuttering will be used for RCC work in, columns, slab and beams.
8. Up to plinth level Sulpahte Resistant Cement (DG) will be used
9. All material to be used will be laboratory tested along with authentication certificate and finally selected by the client/ Consultant.
10. Use of vibrator is must in every RCC work.
11. Before execution of any activity, shop drawings must be submitted for its approval, than execution, if required sample should be prepared for approval.
12. Batch plant/ Semi Auto mixers shall be used in cementing work.
13. Before start of work proper work schedule for completion on Bar Chart, or on any software-based planning schedule for whole project must be submitted, along with this a fortnightly schedule to monitor and evaluate the progress of work.
14. Qualified and Experienced engineer must be available at site.
15. You must establish site office along with site material testing lab for material testing. All safety measures for Staff, surrounding property etc must be taken as asked by Client.

FORMS

BID SECURITY
PERFORMANCE SECURITY CONTRACT AGREEMENT
MOBILIZATION ADVANCE GUARANTEE/BOND AND
INDEMNITY BOND FOR SECURED ADVANCE

BS-1

BID SECURITY
(Bank Guarantee/Pay Order)

Security Executed on _____
(Date)
Name of Surety (Bank) with Address: _____
(Scheduled Bank in Pakistan)
Name of Principal (Bidder) with Address _____

_____
Penal Sum of Security Rupees ._____(Rs._____)
Bid Reference No. _____
KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal (Bidder) we, the Surety above named, are held and firmly bound unto

_____
(Hereinafter called the 'Employer') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Bidder has submitted the accompanying Bid dated_____for Bid No._____for_____(Particulars of Bid) to the said Employer; and

WHEREAS, the Employer has required as a condition for considering said Bid that the Bidder furnishes a Bid Security in the above said sum from a Scheduled Bank in Pakistan or from a foreign bank duly counter-guaranteed by a Scheduled Bank in Pakistan, to the Employer,conditioned as under:

(1) that the Bid Security shall remain in force up to and including the date 28 days after the deadline for validity of bids as stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Surety is hereby waived;

(2) that the Bid Security of unsuccessful Bidders will be returned by the Employer after expiry of its validity or upon signing of the Contract Agreement; and

(3) that in the event of failure of the successful Bidder to execute the proposed Contract Agreement for such work and furnish the required Performance Security, the entire said sum be paid immediately to the said Employer pursuant to Clause 15.6 of the Instruction to Bidders for the successful Bidder's failure to perform.

NOW THEREFORE, if the successful Bidder shall, within the period specified therefore, on the prescribed form presented to him for signature enter into a formal Contract with the said Employer in accordance with his Bid as accepted and furnish within twenty eight (28) days of hisbeing requested to do so, a Performance Security with good and sufficient surety, as may be required, upon the form prescribed by the said Employer for the faithful performance and proper fulfillment of the said Contract or in the event of non-withdrawal of the said Bid within the time specified for its validity then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

PROVIDED THAT the Surety shall forthwith pay the Employer, the said sum upon first written demand of the Employer (without cavil or argument) and without requiring the Employer to prove or to show grounds or reasons for such demand, notice of which shall be sent by the Employer by registered post duly addressed to the Surety at its address given above.

PROVIDED ALSO THAT the Employer shall be the sole and final judge for deciding whether the Principal (Bidder) has duly performed his obligations to sign the Contract Agreement and to furnish the requisite Performance Security within the time stated above, or has defaulted in fulfilling said requirements and the Surety shall pay without objection the said sum upon demand from the Employer forthwith and without any reference to the Principal (Bidder) or any other person.

IN WITNESS WHEREOF, the above bounden Surety has executed the instrument under its seal on the date indicated above, the name and seal of the Surety being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

SURETY (Bank)

WITNESS:

Signature _____

1. _____

Name _____

_____

Title _____

Corporate Secretary (Seal)

Corporate Guarantor (Seal)

2. _____

_____

Name, Title & Address

PS-1

FORM OF PERFORMANCE SECURITY
(Bank Guarantee)

Guarantee No._____
Executed on _____
Expiry date _____

[Letter by the Guarantor to the Employer]

Name of Guarantor (Bank) with address:_____
(Scheduled Bank in Pakistan)
Name of Principal (Contractor) with address:_____
_____
Penal Sum of Security (express in words and figures)_____
_____
Letter of Acceptance No._____Dated _____

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bidding Documents and above said Letter of Acceptance (hereinafter called the Documents) and at the request of the said Principal we, the Guarantor above named, are held and firmly bound unto the _____ (hereinafter called the Employer) in the penal sum of the amount stated above for the payment of which sum well and truly to be made to the said Employer, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has accepted the Employer's above said Letter of Acceptance for _____ _____ (Name of Contract) for the _____ _____(Name of Project).

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the said Documents during the original terms of the said Documents and any extensions thereof that may be granted by the Employer, with or without notice to the Guarantor, which notice is, hereby, waived and shall also well and truly perform and fulfill all the undertakings, covenants terms and conditions of the Contract and of any and all modifications of said Documents that may hereafter be made, notice of which modifications to the Guarantor being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue till all requirements of Clause 49, Defects Liability, of Conditions of Contract are fulfilled.

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall be received by us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

PS-2

We,_____(the Guarantor), waiving all objections and defenses under the Contract, do hereby irrevocably and independently guarantee to pay to the Employer without delay upon the Employer's first written demand without cavil or arguments and without requiring the Employer to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Employer's written declaration that the Principal has refused or failed to perform the obligations under the Contract which payment will be effected by the Guarantor to Employer's designated Bank & Account Number.

PROVIDED ALSO THAT the Employer shall be the sole and final judge for deciding whether the Principal (Contractor) has duly performed his obligations under the Contract or has defaulted in fulfilling said obligations and the Guarantor shall pay without objection any sum or sums up to the amount stated above upon first written demand from the Employer forthwith and without any reference to the Principal or any other person.

IN WITNESS WHEREOF, the above-bounden Guarantor has executed this Instrument under its seal on the date indicated above, the name and corporate seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

_____
Guarantor (Bank)

Witness:

1. _____ Signature _____

_____ Name_____
Corporate Secretary (Seal)

Title _____

2. _____

_____ _____
Name, Title & Address Corporate Guarantor (Seal)

CA-1

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the _____ day of_____(month) 20_____ between _____ (Hereafter called the ("Employer") of the one part and _____ (Hereafter called the "Contractor") of the otherpart.

WHEREAS the Employer 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 witnesses 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 / Clarification as agreed or otherwise, if any, except those parts relating to Instructions to Bidders shall be deemed to form and be read and construed as part of this Contract, 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 O);
   (i) The Drawings;
   (j) The Specifications.
   (k) _____(any other)

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

4. The Employer 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.

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	Signature of Employer
_____	_____
(Seal)	(Seal)
Signed, Sealed and Delivered in the presence of:	
Witness:	Witness:
_____	_____
(Name, Title and Address)	(Name, Title and Address)

MG-1

MOBILIZATION ADVANCE GUARANTEE/BOND

Guarantee No._____Date _____

WHEREAS_____(hereinafter called the 'Employer') has entered into a Contract for _____
(Particulars of Contract)
with_____(hereinafter called the "Contractor').

AND WHEREAS, the Employer 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 Contract.

AND WHEREAS, the Employer has asked 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 Employer) (hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Employer 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 fulfillment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Employer for payment not exceeding the aforementioned amount.

Notice in writing of any default, of which the Employer shall be the sole and final judge, on the part of the Contractor, shall be given by the Employer 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.

GUARANTOR

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

WITNESS

1. _____

_____
Corporate Secretary (Seal)

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

IB-1

INDEMNITY BOND

FOR SECURED ADVANCE

AGAINST MATERIALS BROUGHT AT SITE

(ON RS.40 NONJUDICIAL STAMP PAPER)

This Deed of Indemnity is issued by M/s. _____ _____ *(Name* of *the Contractor)* in favour of *M/s.*_____*(Name* of *the Employer).*

Whereas_____(hereinafter called the Employer) has paid the Secured Advance against the cost of material through any Bank or like agency by any other method by virtue of the terms of the contract existing between the parties. The details of the material and their price for which secured advance is being sought for the period _____till consumption of the material is as under:-

1. _____ at Rs._____ per_____= Rs.
2. _____ at Rs._____ per_____= Rs.
3. _____ at Rs._____ per_____= Rs.
4. _____ at Rs._____ per_____= Rs.

THEREFORE THIS DEED OF INDEMNITY WITHNESSETH AS FOLLOWS:

I/We_____of M/s. _____
do hereby indemnify M/s_____for all losses due to thefts, arson, pilferage, loss due to flood and inundation, shortage, deterioration and depreciation etc. through any act of Man or God or slump in the Market of any or all the materials financed or paid by the Employer on our request for financing payment against material.
I/We_____shall indemnify_____against any or all claims, action damages arising out of or resulting to the said material.
I/We_____further declare that we will faithfully abide by the above declaration and solemnly affirm that we will not remove, sell, pilferage any of the materials against which M/s_____has paid us such a secured advance and will not pledge the same with any Bank, Finance Corporation, Firm, Company, Individual or the like agency or create any change whereon in any from what so ever.
I/We_____do hereby also declare that in the event of my/our infringement of the declaration made above will be entitled to forfeit all such

material and also proceed against me/us according to the relevant clause pertaining to breach of contract and further invoke the power or seek any remedies secured of _____ under the contract Agreement signed with us or otherwise available under law.

Place_____Dated _____

Contractor _____

AFFIDAVIT

IB-1

I._____ S/O _____ Muslim, adult Holding CNIC

No._____ Resident of _____.

_____, do herby declare on oath and solemnly as under: -

1. That I am the deponent of this affidavit and fully conversant with the facts mentioned herein.

2. That I am the Owner/Partner/Director of_____ situated at _____, Sukkur/City name.

3. That I hereby further declare on oath that my firm never remains black listed with any government authorities/office or in private sector or with any entity.

4. That my firm is not involved in any dispute, litigation or Arbitration with any person, with any department of Federal/ Provincial or City Government, Agencies, or Organization, in any court of Law. Further, I and my firm are never indulged in any corrupt, fraudulent and collusive practices.

5. That our firm is Technically & Financially strong & capable to do the tendered work.

That whatever stated above is true and correct of the best of my knowledge and belief.

Karachi – Dated _____

_____

DEPONENT

[Notes on the Conditions of Contract]

The Conditions of Contract comprise two parts:

(a) Part I - General Conditions of Contract
(b) Part II - Particular Conditions of Contract

Over the years, a number of "model" General Conditions of Contract have evolved. The one used in these Standard Bidding Documents was prepared by the International Federation of Consulting Engineers (Federation International des Ingenieurs-Conseils, or FIDIC), and is commonly known as the FIDIC Conditions of Contract. (The used version is the fourth edition, 1987, reprinted in 1992 with further amendments).

The FIDIC Conditions of Contract have been prepared for an ad measurement (unit price or unit rate) type of contract, and cannot be used without major modifications for other types of contract, such as lump sum, turnkey, or target cost contracts.

The standard text of the General Conditions of Contract chosen must be retained intact to facilitate its reading and interpretation by bidders and its review by the Client. Any amendments and additions to the General Conditions, specific to the contract in hand, should be introduced in the Particular Conditions of Contract.

The use of standard conditions of contract for all civil Works will ensure comprehensiveness of coverage, better balance of rights or obligations between Employer and Contractor, general acceptability of its provisions, and savings in time and cost for bid preparation and review, leading to more economic prices.

The FIDIC Conditions of Contract are copyrighted and may not be copied, faxed, or reproduced. Without taking any responsibility of its being accurate, Pakistan Engineering Council with prior consent of FIDIC Secretariat, has reproduced herein the FIDIC General **Conditions of Contract for reference purpose only which cannot be used by the users** for preparing their bidding documents. The bidding document may include a purchased copy, the cost of which can be retrieved as part of the selling price of the bidding document. Alternatively, the FIDIC Conditionsof Contract can be referred to in the bidding documents, and the bidders are advised to obtain copies directly from FIDIC.*

CONDITIONS OF CONTRACT

FOR WORKS OF CIVIL

ENGINEERING CONSTRUCTION

PART I GENERAL CONDITIONS
WITH FORMS OF TENDER AND AGREEMENT

TABLE OF CONTENTS

PART II - PARTICULAR CONDITIONS OF CONTRACT

Clause	Title	Page
1.1	Definitions	**164**
2.1	Engineer's Duties and Authority	**164**
2.2	Engineer's Representative	**166**
2.7	Engineer Not Liable	**166**
2.8	Replacement of the Engineer	**166**
4.3	Approval of Sub-Contractors	**166**
5.1	Language(s) and Law	**166**
5.2	Priority of Contract Documents	**166**
6.6	Shop Drawings	**167**
6.7	As-Built Drawings	**167**
10.1	Performance Security	**167**
10.4	Performance Security Binding on Variations and Changes	**167**
14.1	Programme to be Submitted	**167**
14.3	Cash Flow Estimate to be Submitted	**168**
14.5	Detailed Programme and Monthly Progress Report	**168**
15.2	Language Ability of Contractor's Representative	**168**
15.3	Contractor's Representative	**169**
16.3	Language Ability of Superintending Staff of Contractor	**169**
16.4	Employment of Local Personnel	**169**
18.1	Boreholes and Exploratory Excavation	**169**
19.3	Safety Precautions	**169**
19.4	Lighting Works at Night	**169**
20.4	Employer's Risks	**169**
21.1	Insurance of Works and Contractor's Equipment	**170**
21.4	Exclusions	**170**
25.5	Insurance Company	**170**
31.3	Co-operation with Other Contractors	**171**
34.2	Rates of Wages and Conditions of Labor	**171**
34.3	Employment of Persons in the Service of Others	**171**
34.4	Housing for Labor	**171**
34.5	Health and Safety	**171**
34.6	Epidemics	**172**
34.7	Supply of Water	**172**
34.8	Alcoholic Liquor or Drugs	**172**
34.9	Arms and Ammunition	**172**
34.10	Festivals and Religious Customs	**172**
34.11	Disorderly Conduct	**172**
34.12	Compliance by Subcontractors	**172**
35.2	Records of Safety and Health	**173**

TABLE OF CONTENTS

PART II - PARTICULAR CONDITIONS OF CONTRACT

Clause	Title	Page
35.3	Reporting of Accidents	**173**
39.1	Removal of Improper Work, Materials or Plant	**173**
36.6	Use of Pakistani Materials and Services	**173**
41.1	Commencement of Works	**173**
43.1	Time for Completion	**173**
44.1	Extension of Time for Completion	**173**
47.1	Liquidated Damages for Delay	**173**
47.2	Reduction of Liquidated Damages	**173**
47.3	Bonus for Early Completion of Works	**173**
48.1	Taking-Over Certificate	**173**
48.2	Taking Over of Sections or Parts	**173**
49.1	Defects Liability Period	**173**
50.1	Contractor to Search	**173**
51.1	Variations	**173**
51.2	Instructions for Variations	**173**
52.1	Valuation of Variations	**174**
52.3	Variations Exceeding 15 per cent	**174**
53.4	Failure to Comply	**174**
54.3	Customs Clearance	**174**
54.5	Conditions of Hire of Contractor's Equipment	**174**
56.1	Works to be Measured	**174**
57.2	Breakdown of Lump Sum Items	**174**
59.4	Payments to Nominated Sub-contractors	**174**
59.5	Certification of Payments & Nominated Subcontractors	**174**
60.1	Monthly Statements	**175**
60.2	Monthly Payments	**175**
60.3	Payment of Retention Money	**175**
60.8	Final Payment Certificate	**175**
60.10	Time for Payment	**175**
60.11	Secured Advance on Materials	**175**
60.12	Financial Assistance to Contractor	**176**
63.1	Default of Contractor	**178**
63.3	Payment after Termination	**178**
63.4	Correction of Certificates	**178**
65.2	Special Risks	**178**
65.3	Damage to Works by Special Risks	**178**
65.4	Projectile, Missile	**178**
65.5	Increased Costs arising from Special Risks	**178**
65.6	Outbreak of War	**178**
65.7	Removal of Contractor's Equipment on Termination	**178**
65.8	Payment if Contract Terminated	**178**
67.1	Engineer's Decision	**178**
67.2	Amicable Settlement	**178**
67.3	Arbitration	**178**
67.4	Failure to Comply with Engineer's Decision	**179**

68.1	Notice to Contractor	**179**
68.2	Notice to Employer and Engineer	**179**
70.1	Increase or Decrease of Cost	**179**
73.1	Payment of Income Tax	**181**
73.2	Customs Duty & Taxes	**181**
74.1	Integrity Pact	**181**
75.1	Termination of Contract for Employer's Convenience	**182**
76.1	Liability of Contractor	**182**
77.1	Joint and Several Liability	**182**
78.1	Details to be Confidential	**182**

PART II - PARTICULAR CONDITIONS OF CONTRACT
(Mandatory Provisions not to be Amended / Substituted except as instructed by PEC)

1.1 Definitions

(a) (i) The Employer is **Project Director, Aror University Sukkur**

(a) (iv) The Engineer is Project Director Establishment of AROR University Sukkur.

The following paragraph is added:

(a) (vi) "Bidder or Tenderer" means any person or persons, company, corporation, firm or Joint venture submitting a Bid or Tender.

(b) (v) The following is added at the end of the paragraph:

The word "Tender" is synonymous with "Bid" and the word "Tender Documents" with "Bidding Documents".

The following paragraph is added:

(b) (ix) "Programme" means the programme to be submitted by the Contractor in Accordance
Accordance with Sub-Clause 14.1 and any approved revisions thereto.

(e) (i) The text is deleted and substituted with the following:

"Contract Price" means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works subject to such additions thereto or deductions there from as may be made and remedying of any defects therein in accordance with the provisions of the Contract.

2.1 Engineer's Duties and Authority

With reference to Sub-Clause 2.1(b), the following provisions shall also apply:
The Engineer shall obtain the specific approval of the Employer before carrying out his duties in accordance with the following Clauses. The Employer may further vary according to need of the project;

(i) Consenting to the sub-letting of any part of the Works under Sub-Clause 4.1 "Subcontracting".

(ii) Certifying additional cost determined under Sub-Clauses 12.2 "Not Foreseeable Physical Obstructions or conditions"

(iii) Any action under Clause 10 "Performance Security" and Clauses 21,23,24 & 25 "Insurance" of sorts.

(iv) Any action under Clause 40 "Suspension"

(v) Any action under Clause 44 "Extension of Time for Completion"

(vi) Any action under Clause 47 "Liquidated Damages for Delay" or payment of Bonus for Early Completion of Works (PCC Sub-Clause 47.3)

(vii) Issuance of "Taking over Certificate" under Clause 48.

(viii) Issuing a Variation Order under Clause 51 except:

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

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

(ix) Fixing rates or prices under Clause 52.

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

(xi) Release of Retention Money to the Contractor under Sub-Clause 60.3 "Payment of Retention Money".

(xii) Issuance of "Final Payment Certificate" under Sub-Clause 60.8.

(xiii) Issuance of "Defect Liability Certificate" under Sub-Clause 62.1.

(xiv) Any change in the ratios of Contract currency proportions and payments thereof under clause 72 "Currency and Rate of Exchange".

(Note: Employer may further vary according to need of the project)

* (If in the opinion of the Engineer an emergency occurs 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 52 and shall notify the Contractor accordingly, with a copy to the Employer.)

2.2 Engineer's Representative

Add the following paragraph:
The Employer shall ensure that the Engineer's Representative is a professional engineer as defined in the Pakistan Engineering Council Act 1975 (V of 1976).

The following Sub-Clauses 2.7 and 2.8 are added:

2.7 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 responsibilityof the Engineer to the Contractor, any Subcontractor, any of their representatives or employees or any other person performing any portion of the Works.

2.8 Replacement of the Engineer

"If the Employer intends to replace the Engineer, the Employer shall, not less than 07 days before the intended date of replacement, give notice to the Contractor, of the name, address and relevant experience of the intended replacement Engineer. The Employer shall not replace the Engineer with a person against whom the Contractor raises reasonable objection by notice to the Employer, with supporting particulars."

4.1 Subcontracting

The Contractor shall not subcontract the whole of the Works. Except where otherwise provided by the Contract, the Contractor shall not subcontract any part of the Works without the prior consent of the Engineer. Any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any Subcontractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agent's servants or workmen.

Provided that the Contractor shall not be required to obtain such consent for:

(a) the provision of labor,

(b) the purchase of materials which are in accordance with the standards specified in the Contract,

(c) the subcontracting of any part of the Works for which the Subcontractor is named in the Contract.

5.1 Language(s) and Law

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

5.2 Priority of Contract Documents

The documents listed at (1) to (6) of the Sub-Clause are deleted and substituted with the following:

(1) The Contract Agreement (if completed);
(2) The Letter of Acceptance;
(3) The completed Form of Bid;
(4) Special Stipulations (Appendix-A to Bid);
(5) The Particular Conditions of Contract – Part II;
(6) The General Conditions – Part I;
(7) The priced Bill of Quantities (Appendix-D to Bid);
(8) The completed Appendices to Bid (B, C, E to L);
(9) The Drawings;
(10) The Specifications; and
(11)____(any other).

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.

The following Sub-Clauses 6.6 and 6.7 are added

6.6 Shop Drawings

The Contractor shall submit to the Engineer for review 3 copies of all shop and erection drawings applicable to this Contract as per provision of relevant Sub-Clause of the Contract.
Review and approval 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 and that the Engineer's review or approval shall not relieve the Contractor of any of his responsibilities under the Contract.

6.7 As-Built Drawings

At the completion of the Works under the Contract, the Contractor shall furnish to the Engineer 6 copies and one reproducible of all drawings amended to conform with the Works as built. The price of such Drawings shall be deemed to be included in the Contract Price.

10.1 Performance Security

The text is deleted and substituted with the following:

The Contractor shall provide Performance Security to the Employer in the prescribed form. The said Security shall be furnished or caused to be furnished by the Contractor within 07 days after the receipt of the Letter of Acceptance. The Performance Security shall be of an amount equal to 5% of the Contract Price stated in the Letter of Acceptance. Such Security shall, at the option of the bidder, be in the form of either (a) bank guarantee from any Scheduled Bank in Pakistan or (b) bank guarantee from a bank located outside Pakistan duly counter-guaranteed by a Scheduled Bank in Pakistan.
The cost of complying with requirements of this Sub-Clause shall be borne by the Contractor.

The following Sub-Clause10.4 is added:

10.4 Performance Security Binding on Variations and Changes

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.

12.1 Not Foreseeable Physical Obstructions or Conditions

If, however, during the execution of the Works the Contractor encounters physical obstructions or physical conditions, other than climatic conditions on the Site, which obstructions or conditions were, in his opinion, not foreseeable by an experienced contractor, the Contractor shall forthwith give notice thereof to the Engineer, with a copy to the Employer. On receipt of such notice, the Engineer shall if in his opinion such obstructions or conditions could not have been reasonably foreseen by an experienced contractor, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 44, and

(b) the amount of any costs which may have been incurred by the Contractor by reason of such obstructions or conditions having been encountered, which shall be added to the Contract Price,

and shall notify the Contractor accordingly, with a copy to the Employer. Such determination shall take account of any instruction which the Engineer may issue to the Contractor in connection therewith, and any proper and reasonable measures acceptable to the Engineer which the Contractor may take in the absence of specific instructions from the Engineer.

14.1 Programme to be submitted

The programme shall be submitted with the bid from the date of receipt of Letter of Acceptance, which shall be in the form of:

i) a Grant Bar Chart identifying the critical activities.

(Employer to select appropriate one)

14.3 Cash Flow Estimate to be submitted

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

The following Sub-Clause 14.5 is added:

14.5 Detailed Programme and Monthly Progress Report

a) For purposes of Sub-Clause 14.1, the Contractor shall submit to the Engineer detailed programme for the following:

(1) Execution of Works;
(2) Labor Employment;
(3) Local Material Procurement;
(4) Material Imports, if any; and
(5) Other details as required by the Engineer.

(b) During the period of the Contract, the Contractor shall submit to the Engineer not later than the 8th day of the following month, 04 copies each of Monthly Progress Reports covering:

(1) A Construction Schedule indicating the monthly progress in percentage;
(2) Description of all work carried out since the last report;
(3) Description of the work planned for the next 56 days sufficiently detailed toenable the Engineer to determine his programme of inspection and testing;
(4) Monthly summary of daily job record;
(5) Photographs to illustrate progress; and
(6) Information about problems and difficulties encountered, if any, andproposals to overcome the same.

(c) 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 s equipment.

The following Sub-Clauses 15.2 and 15.3 are added:

15.2 Language Ability of Contractor's Representative

The Contractor's authorized representative shall be fluent in the English language. Alternately an interpreter with ability of English language shall be provided by the Contractor on full time basis.

15.3 Contractor's Representative

The Contractor's authorized representative and his other professional engineers working at Site shall register themselves with the Pakistan Engineering Council.

The Contractor's authorized representative at Site shall be authorized to exercise adequate administrative and financial powers on behalf of the Contractor so as to achieve completion of the Works as per the Contract.

The following Sub-Clauses 16.3 and 16.4 are added:

16.3 Language Ability of Superintending Staff of Contractor

A reasonable proportion of the Contractor's superintending staff shall have a working knowledge of the English language. If the Contractor's superintending staff are not fluent in English language, the Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

16.4 Employment of Local Personnel

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labor from sources within Pakistan.

The following Sub-Clauses 19.3 and 19.4 are added:

19.3 Safety Precautions

In order to provide for the safety, health and welfare of' persons, and for prevention of damage of any kind, all operations for the purposes of or in connection with the Contract shall be carried out in compliance with the Safety Requirements of the Government of Pakistan with such modifications thereto as the Engineer may authorize or direct and the Contractor shall take or cause to be taken such further measures and comply with such further requirements as the Engineer may determine to be reasonably necessary for such purpose.

The Contractor shall make, maintain and submit reports to the Engineer concerning safety, health and welfare of persons and damage to property, as the Engineer may from time to time prescribe.

19.4 Lighting Work at Night

In the event of work being carried out at night, the Contractor shall at his own cost, provide and maintain such good and sufficient light as will enable the work to proceed satisfactorily and without danger. The approaches to the Site and the Works where the night-work is being carried out shall be sufficiently lighted. All arrangement adopted for such lighting shall be to the satisfaction of the Engineer's Representative.

20.4 Employer's Risks

The Employer's risks are:

Delete the text and substitute with the following:

(a) insofar as they directly affect the execution of the Works in Pakistan:

(i) war and hostilities (whether war be declared or not), invasion, act of foreign enemies,
(ii) rebellion, revolution, insurrection, or military or usurped power, or civil war,
(iii) ionizing radiations, or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof,
(iv) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,
(v) riot, commotion or disorder, unless solely restricted to the employees of the Contractor or of his Subcontractors and arising from the conduct of the Works;

(b) loss or damage due to the use or occupation by the Employer of any Section or part of the Permanent Works, except as may be provided for in the Contract;

(c) loss or damage to the extent that it is due to the design of the Works, other than any part of the design provided by the Contractor or for which the Contractor is responsible; and

(d) any operation of the forces of nature (insofar as it occurs on the Site) which an experienced contractor:

(i) could not have reasonably foreseen, or
(ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures:
(a) prevent loss or damage to physical property from occurring by taking appropriate measures, or
(b) insure against.

21.1 Insurance of Works and Contractor's Equipment

(Employer may vary this Sub-Clause 21.1 (b))

21.4 Exclusions

The text is deleted and substituted with the following:

There shall be no obligation for the insurances in Sub-Clause 21.1 to include loss or damage caused by the risks listed under Sub-Clause 20.4 paras (a) (i) to (iv).

Not Applicable

The following Sub-Clause 25.5 is added:

22.1 Damage to Persons and Property

The Contractor shall, except if and so far as the Contract provides otherwise, indemnify the Employer against all losses and claims in respect of:

(a) death of or injury to any person, or

(b) loss of or damage to any property (other than the Works),

which may arise out of or in consequence of the execution and completion of the Works and the remedying of any defects therein, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, subject to the exceptions defined in Sub-Clause 22.2.

22.2 Exceptions

The "exceptions" referred to in Sub-Clause 22.1 are:

(a) the permanent use or occupation of land by the Works, or any part thereof,

(b) the right of the Employer to execute the Works, or any part thereof, on, over, under, is or through any land,

(c) damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any defects therein, in accordance with the Contract, and

(d) death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Employer, his agents servants or other contractors, not being employed by the Contractor, or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or, where the injury or damage was contributed to by the Contractor, his servants or agents, such part of the said injury or damage as may be just and equitable having regard to the extent of the responsibility of the Employer, his servants or agents or other contractors for the injury or damage.

23.1 Third Party Insurance (including Employer's Property)

The Contractor shall, without limiting his or the Employer's obligation and responsibilities under Clause 22, insure, in the joint names of the Contractor and the Employer, against liabilities for death of or injury to any person (other than as provided in Clause 24) or loss of or damage to any property (other than the Works) arising out of the performance of the Contract, other than the exceptions defined in paragraphs (a), (b) and (c) of Sub-Clause 22.2.

23.2 Minimum Amount of Insurance

Such insurance shall be for at least the amount stated in the Appendix to Tender.

23.3 Cross Liabilities

The insurance policy shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Employer as separate insureds.

24.1 Accident or Injury to Workmen

The Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any

Subcontractor, other than death or injury resulting from any act or default ofthe Employer, his agents or servants. The Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation, other than those for which the Employer is liable as aforesaid, and against all claims, proceedings, damages, costs, charges, and expenses whatsoever in respect thereof or in relation thereto.

24.2 Insurance Against Accident to Workmen

The Contractor shall insure against such liability and shall continue such insurance during the whole of the time that any persons are employed by him on the Works.

Provided that, in respect of any persons employed by any Subcontractor, the Contractor's obligations to insure as aforesaid under the Sub-Clause shall be satisfied if the Subcontractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy,but the Contractor shall require such Subcontractor to produce to the Employer, when required, such policy of insurance and the receipt for the payment of the current premium.

25.5 Insurance Company

The Contractor shall be obliged to place all insurances relating to the Contract (including, but not limited to, the insurances referred to in Clauses 21, 23 and 24) with either National Insurance Company of Pakistan or any other insurance company operating in Pakistan and acceptable to the Employer.

Costs of such insurances shall be borne by the Contractor.

Not Applicable

The following Sub-Clause 31.3 is added:

31.3 Co-operation with other Contractors

During the execution of the Works, the Contractor shall co-operate fully with other contractors working for the Employer at and in the vicinity of the Site and also shall provide adequate precautionary facilities not to make himself a nuisance to local residents and other contractors.

The following Sub-Clauses 34.2 to 34.12 are added:

34.2 Rates of Wages and Conditions of Labor

The Contractor shall pay rates of' wages and observe conditions of labor not less favorable than those established for the trade or industry where the work is carried out. In the absence of any rates of wages or conditions of labor so established, the Contractor shall pay rates of wages and observe conditions of labor which are not less favorable than the general level of wages and conditions observed by other employers whose general circumstances in the trade or in industry in which the Contractor is engaged are similar.

34.3 Employment of Persons in the Service of Others

The Contractor shall not recruit his staff and labor from amongst the persons in the services of the Employer or the Engineer; except with the prior written consent of the Employer or the Engineer, as the case may be.

34.4 Housing for Labor

Save insofar as the Contract otherwise provides, the Contractor shall provide and maintain such housing accommodation and amenities as he may consider necessary for all his supervisory staff and labor, employed for the purposes of or in connection with the Contract including all fencing, electricity supply, sanitation, cookhouses, fire prevention, water supply and other requirements in connection with such housing accommodation or amenities. On completion of the Contract, these facilities shall be handed over to the Employer or if the Employer so desires, the temporary camps or housing provided by the Contractor shall be removed and the Site reinstated to its original condition, all to the approval of the Engineer.

34.5 Health and Safety

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labor at all times throughout the period of the Contract. The

Contractor shall further ensure that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements.

34.6 Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government, or the local medical or sanitary authorities, for purpose of dealing with and overcoming the same.

34.7 Supply of Water

The Contractor shall, so far as is reasonably practicable, having regard to local conditions**,** provide on the Site, to the satisfaction of the Engineer or his representative, adequate supply of drinking and other water for the use of his staff andlabor.

34.8 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Government Regulations or Orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his Subcontractors, agents, staff or labor.

34.9 Arms and Ammunition

The Contractor shall not give, or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or suffer the same as aforesaid.

34.10 Festivals and Religious Customs

The Contractor shall in all dealings with his staff and labour have due regard to all recognized festivals, days of rest and religious and other customs.

34.11 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst staff and labour and for the preservation of peace and protection of persons and property in the neighbourhood of the Works against the same.

34.12 Compliance by Subcontractors

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

The following Sub-Clauses 35.2 and 35.3 are added:

35.2 Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

35.3 Reporting of Accidents

The Contractor shall report to the Engineer details of any accident as soon as possible after its occurrence. In the case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means.

The following Sub-Clause 36.6 is added:

36.6 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.

39.1 Removal of Improper Work, Materials or Plant

The Engineer shall have authority to issue instructions from time to time, for:

(a) the removal from the Site, within such time or times as may be specified in the instruction, of any materials or Plant which, in the opinion of the Engineer, are not in accordance with the Contract,

(b) the substitution of proper and suitable materials or Plant, and

(c) the removal and proper re-execution, notwithstanding any previous test thereof or interim payment therefore, of any work which, in respect of

(i) materials, Plant or workmanship, or

(ii) design by the Contractor or for which he is responsible,

is not, in the opinion of the Engineer, in accordance with the Contract

40.1 Suspension of Work

The Contractor shall, on the instructions of the Engineer, suspend the progress of the Works or any part thereof for such time and in such manner as the Engineer may

consider necessary and shall, during such suspension, properly protect and secure the Works or such part thereof so far as is necessary in the opinion of the Engineer. Unless such suspension is:

(a) otherwise provided for in the Contract,

(b) necessary by reason of some default of or breach of contract by the Contractor or for which he is responsible,

(c) necessary by reason of climatic conditions of the Site, or

(d) necessary for the proper execution of the Works or for the safety of the Works or any part thereof (save to the extent that such necessity arises from any actor default by the Engineer or the Employer or from any of the risks defined in Sub-Clause 20.4), Sub-Clause 40.2 shall apply.

40.2 Engineer's Determination following Suspension

Where, pursuant to Sub-Clause 40.1, this Sub-Clause applies the Engineer shall, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 44, and

(b) the amount, which shall be added to the Contract Price, in respect of the cost incurred by the Contractor by reason of such suspension,

and shall notify the Contractor accordingly, with a copy to the Employer.

40.3 Suspension lasting more than 84 Days

If the progress of the Works or any part thereof is suspended on the written instructions of the Engineer and if permission to resume work is not given by the Engineer within a period for 84 days from the date of suspension then, unless such suspension is within paragraph (a), (b), (c) or (d) of Sub-Clause 40.1, the Contractor may give notice to the Engineer requiring permission, within 28 days from the receipt thereof, to proceed with the Works or that part thereof in regard to which progress is suspended. If, within the said time, such permission is not granted, the Contractor may, but is not bound to, elect to treat the suspension, where it affects part only of the Works, as an omission of such part under Clause 51 by giving a further notice to the Engineer to that effect, or, where it affects the whole of the Works, treat the suspension as an event of default by the Employer and terminates his employment under the Contract in accordance with the provisions of Sub-Clause 69.1, whereupon the provisions of Sub-Clause 69.2 and 69.3 shall apply.

41.1 Commencement of Works

The text 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.

The following Sub-Clause 47.3 is added:

43.1 Time for Completion

The whole of the Works and, if applicable, any Section required to be completed within a particular time as stated in the Appendix to Tender, shall be completed, in accordance with the provisions of Clause 48.1, within the time stated in the Appendix to Tender for the whole of the Works or the Section (as the case may be), calculated from the Commencement Date, or such extended time as may be allowed under Clause 44.1.

44.1 Extension of Time for Completion

In the event of:

(a) the amount or nature of extra or additional work,

(b) any cause of delay referred to in these Conditions,

(c) exceptionally adverse climatic conditions,

(d) any delay, impediment or prevention by the Employer, or

(e) other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible,

Being such as fairly to entitle the Contractor to an extension of the Time for Completion of the Works, or any Section or part thereof, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of such extension and shall notify the Contractor accordingly, with a copy to the Employer.

47.1 Liquidated Damages for Delay

If the Contractor fails to comply with the Time for Completion in accordance with Clause 48, for the whole of the Works or, if applicable, any Section within the relevant time prescribed by Clause 43, then the Contractor shall pay to the Employer the relevant sum stated in the Appendix to Tender as liquidated damages for such default and not as a penalty (which sum shall be the only monies due from the Contractor for such default) for every day or part of a day which shall elapse between the relevant Time for Completion and the date stated in a Taking-Over Certificate of the whole of the Works or the relevant Section, subject to the applicable limit stated in the Appendix to Tender. The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

47.2 Reduction of Liquidated Damages

If, before the Time for Completion of the whole of the Works or, if applicable, any Section, a Taking-Over Certificate has been issued for any part of the Works or of a Section, the liquidated damages for delay in completion of the remainder of the Works or of that Section shall, for any period of delay after the date stated in such Taking-Over Certificate, and in the absence of Alternative provisions in the Contract, be reduced in the proportion which the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The provisions of this Sub-Clause shall only apply to the rate of liquidated damages and shall not affect the limit thereof.

47.3 Bonus for Early Completion of Works

The Contractor shall in case of earlier completion for either whole or part(s) of the Works pursuant to Sub-Clauses 48.1 and 48.2(a) respectively of the General Conditions of Contract, be paid bonus up-to a limit and at a rate equivalent to 50% of the relevant limit and rate of liquidated damages prescribed in Appendix-A to Bid “Special Stipulations”.

48.1 Taking-Over Certificate

When the whole of the Works have been substantially completed and have satisfactorily passed any Tests on Completion prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer with a copy to the Employer, accompanied by a written undertaking to finish with due expedition any outstanding work during the Defects Liability Period. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect of the Works. The Engineer shall within 21 daysof the date of delivery of such notice, either issue to the Contractor, with a copy to the Employer, a Taking-Over Certificate, stating the date on which, in his opinion, the Works were substantially completed in accordance with the Contract, or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, is required to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Woks specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate within 21 days of completion, to the satisfaction of the Engineer, of the Works so specified and remedying any defects so notified.

48.2 Taking Over of Sections or Parts

For the purposes of para (a) of this Sub-Clause, separate Times for Completion shall be provided in the Appendix-A to Bid “Special Stipulations”.

49.1 Defects Liability Period

In these Conditions the expression "Defects Liability Period" shall mean the defects liability period named in the Appendix to Tender, calculated from:

(a) the date of completion of the Works certified by the Engineer in accordance with Clause 48, or

(b) in the event of more than one certificate having issued by the Engineer under

Clause 48, the respective dates so certified,

and in relation to the Defects Liability Period the expression "the Works" shall be construed accordingly.

50.1 **Contractor to Search**

If any defect, shrinkage or other fault in the Works appears at any time prior to the end of the Defects Liability Period, the Engineer may instruct the Contractor, with a copy to the Employer, to search under the directions of the Engineer for the cause thereof. Unless such defect, shrinkage or other fault is one for which the Contractor is liable under the Contract, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount in respect of the costs of such search incurred by the Contractor, which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Employer. If such defect, shrinkage or other fault is one for which the Contractor is liable, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case remedy such defect, shrinkage or other fault at his own cost inaccordance with the provisions of Clause 49.

51.1 Variations

The Engineer shall make any variation of the form, quality or quantity of the Works or any part thereof that may, in his opinion, be necessary and for that purpose, or if for any other reason it shall, in his opinion, be appropriate, he shall have the authority to instruct the Contractor to do and the Contractor shall do any of the following:

(a) increase or decrease the quantity of any work included in the Contract,
(b) omit any such work (but not if the omitted work is to be carried out by the Employer or by another contractor),
(c) change the character or quality or kind of any such work,
(d) change the levels, lines, position and dimensions of any part of the Works,
(e) execute additional work of any kind necessary for the completion of theWorks, or
(f) change any specified sequence or timing of construction of any part of the Works.

No such variation shall in any way vitiate or invalidate the Contract, but the effect, if any, of all such variations shall be valued in accordance with Clause 52. Provided that where the issue of an instruction to vary the Works is necessitated bysome default of or breach of contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor

51.2 Valuation of Variations

In the tenth line, after the words “Engineer shall” the following is added:
Within a period not exceeding one-eighth of the completion time subject to a minimum of 56 days from the date of disagreement whichever is later.

52.1 Instructions for Variations

At the end of the first sentence, after the word “Engineer", the words “in writing” are

added.

53.4 Failure to Comply

This Sub-Clause is deleted in its entirety.

54.3 Customs Clearance

(Employer may vary this Sub-Clause)

54.5 Conditions of Hire of Contractor's 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 thehire thereof contains a provision in accordance with the requirements set forth above.

The following Sub-Clauses 59.4 & 59.5 are added:

56.1 Works to be Measured

The Engineer shall, except as otherwise stated, ascertain and determine by measurement the value of the Works in accordance with the Contract and the Contractor shall be paid that value in accordance with Clause 60. The Engineer shall, when he requires any part of the Works to be measured, give reasonable notice to the Contractor's authorized agent, who shall:

(a) forthwith attend or send a qualified representative to assist the Engineer in making such measurement, and

(b) supply all particulars required by the Engineer.

Should the Contractor not attend, or neglect or omit to send such representative, then the measurement made by the Engineer or approved by him shall be taken to be the correct measurement of such part of the Works. For the purpose of measuring such Permanent Works as are to be measured by records and drawings, the Engineer shall prepare records and drawings as the work proceeds and the Contractor, as and when called upon to do so in writing, shall, within 14 days, attend to examine and agree such records and drawings with the Engineer and shall sign the same when so agreed. If the Contractor does not attend to examine and agree such records and drawings, they shall be taken to be correct. If, after examination of such records and drawings, the Contractor does not agree the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor, within 14 days of such examination, lodges with the Engineer notice of the respects in which such records and drawings are claimed by him to be incorrect. On receipt of such notice, the Engineer shall review the records and drawings and either confirm or vary them.

59.4 Payments to Nominated Subcontractors

The Contractor shall pay to the nominated Subcontractor the amounts which the

Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with Clause 58 [Provisional Sums], except as stated in Sub-Clause 59.5 [Certification of Payments].

59.5 Certification of Payments & Nominated Subcontractors

Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

(a) satisfies the Engineer in writing that he has reasonable cause for withholding or refusing to make such payment, and

(b) produces to the Engineer reasonable proof that he has so informed such nominated Subcontractor in writing,

then the Employer may (at his sole discretion) pay direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.

60.1 Monthly Statements

In the first line after the word "shall", the following is added:

"on the basis of the joint measurement of work done under Clause 56.1,"

In Para (c) the words "the Appendix to Tender" are deleted and substituted with the words "Sub-Cause 60.11 (a)(6) hereof".

(in case Clause 60.11 is applicable)

60.2 Monthly Payments

In the first line, "28" is substituted by "14".

60.3 Payment of Retention Money

(a) Upon the issue of the Taking-Over Certificate with respect to the whole of the Works, one half of the Retention Money, or upon the issue of a Taking-Over Certificate with respect to a Section or part of the Permanent

Works only such proportion thereof as the Engineer determines having regard to the relative value of such Section or part of the Permanent Works, shall be certified by the Engineer for payment to the Contractor.

(b) Upon the expiration of the Defects Liability Period for the Works the other half of the Retention Money shall be certified by the Engineer for payment to the Contractor. Provided that, in the event of different Defects Liability Periods having become applicable to different Sections or part of the Permanent Works pursuant to Clause 48, the expression "expiration of the Defects Liability Period" shall, for the purposes of this Sub-Clause, be deemed to mean the expiration of the latest of

such periods. Provided also that if at such time, there shall remain to be executed by the Contractor any work instructed, pursuant to Clause 49 and 50,in respect of the Works, the Engineer shall be entitled to withhold certification until completion of such work of so much of the balance of the Retention Money as shall, in the opinion of the Engineer, represent the cost of the work remaining to be executed.

60.8 Final Payment Certificate

Within 28 days after receipt of the Final Statement, and the written discharge, the Engineer shall issue to the Employer (with a copy to the Contractor) a Final Payment Certificate stating:

(a) the amount which, in the opinion of the Engineer, is finally due under the Contract or otherwise, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled other than under Clause 47, the balance, if any, due from the Employer to the Contractor or from the Contractor to the Employer as the case may be.

60.10 Time for Payment

The text is deleted and substituted with the following:

The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other terms of the Contract, shall , subject to Clause 47, be paid by the Employer to the Contractor within 30 days after such Interim Payment Certificate has been jointly verified by Employer and Contractor, or, in the case of the Final Certificate referred to in Sub Clause 60.8, within 60 days after such Final Payment Certificate has been jointly verified by Employer and Contractor; Provided that the Interim Payment shall be caused in 42 days and Final Payment in 60 days in case of foreign funded project. In the event of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor compensation at the 28 days rate of KIBOR+2% per annum for local currency and LIBOR+1% for foreign currency, upon all sums unpaid from the date by which the same should have been paid. The provisions of this Sub- Clause are without prejudice to the Contractor's entitlement under Clause 69.

The following Sub-Clause 60.11is added:

60.11 Secured Advance on Materials

a) The Contractor shall be entitled to receive from the Employer Secured Advance against an indemnity bond acceptable to the Employer 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:

(1) The materials are in accordance with the Specifications for the Permanent Works;

(2) Such materials have been delivered to the Site and are properly stored and protected against loss or damage or deterioration to the satisfaction of the Engineer but at the risk and cost of the Contractor;

(3) 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;

(4) 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 therefor;

(5) Ownership of such materials shall be deemed to vest in the Employer and these materials shall not be removed from the Site or otherwise disposed of without written permission of the Employer; and

(6) 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 other materials.

(b) The recovery of Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumptionbasis.

60.12 Financial Assistance to Contractor

Financial assistance shall be made available to the Contractor by the Employer by adopting any one of the following three Alternatives**:**

(Appropriate alternative only to be retained)

Alternative One: Mobilization Advance

(1) An interest-free Mobilization Advance up to 10 % of the Contract Price stated in the Letter of Acceptance shall be paid by the Employer to the Contractor in two equal parts upon submission by the Contractor of a Mobilization Advance Guarantee/Bond for the full amount of the Advance in the specified form froma Scheduled Bank in Pakistan. First part within 14 days after signing of the Contract Agreement or date of receipt of Engineer's Notice to Commence, whichever is earlier; and

(2) Second part within 42 days from the date of payment of the first part, subject to the satisfaction of the Engineer as to the state of mobilization of the Contractor.

(b) This Advance shall be recovered in equal installments; first installment at the expiry of third month after the date of payment of first part of Advance and the last installment two months before the date of completion of the Works as per Clause 43 hereof.

Alternative Two: Mobilization/ Demobilization Cost (Not Applicable).

Mobilization Cost shall be paid to the Contractor as a part of the priced Bill of Quantities. This cost shall not exceed 10 % of the Tender Price and shall be paid to the Contractor as follows:

(i) 75 % of the Mobilization Cost shall be paid for mobilization at Site. This payment shall be in three stages as follows:

Stage I: 20% of Mobilization Cost upon obtaining and furnishing of Performance Security and insurance policies and construction of camp and housing facilities as required under the Contract;

Stage II: 30% of Mobilization Cost upon providing & installing preliminary requirements of Contractor's Equipment, materialsand temporary structures for the commencement of Works to the satisfaction of the Engineer and achieving 3 % value of the Works (excluding payment under Stage-I);

Stage III: 30% of Mobilization Cost upon providing balance Contractor's Equipment to complete full requirement for the entire work and after achievement of progress to the extent of 6 % value of the Works (excluding payments under Stages I and II); and

(ii) 20 % of Mobilization Cost shall be paid for operation and maintenance of the constructed facilities and for demobilization as per schedule of payment to be submitted by the Contractor in accordance with Clause 57.2 and approved by the Engineer.

Alternative Three: Materials Supplied by Employer (Not Applicable)

The Employer shall supply to the Contractor materials, like cement, steel, bitumen or any other material whichever deemed necessary to complete the project; and the cost thereof shall be recovered from the Contractor through monthly statements on the basis of actual consumption.

The list of materials, quantities and rates to be charged to the Contractor shall be provided along with Appendix-A to Bid "Special Stipulations".

(Employer may opt either "Secured Advance on Materials" or "Financial Assistance to Contractor")

62.1 Defects Liability Certificate

The Contract shall not be considered as completed until a Defects Liability Certificate shall have been signed by the Engineer and delivered to the Employer, with a copy to the Contractor, stating the date on which the Contractor shall have completed his obligations to execute and complete the Works and remedy any defects therein to the Engineer's satisfaction. The Defects Liability Certificate shall be given by the Engineer within 28 days after the expiration of the Defects Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works, the expiration of the latest such period, or as soon thereafter as any works instructed, pursuant to Clause 49 and 50, have been completed to the satisfaction of the Engineer. Provided that the issue of the

Defects Liability Certificate shall not be a condition precedent to payment to the Contractor of the second portion of the Retention Money in accordance with the conditions set out in Sub-Clause 60.3.

63.1 Default of Contractor

The following para is added at the end of the Sub-Clause:

Provided further that in addition to the action taken by the Employer against the Contractor under this Clause, the Employer 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.

63.3 Payment after Termination

If the Employer terminates the Contractor's employment under this Clause, he shall not be liable to pay to the Contractor any further amount (including damages) in respect of the Contract until the expiration of the Defects Liability Period and thereafter until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any) and all other expenses incurred by the Employer have been ascertained and the amount thereof certified

by the Engineer. The Contractor shall then be entitled to receive only such sum (if any) as the Engineer may certify would have been payable to him upon due completion by him after deducting the said amount. If such amount exceeds the sum which would have been payable to the Contractor on due completion by him, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

63.4 Assignment of Benefit of Agreement

Unless prohibited by law, the Contractor shall, if so instructed by the Engineer within 14 days of such entry and termination referred to in Sub-Clause 63.1, assign to the Employer the benefit of any agreement for the supply of any goods or materials or services and/or for the execution of any work for the purposes of the Contract, which the Contractor may have entered into.

65.1 No Liability for Special Risks

The Contractor shall be under no liability whatsoever in consequence of any of the special risks referred to in Sub-Clause 65.2, whether by way of indemnity or otherwise, for or in respect of:

(a) destruction of or damage to the Works, save to work condemned under the provisions of Clause 39 prior to the occurrence of any of the said special risks,
(b) destruction of or damage to property, whether of the Employer or third parties, or
(c) injury or loss of life.

65.2 Special Risks

The Special Risks are:

(a) the risks defined under paragraphs (a), (c), (d) and (e) of Sub-Clause 20.4,and
(b) the risks defined under paragraph (b) of Sub-Clause 20.4 insofar as theserelate to the country in which the Works are to be executed.

65.3 Damage to Works by Special Risks

If the Works or any materials or Plant on or near or in transit to the Site, or any of the Contractor's Equipment, sustain destruction or damage by reason of any of the said special risks, the Contractor shall be entitled to payment in accordance with the Contract for any Permanent Works duly executed and for any materials or Plant so destroyed or damaged and, so far as may be required by the Engineer or as may be necessary for the completion of the Works, to payment for:

(a) rectifying any such destruction or damage to the Works, and
(b) replacing or rectifying such materials or Contractor's Equipment,

and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 (which shall in the case of the cost of replacement of Contractor's Equipment include the fair market value thereof as determined by the Engineer) and shall notify the Contractor accordingly, with a copy to the Employer.

65.4 Projectile, Missile

Destruction, damage, injury or loss of life caused by the explosion or impact, whenever and wherever occurring, of any mine, bomb, shell, grenade, or other projectile, missile, munition, or explosive of war, shall be deemed to be a consequence of the said special risks.

65.5 Increased Costs arising from Special Risks

Save to the extent that the Contractor is entitled to payment under any other provision of the Contract, the Employer shall repay to the Contractor any costs of the execution of the Work (other than such as may be attributable to the cost of reconstructing work condemned under the provisions of Clause 39 prior to the occurrence of any special risk) which are howsoever attributable to or consequent on or the result of or in any way whatsoever connected with the said special risks, subject however to the provisions in this Clause hereinafter contained in regard to outbreak of war, but the Contractor shall, as soon as any such cost comes to his knowledge, forthwith notify the Engineer thereof. The Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of the Contractor's costs in respect thereof which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Employer.

65.6 Outbreak of War

If, during the currency of the Contract, there is an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the Works, the Contractor shall, unless and until the Contract is terminated under the provisions of this Clause, continue to use his

best endeavor to complete the execution of the Works. Provided that the Employer shall be entitled, at any time after such outbreak of war, to terminate the Contract by giving notice to the Contractor and, upon such notice being given, the Contract shall, except as to the rights of the parties under this clause and Clause 67, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.

65.7 Removal of Contractor's Equipment on Termination

If the Contract is terminated under the provisions of Sub-Clause 65.6, the Contractor shall, with all reasonable dispatch, remove from the Site all Contractor's Equipment and shall give similar facilities to his Subcontractors to do so.

65.8 Payment if Contract Terminated

If the Contract is terminated as aforesaid, the Contractor shall be paid by the Employer, insofar as such amounts or items have not already been covered by payments on account made to the Contractor, for all work executed prior to the date of termination at the rates and prices provided in the Contract and in addition:

(a) the amounts payable in respect of any preliminary items referred to in the Bill of Quantities, so far as the work or service comprised therein has been carried out or performed, and a proper portion of any such items which have been partially carried out or performed;

(b) the cost of materials, Plant or goods reasonably ordered for the Works which have been delivered to the Contractor or of which the Contractor is legally liable to accept delivery, such materials, Plant or goods becoming the property of the Employer upon such payments being made by him;

(c) a sum being the amount of any expenditure reasonably incurred by the Contractor in the expectation of completing the whole of the Works insofar as such expenditure has not been covered by any other payments referred to in this Sub-Clause;

(d) any additional sum payable under the provisions of Sub-Clauses 65.3 and 65.5;

(e) such proportion of the cost as may be reasonable, taking into account payments made or to be made for work executed, of removal of Contractor's Equipment under Sub-Clause 65.7 and, if required by the Contractor, return thereof to the Contractor's main plant yard in his country of registration or to other destination, at no greater cost; and

(f) The reasonable cost of repatriation of all the Contractor’s staff and workmen employed on or in connection with the Works at the time of such termination.

Provided that against any payment due from the Employer under this Sub-Clause, the Employer shall be entitled to be credited with any outstanding balances due from the Contractor for advances in respect of Contractor's Equipment, materials and Plant and any other sums which, at the date of termination, were recoverable

by the Employer from the Contractor under the terms of Contract. Any sums payable under this Sub-Clause shall, after due consultation with the Employer and the Contractor, be determined by the Engineer who shall notify the Contractor accordingly, with a copy to the Employer.

67.1 Engineer's Decision

If a dispute of any kind whatsoever arises between the Employer and the Contractor in connection with, or arising out of, the Contract or the execution of the Works, whether during the execution of the Works or after their completion and whether before or after repudiation or other termination of the Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Engineer, the matter in dispute shall, in the first place, be referred in writing to the Engineer, with a copy to the other party. Such reference shall state that it is made pursuant to this Clause. No later than the eighty-fourth day after the day on which he received such reference the Engineer shall give notice of his decision to the Employer and the Contractor. Such decision shall state that it is made pursuant to this Clause

67.2 Amicable Settlement

Where notice of intention to commence arbitration as to a dispute has been given in accordance with Sub-Clause 67.1, the parties shall attempt to settle such dispute amicably before the commencement of arbitration. Provided that, unless the parties otherwise agree, arbitration may be commenced on or after the fifty-sixth day after the day on which notice of intention to commence arbitration of such dispute was given, even if no attempt at amicable settlement thereof has been made.

67. 3 Arbitration

In the sixth to eight lines, the words “shall be finally settled ..... appointed under such Rules” are deleted and substituted with the following:

shall be finally settled under the provisions of the Arbitration Act, 1940 as amended or any statutory modification or re-enactment thereof for the time being in force.

The following paragraph is added:

The place of arbitration shall be..... , Pakistan.

67.4 Failure to Comply with Engineer's Decision

Where neither the Employer nor the Contractor has given notice of intention to commence arbitration of a dispute within the period stated in Sub-Clause 67.1 and the related decision has become final and binding, either party may, if the other party fails to comply with such decision, and without prejudice to any otherrights it may have, refer the failure to arbitration in accordance with Sub-Clause 67.3. The provisions of Sub-Clause 67.1 and 67.2 shall not apply to any such reference.

68.1 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 Employer 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.

68.2 Notice to Employer and Engineer

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

a) The Employer: **Establishment of AROR University Sukkur**

…….....
(to be filled in by the Employer as appropriate)

b) The Engineer: **Project Director**

…….....
(to be filled in by the Employer as appropriate)

69.1 Default of Employer

In the event of the Employer:

(a) failing to pay to the Contractor the amount due under any certificate of the Engineer within 28 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Employer is entitled to make under the Contract,

(b) interfering with or obstructing or refusing any required approval to the issue of any such certificate,

(c) becoming bankrupt or, being a company, going into liquidation, other than for the purpose of a scheme of reconstruction or amalgamation, or

(d) giving notice to the Contractor that for economic reasons it is impossible for him to continue to meet his contractual obligations,

the Contractor shall be entitled to terminate his employment under the Contract by giving notice to the Employer, with a copy to the Engineer. Such termination shall take effect 14 days after the giving of the notice.

69.2 Removal of Contractor's Equipment

Upon the expiry of the 14 days' notice referred to in Sub-Clause 69.1, the Contractor shall, notwithstanding the provisions of Sub-Clause 54.1, with all reasonable dispatch, remove from the Site all Contractor's Equipment brought by him thereon.

69.3 Payment on Termination

In the event of such termination the Employer shall be under the same obligations to the Contractor in regard to payment as if the Contract had been terminated under the provisions of Clause 65, but, in addition to the payments specified in Sub-Clause 65.8, the Employer shall pay to the Contractor the amount of any lossor damage to the Contractor arising out of or in connection with or by consequence of such termination.

70.1 Increase or Decrease of Cost (not applicable)

Sub-Clause 70.1 is deleted in its entirety, and substituted with the following:

The amounts payable to the Contractor, pursuant to Sub-Clause 60.1, shall be adjusted in respect of the rise or fall in the cost of labor, materials, and other inputs to the Works, by applying to such amount the formula prescribed in this Sub-Clause.

(a) Other Changes in Cost (not applicable)

To the extent that full compensation for any rise or fall in costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall of costs.

(b) Adjustment Formula (not applicable)

The adjustment to the monthly statements in respect of changes in cost shall bedetermined from the following formula:-

$$Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{M\phi} + d\frac{En}{E\delta} + \ldots\ldots\ldots\ldots\ldots$$

Where:

Not Applicable

Pn is a price adjustment factor to be applied to the amount for the payment of the work carried out in the subject month, determined in accordance with Paragraph
60.1 (a), and with Paragraphs 60.1 (b) and (e), where any variations and day workare not otherwise subject to adjustment;

A is a constant, specified in Appendix-C to Bid, representing the nonadjustable portion in contractual payments;

b, c, d, etc., are weightages or coefficients representing the estimated proportionof each cost element (labor, cement and reinforcing steel etc.) in the Works or Sections thereof, net of Provisional Sums and Prime Cost; the sum of A, b, c, d, etc., shall be one;

Ln, Mn, En, etc., are the current cost indices or reference prices of the cost elements for month "n", determined pursuant to Sub-Clause 70.1(d), applicable to each cost element; and
Lo, Mo, Eo, etc., are the base cost indices or reference prices corresponding to theabove cost elements at the date specified in Sub-Clause 70.1(d).

(c) Sources of Indices and Weightages

The sources of indices shall be those listed in Appendix-C to Bid, as approved by the Engineer. As the proposed basis for price adjustment, the Contractor shall have submitted with his bid the tabulation of Weightages and Source of Indices if different than those given in Appendix-C to Bid, which shall be subject to approvalby the Engineer.

(d) Base, Current, and Provisional Indices

The base cost indices or prices shall be those prevailing on the day 28 days prior tothe latest date for submission of bids. Current indices or prices shall be those prevailing on the day 28 days prior to the last day of the period to which a particular monthly statement is related. If at any time the current indices are not available, Provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

(e) Adjustment after Completion

If the Contractor fails to complete the Works within the Time for Completion prescribed under Clause 43, adjustment of prices thereafter until the date of completion of the Works shall be made using either the indices or prices relating tothe prescribed time for completion, or the current indices or prices, whichever is more favorable to the Employer, provided that if an extension of time is granted pursuant to Clause 44, the above provision shall apply only to adjustments made after the expiry of such extension of time.

Not Applicable

(f) Weightages

The weightages for each of the factors of cost given in Appendix-C to Bid shall be adjusted if, in the opinion of the Engineer, they have been rendered unreasonable, unbalanced, or inapplicable as a result of varied or additional work executed or instructed under Clause 51. Such adjustment(s) shall have to be agreed in the variation order.

The following Sub-Clauses 73.1, 73.2, 74.1, 75.1, 76.1, 77.1and 78.1 are added:

72.1 Rates of Exchange

Where the Contract provides for payment in whole or in part to be made to the Contractor in foreign currency or currencies, such payment shall not be subject to

variations in the rate or rates of exchange between such specified foreign currency or currencies and the currency of the country in which the Works are to be executed.

72.2 Currency Proportions

Where the Employer has required the Tender to be expressed in a single currencybut with payment to be made in more than one currency and the Contractor has stated the proportions or amounts of other currency or currencies in which he requires payment to be made, the rate or rates of exchange applicable for calculating the payment of such proportions or amounts shall, unless otherwise stated in Part II of these Conditions, be those prevailing, as determined by the Central Bank of the country in which the Works are to be executed, on the date28 days prior to the latest date for the submission of tenders for the Contract, as has been notified to the Contractor by the Employer prior to the submission of tenders or as provided for in the Tender.

72.3 Currencies of Payment for Provisional Sums

Where the Contract provides for payment in more than one currency, the proportions or amounts to be paid in foreign currencies in respect of Provisional Sums shall be determined in accordance with the principles set forth in Sub- Clauses 72.1 and 72.2 as and when these sums are utilized in whole or in part in accordance with the provisions of Clauses 58 and 59.

73.1 Payment of Income Tax

The Contractor, Subcontractors and their employees shall be responsible for paymentof all their income tax, super tax 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.

73.2 Customs Duty & Taxes

(Employer may incorporate provisions where applicable)

74.1 Integrity Pact

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 Employer 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 Employer 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 63.1 to 63.4 and the payment under Sub-Clause 63.3 shall be made after having deducted the amounts due to the Employer under Sub-Para (a) and

(d) Of this Sub-Clause.

75.1 Termination of Contract for Employer's Convenience

The Employer shall be entitled to terminate the Contract at any time for the Employer's convenience after giving 56 days prior notice to the Contractor, with a copy to the Engineer. In the event of such termination, the Contractor:

(a) shall proceed as provided in Sub-Clause 65.7 hereof; and

(b) shall be paid by the Employer as provided in Sub-Clause 65.8 hereof.

76.1 Liability of Contractor

The Contractor or his Subcontractors or assigns shall follow strictly, all relevant labor laws including the Workmen's Compensation Act and the Employer shall be fully indemnified for all claims, damages etc. arising out of any dispute between the Contractor, his Subcontractors or assigns and the labour employed by them.

77.1 Joint and Several Liability (not Applicable)

If the Contractor is a joint venture of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfilment of the terms of the Contract and shall designate one of such persons to act as leader with authority to bind the joint venture. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer.

78.1 Details to be Confidential

The Contractor shall treat the details of the Contract as private and confidential, save in so far as may be necessary for the purposes thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the prior consent in writing of the Employer or the Engineer. If anydispute arises as to the necessity of any publication or disclosure for the purpose of the Contract, the same shall be referred to the decision of the Engineer whose award shall be final.

79 OWNER's Rights

OWNER shall have power to adopt any of the following (or all courses as they may deem best suited to the interest of OWNER:

79.1 Rescission of CONTRACT; Forfeiture of Security Retention To rescind the CONTRACT (to which rescission, notice in writing to the CONTRACTOR under the hand of OWNER shall be conclusive evidence) and in which case the Security Retention of CONTRACTOR shall stand forfeited, and be absolutely at the disposal of OWNER.

79.2 WORK by OWNER; To employ labour paid by OWNER and to supply materials to carry out the WORK, or any part of the WORK debiting CONTRACTOR with the cost of the labour and the price of materials (of the amount of which cost and price, a Certificate of OWNER and/or CONSULTANT shall be final and conclusive against the CONTRACTOR in all under the terms of his CONTRACT The Certificate of the respect as if it had been carried out by the CONTRACTOR. OWNER as to the value of the WORK done shall be final and conclusive against the CONTRACTOR.

79.2 WORK by Others; To measure up the WORK of the CONTRACTOR and to take such part there of as shall be unexecuted out of his hands, and to give it to another Contractor to complete, in which case any expenses which may the sum which would have CONTRACTOR if the whole would have been executed by him (of the amount of which excess the Certificate in writing of the ARCHITECT and/or OWNER shall be final and conclusive) shall be bone and paid by the CONTRACTOR and may be deducted from any money due to him by OWNER under the CONTRACT otherwise, or from his Security Retention or the proceeds of sale thereof or a sufficient part thereof. In the event of any of the above courses being adopted by OWNER, CONTRACTOR shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any material, or entered into engagements, or made by advances on account of, or with view to the execution of the WORK or the performance of the CONTRACT, and in case the CONTRACT shall be rescinded under the provision aforesaid, CONTRACTOR shall not be entitled to recover or to be paid any sum for any WORK thereto or actually performed under this CONTRACT unless and until ARCHITECT and/or OWNER will have certified in writing the performance of such WORK and the value payable in respect thereof, CONTRACTOR shall only be entitled to be paid the value so certified on the completion of "Period of Maintenance".

79.3 Non-exercise by OWNER of his Rights; In any case in which any of the powers conferred upon OWNER by Clause 3.11.2 thereof shall have become exercisable and the same shall not be exercised, the non-exercise thereof shall not constitute a wave of any of the conditions thereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the CONTRACTOR for which by any Clause or Clauses hereof he is declared to pay compensation amounting to the whole of his Security Retention, and the liability of the CONTRACTOR for past and future compensation shall remain unaffected.

PART II –PARTICULAR CONDITIONS OF CONTRACT

Index	Clause
Alcoholic Liquor or Drugs	34.8
Arbitration	67.3
Arms and Ammunition	34.9
As-Built Drawings	6.7
Bonus for Early Completion of Works	47.3
Cash Flow Estimate to be Submitted	14.3
Commencement of Works	41.1
Compliance by Sub-Contractors	34.12
Conditions of Hire of Contractor's Equipment	54.5
Contractor's Representative	15.3
Co-operation with Other Contractors	31.3
Customs Clearance	54.3
Customs Duty and Taxes	73.2
Default of Contractor	63.1
Definitions	1.1
Detailed Programme and Monthly Progress Report	14.5
Details to be Confidential	78.1
Disorderly Conduct	34.11
Employer's Risks	20.4
Employment of Local Personnel	16.4
Employment of Persons in the Service of Others	34.3
Engineer Not Liable	2.7
Engineer's Duties and Authority	2.1
Engineer's Representative	2.2
Epidemics	34.6
Exclusions	21.4
Failure to Comply	53.4
Festivals and Religious Customs	34.10
Financial Assistance to Contractor	60.11
Health and Safety	34.5
Housing for Labor	34.4
Increase or Decrease of Cost	70.1
Instructions for Variations	51.2
Insurance of Works and Contractor's Equipment	21.1
Insurance Company	25.5
Integrity Pact	74.1
Joint and Several Liability	77.1
Language Ability of Contractor's Representative	15.2
Language Ability of Superintending Staff of Contractor	16.3
Language(s) and Law	5.1
Liability of Contractor	76.1

Index	Clause
Lighting Work at Night	19.4
Monthly Payments	60.2
Monthly Statements	60.1
Notice to Contractor	68.1
Notice to Employer and Engineer	68.2
Payment of Income Tax	73.1
Payments of Nominated Subcontractors	59.4
Performance Security	10.1
Performance Security Binding on Variation and Changes	10.4
Priority of Contract Documents	5.2
Programme to be Submitted	14.1
Rates of Wages and Conditions of Labor	34.2
Records of Safety and Health	35.2
Replacement of the Engineer	2.8
Reporting of Accidents	35.3
Safety Precautions	19.3
Secured Advance on Materials	60.11
Shop Drawings	6.6
Special Risks	65.2
Supply of Water	34.7
Taking Over of Sections or Parts	48.2
Termination of Contract for Employer's Convenience	75.1
Time for Payment	60.10
Use of Pakistani Materials and Services	36.6
Valuation of Variations	52.1

AROR UNIVERSITY OF ART, ARCHITECTURE DESIGN AND HERITAGE SUKKUR			
Summary Cost for the Construction of Boys Hostel (Remaining Work)			
Sr. #	**Description**	**Amount (Rs.)**	
(A)	**Civil Works**		
i	Civil Works	Rs.	
ii	Plinth Protection	Rs.	
	Grand Total (A)	**Rs.**	
(B)	**Plumbing Works**		
i	Plumbing Works	Rs.	
ii	Drainage Work	Rs.	
	Grand Total (B)	**Rs.**	
(C)	**Electrical Work Internal**		
i	Electrical Works	Rs.	
	Total (C)	**Rs.**	
	Grand Total (A+B+C)	**Rs.**	

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work of BOYS HOSTEL (NSI)					
S.No	**DESCRIPTION**	**UNIT**	**Quantity**	**RATE(RS)**	**AMOUNT(RS)**
Item-01	**LEAN 1:4:8**				
	Provide and lay lean concrete 1:4:8 nominal mix ratio under capping beam having minimum cylinder strength F'c=1000Psi at 28 day using ordinary portland cement ,water cement ratio not to exceed 0.55.	P.CFT	100.00		
Item-02	**CEMENT CONCRETE JALI**				
	Providing and fixing ornamental cementjali 3" thick (1:2:4) with nominal steel.	per sft	2,000.00		
Item-03	**Brick Masonry**				
	Providing and laying approved first class burnt brick masonry in super structure walls at any height and any floor, laid and jointed with cement and approved Providing and laying brick masonry from Rahimyar Khan / Gomal /SPL (Special) or approved equv. Ratio 1:4 complete in all respect and directed by the Engineer				
i.	**Ground Floor**				
	Cement Sand Mortar 1:6	cft.	761.96		
ii.	**First Floor**				
	Cement Sand Mortar 1:6	cft.	6,273.08		
ii.	**Second Floor**				
	Cement Sand Mortar 1:6	cft.	1,493.56		
iii.	**Third Floor**				
	Cement Sand Mortar 1:6	cft.	8,812.00		
iv.	**Mumty Floor**				
	Cement Sand Mortar 1:6	cft.	2,528.41		
Item-04	**Plastering,**				
	Providing and laying plaster 3/8' & 1/2" thick for walls as per Specifications, in single coats, with ratio 1:4 i/c making groves or cement pattas where required as directed in charge engineer 2				
	Internal & external walls/columns plaster 3/8" thick in 1:5 CSM				
	a) Ground Floor	P-sft	38,981.00		
	b) First Floor	P-sft	39,609.00		
	c) Second floor	P-sft	35,911.00		
	d) Third floor	P-sft	43,491.00		
	Internal & externaI walls/columns plaster 1/2" thick in 1:4 CSM				
	a) Ground Floor	P-sft	34,284.00		
	b) First Floor	P-sft	34,912.00		
	c) Second floor	P-sft	10,319.00		
	d) Third floor	P-sft	43,490.00		
	e) mumty	P-sft	3,592.00		
Item-5	**Matt Enamel**				
	Providing and applying matt enamel paint of (ICI,Berger, Dulux or equivalent) and shade on wall/ceiling surfaces, including surface preparation (scraping, cleaning, sanding, filling cracks/undulations with approved filler/putty, primer/sealer coat where required) and applying three (03) uniform coats with brush/roller/spray, complete in all respects as per specifications and directions of the Engineer In-Charge (ceiling & wall for all floors)	P-sft	9,300.00		
Item-5a	**Internal Paint (Emulsion)**				

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work of BOYS HOSTEL (NSI)					
S.No	**DESCRIPTION**	**UNIT**	**Quantity**	**RATE(RS)**	**AMOUNT(RS)**
	Preparing the surfaceand painting with matt finish i/c rubbing the surface with Bathy(Silicon carbide rubbingbrick) filling the voide with zink/chalk/plaster of Paris mixture applying first coat premix, making the surface smooth and then painting 3 coat with matt finish of approved make etc. complete (new surface)				
	a) Walls	P-sft	80,500.00		
	b) Ceilling	P-sft	39,000.00		
Item-6	**Weather shield**				
	Providing and applying Weather Shield Paint of approved brand (ICI, Berger, or Equivalent) and shade on external wall surfaces, including complete surface preparation (scraping, cleaning, wire brushing, removal of loose material, filling cracks/undulations with exterior putty, application of exterior primer/sealer coat where required) and applying three (03) uniform coats of Weather Shield Paint with brush/roller/spray, complete in all respects as per manufacturer's specifications and directions of the Engineer In-Charge.	P-sft	39,625.38		
Item-7	**CC Topping 3" thick Oer Roof**				
	Cement concrete (1:2:4) 3" thick over roof including surface finishing and dividing into panels and skyfolding etc : etc complete as directed by engineer.	sft.	10,162.00		
Item-8	**Polythene Sheet**				
	Providing and laying Polythene Sheet of approved quality and thickness (minimum 500 gauge / 125 micron or as specified), laid over the prepared surface for damp proofing / curing / protection purposes, including cutting, jointing, overlapping, and sealing with adhesive tape where required, complete in all respects as per specifications and directions of the Engineer In-Charge.	each	11,178.20		
Item-9	**Two coats of Bitumen**				
	Providing and applying two (02) coats of hot bitumen (Grade 60/70 or as specified) at the rate of 34 lbs/ %Sft over the prepared topping surface, including cleaning, heating, spreading uniformly with brushes/sprayers, complete in all respects as per specifications and directions of the Engineer In-Charge	P-Sft	8,000.00		
Item-10	**<u>RCC 1:1/2:3 4000 psi cylindrical strength</u>**				
	Providing laying and compacting with vibrator Design mix concrete having minimum characteristics cylinder Strength fc'=4000psi at 28 days.including the cost of any plasticizer/admixture used to achieve the required strength. Water cement ratio should not exceed 0.45 Using ORDINARY PORTLAND cement OPC including steel formwork or equivalent of material with even and smooth surface including screening and washing of stone aggregate.				
	i) Ground Floor				
	a) Columns	P-Cft	76.33		
	ii) First Floor				
	a) Columns	P-Cft	327.00		
	iii) Second Floor+ third floor				
	a) Columns	P-Cft	202.00		
	iv) Third				
	a) Columns	P-Cft	1,483.31		
	v) Mumty				

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work of BOYS HOSTEL (NSI)					
S.No	**DESCRIPTION**	**UNIT**	**Quantity**	**RATE(RS)**	**AMOUNT(RS)**
	a) Columns	P-Cft	381.87		
	iv) OHT				
	a) Columns+slab+wall	P-Cft	691.10		
Item-11	**RCC 1:2:4 3000 psi cylindrical strength**				
	Providing laying and compacting with vibrator Design mix concrete having minimum characteristics cylinder Strength fc'=3000psi at 28 days.including the cost of any plasticizer/admixture used to achieve the required strength. Water cement ratio should not exceed 0.5 Using ORDINARY PORTLAND cement OPC including formwork of material with even and smooth surface.				
	i) Ground Floor	P-Cft	5,389.00		
	ii) First Floor	P-Cft	6,085.00		
	iii) Second Floor	P-Cft	6,636.00		
	iv) Third Floor	P-Cft	10,632.00		
	v) Third Floor Parapit	P-Cft	1,215.00		
Item-12	**Water Spout**				
	GI Pipe 4" dia or equivalent Fixing water spouts or parnal as directed by engineer	each	50.00		
Item-13	**STEEL REINFORCEMENT**				
	Fixing and Providing cutting, bending, binding in position with approved annealed binding wire of 16 SWG grade 60 bars conforming to ASTM A615 grade 60 cold drawn / hot rolled at all heights and depths above & below plinth level as specified including the cost of cover blocks and all materials and labour complete (the cost of preparation of bar bending schedule and supplying three copies of the schedule, binding wire, chairs and separators shall be included in the rate and will not be paid as an extra.				
	i) Ground Floor				
	a) Grade 60	P-Ton	28.55		
	ii) First Floor				
	a) Grade 60	P-Ton	30.65		
	iii) 2nd Floor				
	a) Grade 60	P-Ton	20.90		
	iv) 3rd Floor				
	a) Grade 60	P-Ton	30.60		
	V)OHT				
	a) Grade 60	P-Ton	2.39		
	VI) Mumty				
	a) Grade 60	P-Ton	7.09		
Item-14	**C.I MAN HOLE COVER AND FRAME**				
	Providing and fixing C.I Manhole Cover with frame i/c cost of material.	CWT	4.00		
Item-15	**Porcelain Glazed Tile for Toilet & Kitchen:-**				
	Provide and lay porcelain Tiles (Matt or Glazed) of SHABBIR/MASTER approved quality 30cm x 60cm in slope, if required, with 1:4 cement sand mortar of required thickness to achieve a minimum overall finished floor thickness of 2", setting the tiles with neat cement mortar, grouting the joints 1/4" with matching grout of approved supplier, curing, cleaning, finishing & hacking/chipping of existing surface for bonding where necessary, etc. complete in all respect. (Base Price Rs.2500/= Sq.m)				
	Wall and Floor Finishes	P-Sft	15,144.00		
Item-16	**DOORS WOOD WORK :-**				

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work of BOYS HOSTEL (NSI)					
S.No	**DESCRIPTION**	**UNIT**	**Quantity**	**RATE(RS)**	**AMOUNT(RS)**
	Providing and Fixing Wooden doors consisting of GI frame with size 7"x2" or 4-1/2"x3" or equivalent size 16 gauge sheet, 40mm thick 100% solid soft wood core free design door, 1.0mm thick mahogany veneer pressed on 4mm thick MDF on both side with grooves, 6mm thick solid beach wood edging all around, 50 x 12 mm thick solid beach wood Architrave and 30 x 10mm thick solid beach wood gola with PU Lacquered finish polish, including all accessories and hardware to include hinges and pivots, security locks, flush bolts, handles etc. complete in all respect as per drawings, specifications, as per approved sample and instructions of Architect / Site Engineer. (Basic Rate of Lock Rs.2000/ each)	P-Sft	4,424.00		
Item-17	**Almunium Sliding Windows Deluxe Model (Bronze)** Providing and Fixing Aluminum Windows Champagne Anodized using 2.0 mm thk Deluxe box sections with 5mm Tinted Imported Glass including all best quality standards Hardware, coacking, silicon filling, wastage, Scaffolding and accessories etc. Complete in all respect as per Drawings, specifications Aluminum fly screen I/c handles stoppers & locking arrangement etc. completeand instructions of Architect / Site Engineer.	P-Sft	2,975.00		
Item-18	**Almunium Doors** Supplying & fixing in position Aluminum channels of 2.0 mm framing for hinged doors or made with 5 mm thick tinted glass glazing (Belgium) and Alpha (Japan) locks I/c handles, stoppers etc. a) Deluxe Model (Bronze)	P-Sft	250.00		
Item-19	**MAIN STAIR CASE RAILING:** Providing, making & fixing Stair case stainless steel railing 3 feet in height consisting of 2-1/2"or 2" dia 16 swg hand rail pipe, 2" ot 1-1/2"dia stainless steel 16 swg blaster welded with stainless steel base plate and fixed with concrete by 4 Nos Expansion bolts at 3'-0" C/C including 3 Nos 3/4" dia diagonal S.S. pipes as shown in drawings, complete as per drawing and as directed by the Engineer.	Rft	384.00		
Item-20	**Collapsible gate** Providing and fixing 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"x1", 1/8" along with roller also i/c locking arrangement and fixing in floor/ceiling or wall etc., completed.	sft	200.00		
Item-21	**Iron grill** Providing and fixing iron grill using solid square bars size 1/2" x 1/2" placed 4" c/c and frame of flat iron Patti of 3/4" x 1/4" i/c circle shape at 1'-0" apart fitted with screws and pin i/c painting 3 coats with coat of red oxide paint etc.	sft.	3,915.00		
Item-22	**Granite on Steps** Providing and laying Black Graenite (without streak) colour detail shown on the drawing counters / stair steps steps including landing and risers set over and including average 1" thick (1:3) CSM with cement slurry and grouting the joint with neat white cement mixed with colour pigment to match the marble colour including curing,grinding and chemical polishing etc, complete i/c cc toping under the marble as per specifications,drawings and as directed by the Engineer. **A) Stairs** On Treads with bull nozing 3/4" thick bull nozed size 6'x12" to 15" or size 4'x12" to 15"	sft.	4,368.00		
	B) Risers & skirting Marble skirting ½" think, 6" high	sft.	2,000.00		
Item-23	**Marble Flooring** **Flooring & Skirting**				

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work of BOYS HOSTEL (NSI)					
S.No	**DESCRIPTION**	**UNIT**	**Quantity**	**RATE(RS)**	**AMOUNT(RS)**
	Providing and laying **White Marble** of approved quality, shade, and thickness 3/4" , machine-cut and mirror polished, laid on a 1" thick cement-sand (1:4) mortar bed including neat cement slurry for proper bonding, joints filled with white cement mixed with matching pigment, curing, rubbing, grinding, polishing, and finishing to a smooth and even surface, complete in all respects as per specifications and directions of the Engineer In-Charge.	sft.	25,824.00		
				TOTAL	

ARORA UNIVERSITY OF ART, ARCHITECTURE DESIGN AND HERITAGE SUKKUR

Remaining Work of BOYS HOSTEL

PLINTH PROTECTION

Samples of all materials to be used should be got approved and concrete mixes designed prior to the execution of works. Material strengths as indicated in drawings & B.O.Q for both steel and concrete should be strictly adhered with by frequent testing.

S.No	DESCRIPTION	UNIT	QTY.	RATE(RS)	AMOUNT(RS)
Item-01	**EXCAVATION FOR FOUNDATION**				
	i)Excation in hord rock requiring blasting but blosting is prohibaited and disposal of excavated material, blasted material up to 50 ft lead , including dressing and leveling to designed section etc complete .	P-Cft	2,681		
Item-02	i) Filling, watering and ramming earth in floor with surplus earth from foundation lead upto one chain and lift upto 5 ft.with Surplus earth from foundation etc	P-Cft	1,788		
Item-03	**Sand Filling**				
	Filling, watering and ramming earth in floor with new earth/sand excavated from out side lead upto 10 mile and lift upto 5 ft i/c cost earth	P-Cft	15,000		
Item-04	**LEAN 1:4:8**				
	Provide and lay lean concrete 1:4:8 nominal mix ratio under capping beam having minimum cylinder strength F'c=1000Psi at 28 day using ordinary portland cement ,water cement ratio not to exceed 0.55.	P-Cft	1,297		
Item-05	**LEAN 1:3:6**				
	Provide and lay lean concrete 1:3:6 nominal mix ratio under capping beam having minimum cylinder strength F'c=1000Psi at 28 day using ordinary portland cement ,water cement ratio not to exceed 0.55.with form asdirected engineer	P-Cft	2,300		
	CC Topping 2" thick				
Item-06	Cement concrete (1:2:4) 2" thick over roof including surface finishing and dividing into panels and skyfolding etc : etc complete as directed by engineer.	P-Sft	5,520		
				TOTAL (Rs.)	**0**

AROR UNIVERSITY OF ART, ARCHITECTURE DESIGN AND HERITAGE SUKKUR					
Remaining Plumbing Work of Boys Hostel					
S. No.	**DESCRIPTION**	**QTY.**	**UNIT**	**RATE (Rs.)**	**AMOUNT (Rs.)**
A	**PLUMBING WORKS**				
1	Providing and fixing squatting type white glazed earthen ware W.C. pan with front flush inlet & complete with including the cost of flushing cistern with internal fitting and flush pipe with bend and making requisite number of holes in walls, plinth & floor for pipe connection & making good in cement concrete 1:2:4.(23 inch) earthen ware trap and plasic thumble etc complete as directed by engineer	25	Each		
2	Providing and fixing European type white glazed earthen ware wash down W.C. pan complete with & including the cost of white / black plastic seat (Best quality) and lid with C.P. brass hinges best quality and buffers 3 gallons white glazed earthen ware low level flushing cistem with siphon fitting 1½ " dia white porcelain enameled flush bend dia and making requisite number of holes in walls,plinth & floor for pipe connection & making good in cement concrete 1:2:4 Porta or Equivalent as directed by engineer	18	Each		
3	Providing and fixing 24x18" lavatory basin in white glazed carthen ware complete with &e including the cost of W.I. or C.I. cantilever bracket 6 inches built into wall, painted white in two coats after a primary coat of red lead paint, a pair of ½" dia chrome plated pillar taps, 1-1/2" rubber plug & chrome plated 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 & making good in cement concrete 1:2:4 (Standard Pattern) (Karam Ceramics or Equivalent).	51	Each		
4	Providing and fixing steel sinks stainless local bt make complete with cast iron or wrought iron LINA ALVH brackets 6 inches built into wall, 1- 1/2" rubber plug and chrome plated brass chain 1- 1/2" C.P. brass waste wvith 1-1/2" P.V.C. waste pipe & making requisite number of holes in walls, plinth & floor for pipe connection & making good in cement concrete 1:2:4.as directed by engineer				
b)	Steel Sink stainless size 36''x18'' local make (standard patteren)	5	Each		
5	Providing and fixing c.p. brass toilet paper holder of standard size with chrome plated brass brackets complete (superior quality)	43	Each		
6	Providing & fixing 24" x 18" bavelled edge mirror of Belgium glass complete with 1/8" thick hardboard and c.p brass screw fixed to wooden pleat with glass shelves.b) Standard quality	51	Each		
7	Providing & fixing soap tray earthen with c.p. brass screws etc. complete.	86	Each		

AROR UNIVERSITY OF ART, ARCHITECTURE DESIGN AND HERITAGE SUKKUR					
Remaining Plumbing Work of Boys Hostel					
S. No.	**DESCRIPTION**	**QTY.**	**UNIT**	**RATE (Rs.)**	**AMOUNT (Rs.)**
8	Supplying & fixing in position 1/2" dia. C.P. bib cocks standard pattern..	90	Each		
9	Supplying & fixing in position 1/2" dia tee stop of superior quality with C.P. head .	145	Each		
10	Supplying and fixing of CP Muslim shower with double bib cock and ring pipe etc complete. .	83	Each		
11	Providing and fixing of swan neck piller cock of superior quality single C.P. Head Dia 1/2 inch,	91	Each		
12	Supplying and fixing of Wash Basin Mixer of superior quality with C.P. Heads etc. !/2 inch dia.	56	Each		
13	Providing and fixing of Sink mixer of superior qualitywith C.P. headsc. 1/2 inch dia.	5	Each		
14	Supply and fixing of jet showers with rod, superior quality, C. P. Heads dia 1/2 inches etc. complete.	40	Each		
15	Supplying and fixing of Bath mixer of superior quality, with Heads of approved quality.	93	Each		
16	Supplying and fixing of bath room accessories (7) piece ic Towel Rod, Brush holder, Soap Tray, Shelf of approved design is cost of Screw, nuts and etc complete, (Master Brand). In Guests Room & Parents Room.	3	Each		
17	Providing & fixing 6"x2" or 6"x3" Floor trap of approved self cleaning design with a C.I. Screwed down grating with or without a vent arm complete with and i/c, making requisite No. of holes in walls, plinth and floor for making pipe connection and making good in cement concrete 1:2:4.	17	Each		
18	Providing & fixing Handle valves (China)				
	i) 1/2" Dia (For Dia 20mm PPRC Pipe)	2	Each		
	ii) 3/4" Dia (For Dia 25 mm PPRC Pipe)	4	Each		
	iii) 1" Dia (For Dia 32 mm PPRC Pipe)	25	Each		
	iv) 1-1/4" Dia (Dia 40mm for PPRC Pipe)	10	Each		
	v) 1-1/2" Dia (Dia 50 mm for PPRC Pie)	10	Each		
	vi) 2" Dia (For Dia 63mm PPRC Pipe)	22	Each		
	vii) 2-1/2 Dia, (For Dia 75mm PPRC Pipe) gate valve "Make Anwar"	6	Each		
19	Providing, supplying and fixing PPRC pipes (PN-20/PN-16, as specified) with fittings of approved make for hot and cold water supply, including specials (elbows, tees, reducers, unions, sockets, nipples, etc.), cutting, threading, jointing by fusion welding/heat fusion method with necessary clamps/supports, testing for leakage at required pressure, complete in all respects as per specifications and directions of the Engineer In-Charge.				
	i) 3/4 inch Dia	50	P.Rft.		
	ii) 1 inch Dia	322	P.Rft.		
	iii) 1-1/4 inch Dia	180	P.Rft.		
	iv) 1-1/2 inch Dia	180	P.Rft.		
	v) 2 inch Dia	452	P.Rft.		

AROR UNIVERSITY OF ART, ARCHITECTURE DESIGN AND HERITAGE SUKKUR					
Remaining Plumbing Work of Boys Hostel					
S. No.	**DESCRIPTION**	**QTY.**	**UNIT**	**RATE (Rs.)**	**AMOUNT (Rs.)**
	vi) 2-1/2 Inch Dia	125	P.Rft.		
	vii) 3 Inch Dia	0	P.Rft.		
	viii) 3 inch Dia (For Rain water disposal)	0	P.Rft.		
20	Providing, Laying UPVC Pressure Pipes of Class 'B' (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 61meter or 200 ft.				
	i) Dia 75 mm	300	Rft		
	ii) Dia 100 mm.	300	Rft		
				TOTAL	
b)	**Drainage Works**				
1	Excavation for pipe line in trenches, and pits in hard soils i/c trimming and dressing sides to true alignment and shape levelling of beds of trenches to correct level and grade, cutting joint holes and disposal of surplus earth within a one chain as directed by Engineer Incharge . Providing fence guards, lights, flags and temporary crossings for nonvehicular traffic where ever required.	150.00	cft		
2	Excavation for pipe line in trenches, and pits in gravely soils i/c trimming and dressing sides to true alignment and shape levelling of beds of trenches to correct level and grade, cutting joint holes and disposal of surplus earth within a one chain as directed by Engineer Incharge . Providing fence guards, lights, flags and temporary crossings for nonvehicular traffic where ever required..	2250.00	Cft		
3	Contructing small wheel valve chamber clear inside size 18" x 18" x 18" with walls of 9" thick of B.B in cement mortar 1:3 over 4" thick cement concrete 1:3:6 cement plastered 1/2" thick 1:3 inside i/c supplying & fixing C.I light weight manhole cover with frame and locking arrangement of 18" x 18" clear opening etc. complete	4	Each		
4	Providing, Laying UPVC Pressure Pipes of Class 'B' (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 61meter or 200 ft. (item D(1), page 110)				
	i) Dia 150 mm	205	Each		
	ii) Dia 200 mm.	165	Each		

AROR UNIVERSITY OF ART, ARCHITECTURE DESIGN AND HERITAGE SUKKUR					
Remaining Plumbing Work of Boys Hostel					
S. No.	**DESCRIPTION**	**QTY.**	**UNIT**	**RATE (Rs.)**	**AMOUNT (Rs.)**
5	Construction manhole or inspection chamber for the required dia of circular sewer of 3'-6" depth with walls of B.B. in cement mortar 1:3 and 1:3 cement plastered 1/2" thick inside of walls and 1" thick over benching and channels including fixing C.I. manhole cover with frame of clear opening 1-1/2" x 1-1/2" of 1.75 Cwt embedded in plain C.C. 1:2:4 and fixing 1" dia M.S. steps 6" wide projecting 4" from the face of wall at 1" C/C duly painted etc. complete as per specification and drawing No. D-P/1 of Public Health Circle, Southern Zone.				
	internal dia of Chamber 2'-0" x 2'-0"	30	Each		
6	Contructing small wheel valve chamber clear inside size 12" x 12" x 12" with walls of 9" thick of B.B in cement mortar 1:3 over 4" thick cement concrete 1:3:6 cement plastered 1/2" thick 1:3 inside i/c supplying & fixing C.I light weight manhole cover with frame and locking arrangement of 12" x 6" clear opening etc. complete. (Item 7, page 140	26	Each		
				TOTAL	

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR			
Summary Remaining Work Of Electrical Work at Boys Hostel			
S.No	**Section**	**Description**	**Amount**
1	Section-A	Wiring/Wiring Accessories	
2	Section-B	Main Cables	
3	Section-C	Cable Containment	
4	Section-D	Distribution Boards	
5	Section-E	Switches & sockets	
6	Section-F	Lighting Fixtures	
7	Section-G	Data Communication system	
8	Section-H	Earthling/Grounding System	
9	Section-I	As Built Drawings	
		TOTAL	**-**

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work Of Electrical Work at Boys Hostel					
S.#	**DESCRIPTION**	**UNIT**	**QTY.**	**RATE (RS.)**	**AMOUNT (RS.)**
	SECTION - A WIRING / WIRING ACCESSORIES				
	Supply, installation, testing & commissioning of following items including all material, tools, labor & accessories required for completion of work as per description & drawings. Complete in all respects. **(Cable : Pakistan Cables/equivalent)**				
1	**Circuit wiring** from **DB to switch board including any wiring from switch board to switch board** with 2x2.5 Sq.mm + ECC 1x2.5 Sq.mm 1-core PVC wires including any wiring between switch board to switch board in 25mm dia of PVC conduit.	No.	155		
a	**Wiring for light or fan point** from switch board to first light point with 1.5 Sq.mm, common neutral of 2.5 Sq.mm and common ECC of 2.5 Sq.mm + wires in 25mm dia of concealed PVC conduit including 100mmx100mm 16 SWG GI Back Boxes, as shown on drawings.	No.	600		
b	Same as above item but wiring from **point to point**.	No.	150		
2	**Wiring for Group Control light** fixtures From DB to first light point with 2x2.5 Sq.mm + ECC 1x2.5 Sq.mm in 25mm dia concealed PVC conduit including 100mmx100mm 16 SWG GI Back Boxes, as shown on drawings.	No.	8		
a	Same as above item but wiring from **point to point**.	No.	32		
3	**Wiring of 13A International Switch Socket** unit from **nearest light switch to first socket outlet** with following size of wires in 25mm dia of concealed PVC conduit as shown on drawings.				
a	2x2.5 Sq.mm + ECC 1x2.5 Sq.mm	No.	150		
4	Wiring of **13A International Switch Socket unit** from **DB to first socket outlet** with following size of wires in 25mm dia of concealed PVC conduit as shown on drawings.				
a	2x2.5 Sq.mm + ECC 1x2.5 Sq.mm	No.	150		
b	Same as above item but wiring from **outlet to outlet.**	No.	300		
5	**Wiring of 20A** DP Isolator (for ACs) from **DB to first outlet** with following size of wires in 25mm dia size of concealed PVC conduit as shown on drawings.				
a	2x4 Sq.mm + ECC 1x2.5 Sq.mm	No.	6		
	Note: **1)** Contractor is advised to confirm the cable running lengths and termination as per site conditions before commencement of work. **2)** The ECC to be run with each circuit shall be loop-in and loop-out type, joints are not allowed. **3)** All the cables shall be color coded according to phases / types of services.				
	TOTAL RS. SEC - A (CARRIED FORWARD TO SUMMARY)				-
	SECTION - B MAIN CABLES				
	Supply, installation, testing and commissioning of following size of cables for Distribution Board in already installed PVC conduit including all accessories, complete in all respect as shown on drawing. **(Pakistan Cables)**				

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work Of Electrical Work at Boys Hostel					
S.#	**DESCRIPTION**	**UNIT**	**QTY.**	**RATE (RS.)**	**AMOUNT (RS.)**
1	**From Power House to MDB** 4C, 95 Sq.mm Cu/XLPE/PVC + ECC 1C, 35 Sq.mm Cu/PVC	Rm.	65		
2	**From MDB to LPDB-GF-1** 4C, 25 Sq.mm Cu/XLPE/PVC + ECC 1C, 16 Sq.mm Cu/PVC	Rm.	20		
3	**From MDB to LPDB-GF-2** 4 No. 1C, 25 Sq.mm Cu/XLPE + ECC 1C, 16 Sq.mm Cu/PVC	Rm.	30		
4	**From MDB to LPDB-FF-1** 4C, 25 Sq.mm Cu/PVC/PVC + ECC 1C, 10 Sq.mm Cu/PVC	Rm.	25		
5	**From MDB to LPDB-FF-2** 4C, 25 Sq.mm Cu/PVC/PVC + ECC 1C, 10 Sq.mm Cu/PVC	Rm.	35		
6	**From MDB to LPDB-SF-1** 4C, 25 Sq.mm Cu/PVC/PVC + ECC 1C, 10 Sq.mm Cu/PVC	Rm.	35		
7	**From MDB to LPDB-SF-2** 4C, 25 Sq.mm Cu/PVC/PVC + ECC 1C, 10 Sq.mm Cu/PVC	Rm.	45		
8	**From MDB to LPDB-TF-1** 4C, 25 Sq.mm Cu/PVC/PVC + ECC 1C, 10 Sq.mm Cu/PVC	Rm.	45		
9	**From MDB to LPDB-TF-2** 4C, 25 Sq.mm Cu/PVC/PVC + ECC 1C, 10 Sq.mm Cu/PVC	Rm.	55		
	Note: **1)** Contractor is advised to confirm the cable running lengths and termination as per site conditions before commencement of work. **2)** Rain water drip protection is required for laying of cables from building service shaft to respective distribution boards. All the cable crossings through partition walls shall be properly sealed by fire retardant material after installation.				
				TOTAL RS. SEC - B	-
	SECTION - C CABLE CONTAINMENT				
1	**Supply and installation** of following size of **PVC / UPVC conduit** including all accessories such as junction box, bend, socket etc. Complete in all respect.				
a	25mm dia PVC Conduit	Rm.	80		
b	32mm dia PVC Conduit	Rm.	40		
c	38mm dia PVC Conduit	Rm.	45		
d	50mm dia PVC Conduit	Rm.	210		
e	100mm dia UPVC Conduit (Class-D)	Rm.	70		
				TOTAL RS. SECTION - C	-
	SECTION - D DISTRIBUTION BOARDS				
	Supply and installation of Distribution board made with 16 SWG sheet steel housing with approved color and having specified circuit breakers as shown on drawing. **Note:** Lighting Control Relays, Dimmers and Power Supply units shall be installed in with respective distribution boards as shown in single line diagrams.				

AROR UNIVERSITY OF ART, ARCHITECTURE, DESIGN AND HERITAGE SUKKUR					
Remaining Work Of Electrical Work at Boys Hostel					
S.#	**DESCRIPTION**	**UNIT**	**QTY.**	**RATE (RS.)**	**AMOUNT (RS.)**
1	MDB	No.	1		
2	LPDB-GF-1	No.	1		
3	LPDB-GF-2	No.	1		
4	LPDB-FF-1	No.	1		
5	LPDB-FF-2	No.	1		
6	LPDB-SF-1	No.	1		
7	LPDB-SF-2	No.	1		
8	LPDB-TF-1	No.	1		
9	LPDB-TF-2	No.	1		
				TOTAL RS. SEC - D	-
	SECTION - E SWITCHES & SOCKETS				
	Supply and installation of following **10 Amps, one-way gang type switches and 13/15 Amps socket outlets** MK /Clipsal make including back boxes, recessed on wall or column as per design drawings. **(Clipsal C-Vivace Series/ Orange / Pakistan Cable or equivalent)**				
1	10A, 220V One Gang Switch Unit	No.	45		
2	10A, 220V Two Gang Switch Unit	No.	75		
3	10A, 220V Three Gang Switch Unit	No.	310		
4	13A, International Switch Socket unit - Simplex	No.	350		
5	13A, 3-Pin International Duplex Switch Socket Unit	No.	130		
6	15A, 3-Pin Round Switch Socket Unit	No.	6		
7	20A DP Isolator Switch for indoor A/C 2 Ton unit	No.	6		
8	63A, 3-Pin Industrial Socket with plugtop for UPS	No.	2		
				TOTAL RS. SEC - E	-
	SECTION - F LIGHTING FIXTURES				
	Supply, installation, testing and commissioning of the following **lighting fixture** complete with all aspects (Phillips / equivalent with minimum 50,000 life)				
1	Surface Mounted 20W LED Down Light 6500K	No.	410		
2	Surface Mounted 15W LED Down Light 6500K	No.	110		
3	Weather Resisitant Bulk head 20W LED Light 6500K	No.			
4	Ceiling Fan 56" Dia - 30 W energy effiecient inverter type AC only inverter type with 5 year warranty (GFC/Pakfan/equivalent)	No.	140		
5	Wall Bracket Fan 18" Dia, inverter type	No.			
6	Exhaust Fan 12" Dia	No.	20		
				TOTAL RS. SEC - F	-
	SECTION - G DATA COMMUNICATION SYSTEM				
	Supply, installation, testing & commissioning of following items for Voice and Data Communication System in 1" dia pvc conduit including all material, labor, tools, accessories etc. Complete in all respects. Quantities for cables shown in BOQ are estimated and taken from drawings. Contractor is advised to take measurement at site before commencement of works. **Different colors of voice and data cables shall be used.** (Clipsal C-Vivace Series or equivalent)				
1	**Simplex Face plate** with **1 Gang CAT-6** RJ-45 I/O for Voice, white/off white finish, complete with shuttered click-ins, labels and all accessories including back box.	No.	20		

ARor University
of Art, Architecture,
Design & Heritage,
Sukkur, Sindh

Volume – III

Establishment of Aror University of Art, Architecture Design and Heritage, Sukkur (ADP NO 819/2025-26)

SPECIFICATION

FOR

"Construction of Boys Hostel – Remaining Works at Aror University of Art, Architecture Design and Heritage Sukkur"

SPECIFICATIONS FOR

CIVIL, ELECTRICAL & PLUMBING AND FIRE FIGHTING WORKS

Lead Consultant
NAQVI & SIDDIQUIE
Inc. Architects - Islamabad
Lower Ground, I&T Centre,
Plot # 61, Street # 14, Sector G-8/1, Islamabad.
Ph: 92-51-2289407-8
Email:
naqvisiddiquie@gmail.com
naqvisiddiquie@yahoo.com

JV Member
M/s Global Engineering Services.
H. No. NE 122/F, St.No.7
Chaman Zar Colony, Rawalpindi
Ph:5765514

Construction of Boys Hostel – Remaining Works at Aror University of Art, Architecture Design and Heritage Sukkur

SPECIFICATION – INDEX

DIVISION - 1 GENERAL REQUIREMENTS

01050 FIELD ENGINEERING
01091 REFERENCE STANDARDS
01300 SUBMITTALS
01400 QUALITY CONTROL
01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
01600 MATERIALS AND EQIPMENT
01700 PROJECT CLOSE-OUR REQUIREMENTS

DIVISION - 2 SITE CONSTRUCTION

02110 SITE CLEARING
02200 EARTHWORK
02204 BASE COURSE
02225 TRENCHING AND BACK FILLING
02285 TERMITE CONTROL
02515 PAVING AND SURFACING
02529 PRECAST CONCRETE CURBS AND WHEEL STOPPERS
02580 PAVEMENT MARKING
02900 LANDSCAPING

DIVISION - 3 CONCRETE

03100 CONCRETE FORMWORK
03200 CONCRETE REINFORCEMENT
03300 CAST-INPLACE CONCRETE
03450 ARCHITECTURAL PRECAST COCNRETE

DIVISION - 4 MASONRY

04150 SIDEWALKS, PATWAYS, DRIVEWAYS, ENTRANCES AND RAMPS
04200 UNIT MASONRY

DIVISION - 5 METALS

05500 METAL FABRICATION
05810 EXPANSION JOINT COVER ASSEMBLIES

DIVISION - 6 WOOD AND PLASTIC

06100 ROUGH CARPENTRY
06400 ARCHITECTURAL WOODWORK

DIVISION - 7 THERMAL AND MOISTURE PROTECTION

07100 WATER PROOFING
07150 DAMP PROOFING
07210 BUILDING INSULATION
07500 ROOFING
07900 SEALANTS

DIVISION - 8 DOORS AND WINDOWS

08100 HOLLOW METAL DOORS AND FRAMES
08120 ALUMINIUM DOORS AND FRAMES
08210 WOODEN DOORS AND FRAMES
08311 ALUMINUM SLIDING GLASS DOORS
08520 ALUMINUM WINDOWS
08710 DOOR HARDWARE
08800 GLAZING
08920 GLAZED ALUMINUM CURTAIN WALL

DIVISION - 9 FINISHES

09200 LATH AND PLASTER
09250 GYPSUM AND CEMENT BOARD
09310 CERAMIC TILES
09320 PORCELAIN TILES
09400 TERRAZZO TILES
09510 ACOUSTICAL CEILING
09660 TERRAZZO FLOORING
09900 PAINTING

DIVISION -10 SPECIALITIES

10615 DOMOUNTABLE PARTITION
10800 TOILET AND BATH ACCESSORIES

DIVISION - 11 EQUIPMENT

11010 MAINTENANCE EQUIPMENT

DIVISION -12 FURNISHING

12800 INTERIOR PLANTS AND PLANTERS

DIVISION - 13 HEALTH, SAFETY AND ENVIRONMENT

13529 HAZARDOUS MATERILS, HEALTH AND SAFEY
13543 ENVIRONMENTAL PROTECTIONS

DIVISION - 15 PEST CONTROL

15716 PEST CONTROL

DIVISION - 17 DEMOLITION WASTE MANAGEMENT

17419 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

****

DIVISION - 1

GENERAL REQUIREMENTS

SECTION 01050

FIELD ENGINEERING

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Administrative and procedural requirements for Field Engineering services, including, but not limited to land survey work and Civil, Architectural, Mechanical and Electrical Engineering Services.

1.02 QUALITY ASSURANCE

A. Contractor shall engage a qualified land surveyor(s) to perform the required land surveying services.

B. Contractor shall carry out a soil investigation. If any findings conflict with those assumed by the Designer, then foundations shall be adjusted accordingly.

C. Contractor shall engage a professional Engineer(s) to perform the required engineering services.

D. The engaged surveying and/or engineering team shall be approved by The Engineer.

2. PART 2 - PRODUCTS

(Not Used)

3. PART 3 - EXECUTION

3.01 EXAMINATION

A. 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.

1. 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.

2. 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.

3. 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.

B. Existing utilities and equipment:

1. 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.

2. 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.

3.02 PERFORMANCE

A. General:

1. 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.

B. Surveyor's Log:

1. Maintain a Surveyor's Log of control and other survey work. Surveyor's Log shall be made available for The Engineer reference.

2. 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.

C. Site Works:

1. Locate and lay out works, fill and topsoil placement, slopes and invert elevations by instrumentation and similar appropriate means.

2. 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.

END OF SECTION

SECTION 01091

REFERENCE STANDARDS

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. References and Standards that are referred to throughout the Contract Documents to establish the following:

1. Quality of a product.

2. Type of product and workmanship.

3. Methods for testing and reporting on the pertinent characteristics.

B. Where materials or workmanship are required by the Contract Documents to meet or exceed the specifically named code or standard, the Contractor shall be responsible to provide materials and workmanship which meet or exceed the specifically named code or standard.

C. Contractor shall be responsible, when required by Contract Documents, to deliver to the Engineer and/or Construction Manager documentation to prove that materials or workmanship, or both, meet or exceed the requirements of the specifically named code or standard. Such proof shall be in the form of a certified report of tests conducted by an approved testing agency.

D. Specific naming of the codes or standards occurs on the Drawings and through the Sections of Specifications.

1.03 QUALITY ASSURANCE

A. In procuring items used in this Work, the Contractor shall be responsible to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.

B. The Construction Manager reserves the right to reject items incorporated into the Work which fail to meet the specified minimum requirements.

C. Reference to recognized Codes and Standards shall be by the use of the abbreviations listed. Reference to Codes and Standards shall not be limited to the institutes listed herein:

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction

AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	American Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
AWI	American Welding Institute
AWPB	American Wood Preservative Bureau
AWS	American Welding Society
AWWA	American Water Works Association, Inc.
BHMA	Builders Hardware Manufacturers Association
BSI	British Standards Institution
CITT	International Telegraphic and Telephone Consultative Committee
CRSI	Concrete Reinforcing Steel Institute
DIN	Deutsches Institut fur Normung e. V.
EIA	Electronics Industries Association
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
IEC	International Electrotechnical Commission
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	National Association of Architectural Metal Manufacturers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association

PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
REA	Rural Electrification Administration
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association, Inc.
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.
UPC	Uniform Plumbing Code

References listed herein shall be deemed to include the latest edition or issue of such standards.

D. Whenever there is conflict between the Drawings and/or the Specifications and the Codes, the Contractor shall bring the conflict to the Construction Manager's attention. The Engineer and/or Construction Manager shall then decide which shall govern.

2. PART 2 – PRODUCTS (Not Used)

3. PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01300

SUBMITTALS

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Administrative and procedural requirements for the preparation of submittals required in the performance of Work, including construction schedules, submittal schedules, daily/monthly construction progress reports, shop drawings, product data and samples.

1.02 CONSTRUCTION SCHEDULE

A. Prepare a fully developed and cost loaded, horizontal bar chart type contractor's construction schedule. Submit schedule within 21 days of the date established for - Commencement of Work. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Coordinate Contractor's construction schedule with the schedule of values, list of subcontractors, submittal schedule, progress reports, payment requests and other schedules. Contractor's Construction Schedule shall be subject to approval of the Engineer.

B. Upon the request of the Engineer, Contractor shall submit a CPM schedule for the Engineer review and approval.

1.03 PROCUREMENT SCHEDULE

A. Prepare a fully developed horizontal bar chart type material arrival schedule. The procurement schedule shall identify the material's submittal, ordering and arrival dates. Coordinate the procurement schedule with construction activities, submittal schedule, payment requests and other schedules. Contractor's Procurement Schedule shall be subject to approval of the Engineer.

1.04 SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's construction schedule, Contractor shall prepare schedule of submittals. Submit schedule within 10 days of the date required for establishment of construction schedule.

Prepare schedule in chronological order, include submittals required during the first 90 days of construction including the necessary information (schedule dates for first submittal, for resubmittal, for the Engineer final release or approval and submittal category). Submittal Schedule shall be subject to approval of the Engineer.

1.05 PROGRESS REPORTS

A. Daily Construction Reports: Contractor shall prepare Daily Construction Reports utilizing the form approved by The Engineer. The Daily Construction Report shall include; date, duration of working hours, count of personnel at the site, machinery and equipment at the site, general weather conditions, work performed, deliveries of material and equipment; special events, visitors, and inspections. Daily Construction Report shall be submitted to the Engineer.

B. Monthly Work Progress Reports: At the end of each month or at such periods of time as may be requested by the Engineer, the Contractor shall submit a detailed Monthly Work Progress Report utilizing the format approved by the Engineer. Monthly Work Progress Reports shall be prepared in English and shall include a minimum of 25 photographs. Monthly Work Progress Report shall be submitted to the Engineer as one original and 4 copies.

1.06 SHOP DRAWINGS

A. General:

1. Shop Drawings shall be submitted as newly prepared information, drawn to accurate scale. Shop drawings shall be prepared using AutoCAD 14 or latest AutoCAD version (*.DWG Format). Shop Drawings shall be highlighted, clouded, or otherwise marked to indicate deviations from the Contract Documents. Contractor shall not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to Project will not be considered as Shop Drawings. Shop Drawings shall be submitted to the Engineer utilizing the Transmittal Form provided by The Engineer.

2. Shop Drawings shall include fabrication and installation drawings, setting-out diagrams, equipment or material schedules, patterns, templates and similar drawings.

   Shop Drawings shall include, but not limited to the following information:

   - Dimensions
   - Identification of products and materials included
   - Compliance with specified standards
   - Notation of coordination requirements
   - Notation of dimensions established by field measurement
   - Profiles and cross sections
   - Materials and finishes

B. Sheet Size: Except for templates, patterns and similar full-size drawings, shop drawings shall be submitted on sheets sized as agreed with the Engineer.

C. Initial Submittal: Submit 2 blue or black-line prints for the Engineer's review, the corrected one will be returned to the Contractor.

D. Final Submittal: Submit 3 blue or black-line prints and one reproducible; submit 5 prints where required for maintenance manuals. Two prints will be retained; the remainder will be returned. Do not use shop drawings without an appropriate final stamp indicating action taken in connection with construction.

E. Coordination Drawings: Coordination Drawings shall be submitted as required to eliminate potential conflicts in use of space. Coordination Drawings shall indicate the relationship and integration of different construction elements and/or pieces of equipment that require careful coordination during fabrication or installation to fit in the space provided.

1.07 PRODUCT DATA

A. General:

1. Collect Product Data into a single submittal for each element of construction or system. Product data shall include printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves, and operation and maintenance manuals. Where Product Data must be specifically prepared because standard printed data is not suitable for use, submit as **Shop Drawings**.

2. Each copy of Product Data shall be marked to indicate the applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information.

B. Alternative Products: Specified manufacturers, materials, or products are indicative of quality and standard required. Manufacturers and products, other than those which are specified, will be considered only if the Contractor identifies his proposed material or product substitutions and/or manufacturers' names at the time of tender. Differences, including variation in the cost and/or schedule improvements to affected work, between the Contractor's proposed substitution and that which is specified shall be provided. Details of equality and difference, item by item, shall be provided for each proposed substitute material, product, or manufacturer.

C. Submittals: Submit 2 copies of each required submittal, and 4 copies where required for maintenance manuals. The Engineer shall retain one copy, and return the other copies marked with action taken and corrections or modifications required. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

1.08 SAMPLES

A. Contractor shall submit samples, as specified or as otherwise directed by The Engineer for the review of kind, color, pattern and texture; for a final check of these characteristics and there compatibility with other elements; and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

B. Full-size, fully fabricated samples shaped and finished as specified and physically identical with the material or product proposed, shall be submitted to the Engineer. Samples shall include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

C. Samples shall be mounted, displayed, or packaged in the manner specified or as to facilitate review of the qualities indicated.

D. Refer to other Specification Sections for requirements for samples illustrating workmanship, fabrication, techniques, details of assembly, connections, operation and similar construction characteristics.

1.09 AS-BUILT DRAWINGS

A. During work progress and prior to acceptance of work, Contractor shall submit As-Built Drawings for the Engineer review and approval. Drawings shall be prepared using AutoCAD 14 or latest AutoCAD version (*.DWG Format).

B. Approved As-Built Drawings shall be submitted including two sets full size (A0) printed copies and two sets electronic copies on Compact Disk. Electronic copies shall be properly labeled.

C. As-Built Drawings shall be properly signed, dated and numbered.

2. PART 2 - PRODUCTS

(Not Used)

3. PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01400

QUALITY CONTROL

1. PART 1 - GENERAL

1.01 CONTRACTOR QUALITY CONTROL PROGRAM

A. Provide a comprehensive Quality Control Program to assure that engineering, construction, materials, equipment and workmanship under this Contract are in compliance with contract provisions, applicable laws, codes and standards, and sound engineering and construction practices, unless specifically instructed otherwise by the Engineer.

B. Quality Control program shall include, but not limited to, the following:

1. Provisions for review and certification by a responsible representative of engineering, design and technical submittals to The Engineer under the terms of the Contract.

2. Coordination of the Independent Testing Laboratory activities.

C. Prior to commencing work at Site, appoint Contractor Quality Control (CQC) Manager supplemented as necessary by additional quality control personnel, who shall be on site at all times during progress, with complete authority to take any action necessary to ensure compliance with contract. CQC Manager shall report directly to the Engineer. CQC Manager's responsibilities may delegated to the full-time Site Manager.

D. Employ an Independent Testing Laboratory acceptable to the Engineer for performing quality control testing (soils, concrete, precast concrete, steel structure, masonry, asphalt and welding). As a minimum, laboratory shall meet the Recommended Requirements for Independent Laboratory Qualifications, published by the American Council of Independent Laboratories, the basic requirements of ASTM E 329 - Standards of Recommended Practice and Testing Agencies for Concrete and Steel as used in Construction. Contractor (within 30 days of effective date of site hand over) shall submit name, address and qualifications of the proposed Independent Testing Laboratory along with evidence of authority to operate and qualifications of key laboratory personnel who will be responsible for the services for the Engineer’s review and approval.

1.02 CONTRACTOR QUALITY CONTROL PLAN

A. Provide 5 copies of the Quality Control Plan to the Engineer for approval within 30 calendar days after the effective date of Site Handover. Quality Control Plan shall detail the procedures, instructions, and reports to be used to assure compliance with quality provision of this Contract. Quality Plan shall also include CQC organization chart, names and qualifications of personnel in quality control organization.

B. Prior to submittal of Quality Control Plan for acceptance, Contractor shall meet with the Engineer and discuss quality control requirements. Quality system including forms to be used for recording the quality control operations, inspections, tests, approvals, certifications, administration of the system, The Engineer surveillance, and on site/off-site testing facilities shall be detailed during this meeting(s).

C. Unless specifically authorized by the Engineer, on-site constructions or off-site fabrication shall not start until the acceptance of the Quality Control Plan. Work will commence only after acceptance of the plan, or at least acceptance of that portion of the plan applicable to the specific feature of work.

1.03 WEEKLY REPORTS

A. CQC Manager shall submit weekly CQC reports to The Engineer identifying prime contractor and subcontractor(s) activities such as work accomplished, inspections and tests conducted, results of inspection and tests, nature of defects found, causes of rejection, and corrective actions taken together with the following certification:

'On behalf of Contractor, I certify that this report is complete and correct, and materials and equipment used, and work performed during this reporting period are in compliance with Drawings and Specifications to the best of my knowledge, except as noted above.'

This certification shall be signed for the Contractor, and by authorized CQC Manager.

1.04 WORK DEFICIENCIES AND CORRECTION

A. Contractor shall not build upon or conceal any work containing uncorrected defects. If deficiencies show that CQC Program is not adequate or does not produce desired results, corrective actions in both Contractor Quality Control Program and Work will be taken by Contractor. The Engineer may direct that changes be made in Contractor Quality Control Program or organization, including but not limited to, removal of unsatisfactory quality control representatives at any level.

1.05 CERTIFIED TEST REPORTS AND MANUFACTURER'S CERTIFICATES

A. Before delivery of materials and equipment, submit and approve by The Engineer certified copies of reports of tests as required by Technical Specifications Sections, Applicable Codes, and Standards on good engineering practice.

B. Unless the specific items provided were tested, test reports shall be accompanied by manufacturer certificates certifying that material and equipment proposed to be supplied is of the same type, quality, manufacturer, and as that tested.

C. Certifications shall be original, naming appropriate item of equipment or material, specification, standard, or other document specified as controlling quality of that item and shall have attached thereto certified copies of test data upon which certifications are based. Certificates shall be signed by manufacturer's official authorized to sign certificates of conformance or compliance.

1.06 AUDIT

A. Contractor Quality Control Plan implementation shall be subject to audit by The Engineer.

1.07 DUTIES OF INDEPENDENT TEST LABORATORY

A. Provide adequate and acceptable plant and calibrated equipment to perform the required testing service.

B. Develop qualified procedures for all required tests.

C. Perform specified sampling and testing of materials and methods of construction.

1. Comply with specified sampling and testing standards.

2. Ascertain compliance of materials with requirements of Contract Documents.

D. Promptly notify CQC of observed irregularities or deficiencies of work or products.

E. Maintain accurate and complete records of all tests performed and promptly submit the original and one copy of the certified test report to the Contractor, one copy to The Engineer and one copy to Owner. Test report shall include the following as a minimum:

- Date issued
- Project title and number
- Testing laboratory name, address and telephone number
- Name and signature of laboratory inspector
- Date and time of sampling or inspection
- Record of temperature and weather conditions
- Date of test
- Identification of product and specification section
- Location of sample or test in the Project
- Type of inspection or test
- Results of test and all test data in compliance with Contract Documents
- Interpretation of test results, when requested by Owner

F. Provide access to facilities and records to the Engineer and/or Owner and at reasonable times for the purpose of verifying qualifications of personnel, suitability of equipment, adequacy of methods, analysis of results and reporting methods.

G. Prior to final payment, provide a tabulation of tests performed in connection with the Construction Contract, including conforming, non-conforming, and repeated test results. Tabulation(s) shall be certified as complete, and signed by authorized representative of laboratory, and a copy shall be delivered to the Engineer.

2. PART 2 - PRODUCTS

(Not Used)

3. PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor shall provide, erect, install, maintain, alter as necessary, and remove on completion or when directed by the Engineer, temporary facilities and as described in Project Documents and/or specified herein.

1.02 TEMPORARY ROADS

A. Contractor shall prepare and maintain such temporary roads as may be necessary from the site to the nearest road and also within plot. Roads shall be positioned strictly in accordance with the Engineer instructions and the Contractor shall reduce or control any dust nuisance by spraying with water was directed.

B. Contractor shall satisfy himself as to the location and nature of the proposed access routes to 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.

1.03 TEMPORARY SERVICES

A. General:

1. Contractor shall make his own provisions with prior approval of the Engineer, or he shall perform necessary works required in conjunction with Project Documents.

2. Contractor shall bear costs related to installation, connection, maintenance and removal of all temporary services and consumption of water and electricity during the entire duration of Project.

B. Temporary Water:

1. Contractor shall supply in sufficient quantity all necessary potable and other water for construction purposes for other trades at a point within a reasonable distance from buildings being constructed. Contractor shall make arrangements and pay charges for water service installation, maintenance, and removal thereof, and pay cost of water for other trades.

2. When 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 assumes full responsibility for the entire water distribution system, and pays all cost of operation and maintenance of the system.

3. Temporary pipe lines and connections from the permanent service line, whether outside or within the building, but necessary for the use of the Contractor and his subcontractors, shall be installed, protected and maintained at the expense of the Contractor.

4. At completion of the work or at such time as the Contractor makes use of the permanent water supply installation, the temporary water service equipment and piping shall be removed by Contractor at his own expense.

C. Temporary Electricity:

1. Contractor shall make all necessary arrangements for a temporary electrical service, pay all expenses in connection with the installation, operation and removal thereof, and pay the costs of electricity consumed by all trades.

2. In event that site cannot be connected to a local electricity network or where the available power is insufficient, Contractor shall make his own temporary provision and maintain such temporary installation until permanent supply is available and pay for expenses related in connection with such process.

3. A temporary lighting system shall be furnished, installed and maintained by the Contractor as required to satisfy the minimum requirements for safety and security. 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.

4. 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 utilized so as not to constitute a hazard to persons or property.

5. When the permanent electrical power/lighting systems are in an operating condition, they may be used for temporary power and lighting for construction purposes, provided that Contractor obtains written approval of the Engineer and shall assume full responsibility for the entire power and lighting systems, and pays for operation and maintenance of the systems.

6. 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 at his own expense.

D. Waste Disposal:

1. Contractor shall make such temporary provisions as may be required in order to dispose of any chemicals, fuels, oils, greases, bituminous materials, waste and soil waste and the like without causing pollution to either the site or the environment.

2. Disposal of any materials, wastes, effluent, garbage, oil, grease, chemicals and the like shall be in areas specified by the concerned local authority or municipality proposed by Contractor and subject to approval of the Engineer.

3. If any waste material is dumped in unauthorized areas, Contractor shall remove material and restore areas to condition of adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed of as directed by the Engineer, and replaced with suitable fill material, compacted, and finished with topsoil at the expense of the Contractor.

E. Fire Protection:

1. 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 of extinguishing fire, 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 buildings. Torch-cutting and welding operations performed by Contractor shall have the approval of the Engineer before such work is started and a chemical extinguisher is to be available at location where such work is in progress. Contractor shall follow instructions and specifications of the Civil Defense Department.

F. Telephone and Fax:

1. Contractor shall immediately after receiving the Letter of Acceptance, install telephone system as mentioned in Clause 1.04 below including fax line for the Engineer. In case of non-availability of telephone lines through PTCL, the Contractor shall provide one mobile telephone for exclusive use of the Engineer.

2. Contractor shall be responsible for payment of installation charges and periodic billing for telephone and fax lines during construction period and up to substantial hand-over.

1.04 TEMPORARY ACCOMMODATION AND FACILITIES

A. General: Location, construction, operation, maintenance and removal of site offices, storage facilities and other temporary buildings of all persons or parties within perimeter of site, operating or associated as Sub-Contractors to Contractor shall be subject to approval of Engineer. Contractor shall submit to Engineer, prior to commencement of any temporary installations, plans showing proposed position of site offices, storage and buildings of temporary nature.

B. Habitable rooms shall be properly insulated, having dust-sealed windows with sun protection and insect screens, and shall be equipped with electric lights, air conditioning and/or mechanical ventilation, supporting facilities, hot and cold water, sewer and electrical facilities, and maintenance as required and to the satisfaction of Engineer.

C. Engineer's Site Office

1. Contractor shall provide and maintain for entire duration of Project such administrative and supporting facilities as required for the sole use of Engineer and his staff. Building(s) shall be pre-fabricated or conventionally constructed and all rooms shall be sufficiently dimensioned to include essential furnishings. Temporary offices shall be available for use not later than one month after date of site handing over.

2. The Engineer's/Employer’s site office shall consist of at least the following:

- 4+2 Offices: Minimum 12 m² floor area each
- 1 Conference Room: Minimum 20 m² floor area
- 1 Reception Area: Minimum 9 m² floor area

- 1 sample Room: Minimum 12 m² floor area
- 1 Storage: Minimum 9 m² floor area
- 1 Kitchen 6 m² floor area
- 2+1 Toilets/washroom to serve 20 persons

Rooms shall have minimum 2.45 m head. Construction shall be approved by the Engineer prior to erection. Contractor shall provide water, electricity, ACs, telephones, transport, drainage system and such supplies shall be continuously furnished throughout construction period. Contractor shall be responsible to provide adequate and sufficient services for Engineer and his representatives including messenger/office boys acceptable to Engineer/Employer on full time basis and shall keep the building in clean conditions. Contractor shall supply to the satisfaction of Engineer the necessary office equipment and furniture including telephone sets, fax machine, electrical typewriter, desk calculators, advanced photocopy machine, chairs, desks, tables, filing cabinets and other items as required.

3. Communication Facilities: Contractor shall provide each room with telephone connection. Telephone system shall be provided with a small PABX system with two outside lines and 4+2 extensions and the required number of telephone sets and a fax machine. Contractor to provide (4+2) walky-talky sets for Engineer/Employer's use with the supporting system to work within site limits. Installation shall be maintained in good order.

4. Contractor shall furnish all offices to the satisfaction of the Engineer, and supply offices with office supplies of adequate quantities as directed by Engineer during entire project duration.

5. Contractor shall provide computer network complete with a server, 6 PC's (minimum), LaserJet printer, A-4 size scanner and other required hardware and cabling. Latest Microsoft Windows based software shall be provided including AutoCAD, MS Office, MS Project, Lotus Notes and any other software required for the project.

D. Contractor's Facilities

1. Contractor shall, for his own use, furnish and maintain suitable offices, stores and auxiliary facilities on site. Contractor's office shall have computer network similar to Engineer's office, along with telephone services. He shall include for general use the following:

   a. Sanitary Facilities: Toilets shall be provided and maintained on site or as directed by Engineer. Toilets shall be individually partitioned and enclosures provided with lockable doors.

   b. First Aid Facilities: Contractor shall provide adequate first aid facilities for joint use of his staff and Engineer and his personnel. They shall be made available at no extra cost.

   c. Vehicle Parking: Contractor shall provide car park shade structure for 6 Engineer/Owner's cars and 2 spaces for visitors' cars. Parking shade structure shall be subject to approval of Engineer.

d. Sample Room: Contractor shall provide as directed by Engineer and near his offices a sample room with appropriate shelving for the storage of complete set of approved samples of Project. Contractor shall make the necessary modifications to the room as directed by the Engineer.

E. Labor Camps

1. A labor camp is not permitted on site.

2. Any labor camp or accommodation shall be provided for laborers off site and the Contractor shall be accountable and responsible for ensuring that labor laws are complied with, and security and conduct of such men are lawful.

F. Temporary Signboards:

1. Contractor shall provide, erect and maintain on suitable supports at entrances to site and as directed by Engineer, 2 signboards of minimum size 6 x 3.5 m constructed to the Engineer's design and consisting of softwood framing covered using marine quality plywood, primed and painted.

2. Provide signboards with the necessary lighting. Signboard shall be lettered in English, giving name of Employer, name of Designer, Engineer, Contractor and Sub-Contractors. Setting out of signboards, type and sizes of lettering shall be approved by Engineer. Contractor shall clear away signboards upon completion of Contract or when requested to do so by the Engineer.

1.05 TEMPORARY FENCE

A. Contractor shall provide, install, maintain and remove a temporary fence around site. Construct fence using hollow steel tubes conforming to ASTM A 36 and corrugated galvanized sheet steel conforming to SDI Specifications. Sheet material shall be structural quality, 22 gage thick conforming to of ASTM A 446, Grade C, hot-dipped galvanized as per ASTM A 525, Class G-90. Size and shape of fence shall be as approved by Engineer.

- Excavation shall be in compliance with the requirements of Sections 02200 - EARTHWORK.

- Concrete shall be in compliance with the requirements of Section 03300 –

CAST-IN-PLACE CONCRETE

1.06 TEMPORARY HOISTS AND CHUTES

A. Contractor shall provide, install, maintain and remove material and personnel hoists as required for normal use by all trades, and employ only skilled operators for them. He shall provide necessary guards, signals, protective facilities, safety devices and the like required for safe operation, provide suitable runways from hoists to each floor level and roof, and remove all such facilities after they have served their purpose or when directed by the Engineer.

B. Contractor shall also provide and maintain all temporary ladders, ramps, runways, chutes, derricks, stairs, and similar items required for the proper execution of the work and permit the use of such facilities by other contractors, subcontractors or trades. Hoists and chutes

shall be so constructed as to prevent damage, staining or marring of permanent work.

C. No materials, rubbish or debris shall be permitted to drop free, but shall be removed by use of material hoist and/or fully enclosed rubbish chute.

D. Where required, openings in slabs, walls and partitions shall be provided for installing large pieces of equipment. Openings shall be closed and/or made good after the equipment is in place. Structural modification, if required, shall be subject to prior approval by the Engineer.

1.07 STAGING AND SCAFFOLDING

A. Contractor shall provide, erect and maintain all staging and scaffolding (exterior and interior) for all trades for their use during the construction of the building. Staging and scaffolding shall be of approved design, erected and removed by experienced stage builders and shall have all accident prevention devices required by government laws.

B. Such staging and scaffolding shall be erected in sufficient time and in a proper sequence so as not to delay the works. Subcontractors shall schedule and commence their work so that building progress is not delayed or obstructed once staging and scaffolding becomes available.

C. The above facilities shall be constructed and maintained in accordance with the applicable requirements of Government Authorities and designed to comply with the recommendations of the British Standards CP 97, Parts 1, 2 and 3, as applicable, and be removed after they have served their purpose or when directed by the Engineer.

1.08 TEMPORARY COVERINGS

A. Contractor shall protect finished surfaces, including jambs and soffits of openings used as passageways or through which materials are handled, against possible damage resulting from the conduct of work by trades.

B. Adequate protective material shall be laid under all materials stored on finished surfaces, and shall be laid before moving materials over finished areas. Wheelbarrows used over such areas shall have rubber type wheels.

C. Finished surfaces, including factory-finished and job-finished items shall be clean and not marked upon handing over of building(s) to Owner. Contractor shall, without extra compensation, re-finish such spaces where surfaces were proved to have been inadequately protected, and which are damaged.

D. As soon as an area of flooring is finished, it shall be protected by the Contractor from dirt and damage by covering as necessary with paper or by other approved method.

E. Waterproofed and roof surfaces shall not be subjected to traffic, nor be used for storage of material. Where some activity must take place in order to carry out the work, adequate protection, subject to approval by the Engineer shall be provided.

1.09 TEMPORARY SAFETY MEASURES

A. Contractor shall provide and maintain during the entire contract period all temporary safety measures necessary for the protection of people, buildings, structures, pavings, curbs, channels, fences and the like on the site or adjacent properties, and he shall be solely

responsible for any damage to life and property caused as a result of not having taken adequate precautions against such damage.

2. PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Materials shall be new and approved by the Engineer, and must not violate requirements of applicable codes and standards.

3. PART 3 - EXECUTION

3.01 GENERAL

A. Maintain systems to assure continuous service.

B. Modify and extend systems as work progress requires.

3.02 REMOVAL

A. Completely remove temporary materials and equipment when their use is no longer required.

B. Clean and repair damage caused by temporary installations or use of temporary facilities.

C. Restore permanent facilities used for temporary services to specified conditions.

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Products.

B. Transportation and handling.

C. Storage and protection.

D. Product options.

E. Substitutions.

1.02 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming Work. Products do not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for re-use.

B. Where applicable, use of materials and equipment removed from existing premises shall not be permitted, unless otherwise indicated on Contract Documents.

C. For similar components, provide interchangeable components of same manufacturer.

D. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to The Engineer. Product List Schedule shall include generic names of products required, manufacturer's name and proprietary product names for each item listed. Coordinate product list schedule with Construction Schedule and Schedule of Submittals.

E. Product Selection:

1. Provide products complying with Contract Documents specific performances indicated or specified, and which are recommended by manufacturer in writing for the intended application.

2. Materials and equipment to be used in Work shall be best quality, standard products of manufacturers and shall not show sign of defects or impurities. Where available, provide standard products of types that have been produced and used successfully in similar installations on other projects.

3. When matching of an established sample is required, The Engineer shall be the final judge of whether proposed product by Contractor matches the sample satisfactorily.

4. References made in the Specifications to approved manufacturers shall be construed as establishing a standard of quality and not as a limitation to the competition.

1.03 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with manufacturer's instructions.

B. Inspect shipments to assure that products comply with the requirements, undamaged and are correct in quantities.

C. Provide equipment and personnel as necessary to handle products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

A. Provide secure storage for products, and protect stored products from pilferage, vandalism, and other loss or damage. Store and secure products so as not to present a safety hazard.

B. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

C. For exterior storage, fabricated products shall be placed on sloped supports, located above ground.

D. Provide off-site storage and protection when site does not permit on-site storage or protection.

E. Products subject to deterioration shall be covered with impervious sheet covering. Ventilation of covered products shall be provided to avoid condensation damage.

F. Loose granular materials shall be stored on solid flat surfaces in a well-drained area. Precautions shall be taken to prevent mixing with foreign matter.

G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

H. Store products organized in such a way as to permit access for inspection. Contractor shall periodically inspect stored products to assure that they are undamaged and are being maintained under specified conditions.

1.05 PRODUCT OPTIONS

A. Reference in Specifications to approved manufacturers shall be construed as establishing a standard for minimum quality and not as limiting of competition.

B. Products of equal in quality to or better than those specified, shall be considered acceptable or approved. Acceptability and/or approval shall be decided and/or approved by the Engineer.

1. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description may be furnished.

2. Products Specified by Naming One or More Manufacturers: Products of named

manufacturers and meeting specified requirements shall be furnished; no options or substitutions shall be allowed.

3. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions (i.e. or approved equal): Submit a request for substitution for any manufacturer not named complying with the requirements detailed herein.

1.06 SUBSTITUTIONS

A. Requests for Substitutions shall be in accordance with the General Conditions and Section 01300 - SUBMITTALS of this Specification.

B. The Engineer's consideration of Contractor requests for Substitutions shall be subject to the Construction Manager's review and approval. Construction Manager shall have final approval authority over requests for Substitutions.

C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

D. Contractor shall document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

E. A request for product substitution constitutes a representation that the Contractor:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.

2. Will provide same warranty for Substitution as for specified product.

3. Will coordinate installation of Substitution and make changes to other Work which may be required for Work to be complete at no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

G. Substitution Submittal Procedure:

1. Submit 4 copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.

3. The Engineer will notify Contractor, within 2 weeks of receipt of a substitution request and in writing, of his decision to accept or reject such a request.

2. PART 2 - PRODUCTS

(Not Used)

3. PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01700

PROJECT CLOSE-OUT REQUIREMENTS

1. PART 1 - GENERAL

1.01 DEFINITION

A. Project Closeout: Term used to describe certain collective project requirements, indicating completion of Work that are to be fulfilled near end of Contract Time in preparation for final acceptance and occupancy of Work by Owner, as well as final payment to the Contractor and normal termination of Contract.

B. Time of Closeout: Directly related to "Substantial Completion"; therefore, the time of closeout may be a single time for individual elements of the work that have been certified as substantially complete at different dates. This time variation, if any, shall be applicable to the other provisions of this Section.

1.02 PREREQUISITES TO SUBSTANTIAL COMPLETION

A. General: Complete the following before requesting the Handover Committee inspection for certification of substantial completion, either for the entire work or for portions of the Work.

1. In progress payment request that coincides with, or is the first request following date of substantial completion is claimed, show either 100% completion for portion of work claimed as "substantially complete", or list incomplete items, the value of incomplete work, and reasons for Work being incomplete.

2. Include supporting documentation for completion as indicated in this contract documents.

B. Submit a statement showing an accounting of changes to the Contract Sum.

C. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.

D. Obtain and submit releases enabling the Owner's full, unrestricted use of the Work and access to services and utilities. Where required, include occupancy permits, operating certificates and similar releases.

E. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

F. Deliver tools, spare parts, extra stock of materials and similar physical items to the Owner.

G. Make final change-over of locks and transmit keys to Owner. Advise Owner's personnel of change-over in security provisions.

H. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities and services from the project site, along with construction tools and facilities, mock-ups, and similar elements.

I. Complete final cleaning-up requirements, including touch-up painting of marred surfaces.

J. Touch-up and otherwise repair and restore marred exposed finishes.

K. Inspection Procedures: Upon receipt of Contractor's request for inspection, Handover Committee will either proceed with inspection or advice Contractor of unfilled prerequisites.

1. Following initial inspection, Handover Committee will either prepare Certificate of Substantial Completion, or will advise Contractor of work which must be performed before certificate will be issued. Handover Committee will repeat inspection when requested and when assured that work has been substantially completed.

2. Results of the completed inspection will form the initial "Punch List" for final acceptance.

1.03 PREREQUISITES TO FINAL ACCEPTANCE

A. General: Complete the following before requesting the Engineer's final inspection for certification of final acceptance, and final payment as required by the General Conditions. List known exceptions, if any, in the request.

1. Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Engineer final Punch List of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and has been endorsed/dated by the Engineer.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data either as of the date of substantial completion, or else when the Owner took possession of and responsibility for corresponding elements of the work.

B. Re-inspection Procedure: the Engineer shall re-inspect the Work upon receipt of the Contractor's notice that the Work, including Punch List items resulting from earlier inspections, has been completed, except for these items whose completion has been delayed because of circumstances that are acceptable to the Engineer.

1. Upon completion of re-inspection, the Engineer will either prepare a certificate of completion of the Maintenance Period or will advice the Contractor of work that is incomplete or of obligations that have not been fulfilled, but are required for final acceptance.

2. If necessary, the re-inspection procedure will be repeated.

1.04 RECORD DOCUMENT SUBMITTALS

A. As-Built Drawings: Contractor shall prepare As-Built drawings from the record drawings.

Information shall be presented in the following form:

1. Electronic Files: As-Built drawings files shall be submitted to the Engineer. Drawings shall be prepared using AutoCAD 14 or latest AutoCAD version (*.DWG Format).

2. Reproducible Copies (Transparencies or Sepias): All As-Built drawings and other Contract documents.

   Copies of the As-Built drawings shall be submitted in accordance with SECTION 01300 - SUBMITTALS for approval.

B. Specifications: Complete mark-up of Technical Specifications shall be submitted to the Engineer before initial acceptance.

C. Record Product Data: During the progress of the work maintain one copy of each product data submittal, and mark up significant variations as approved by the Engineer in the actual work in comparison with the submitted information. Include both variations from the manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark-up of record drawings and specifications. Upon completion of mark-up, submit complete set to the Engineer for record.

D. Record Sample Submittal: Immediately prior to the time(s) of initial completion, the Engineer will meet with Contractor at site, and will determine which of the submitted samples maintained by the Contractor during the progress of the work are to be submitted to the Engineer for record purposes.

E. Miscellaneous Record Submittals: Immediately prior to time(s) of initial completion, complete miscellaneous records and place in good order, properly identified and bound or filled, ready for continued use and reference. Submit to the Engineer for record.

1.05 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Arrange for each Installation of work requiring continuing maintenance or operation to meet with the operating personnel at the project site to provide basic instructions needed for proper operation and maintenance of the entire work. Review maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and similar procedures and facilities. For operation equipment, demonstrate start-up, shut-down, emergency operations, noise and vibration adjustments, safety, economy/ efficiency adjustments, and similar operations. Review maintenance and operations in relation with applicable guarantees, warranties, agreements to maintain, bonds, and similar continuing commitments.

B. Contractor shall submit 2 sets of Operation and Maintenance data prior to final inspection, size A-4 and/or A-3 text pages as applicable, bound in expandable binders with durable covers.

C. Contractor shall prepare binder covers with printed title - OPERATION AND MAINTENANCE INSTRUCTIONS, title of project, and subject matter of binder when multiple binders are required.

D. Language for Operation and Maintenance Manuals: Manuals shall be prepared in English.

E. Binder contents shall be internally subdivided with permanent page dividers; logically organized as described below, with tab titling clearly printed under reinforced laminated plastic tabs.

F. Binder Contents: Contractor shall prepare a Table of Contents for each volume, with each Product or system description identified.

G. Binder - Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, the Engineer, Contractor, subcontractors, and major equipment suppliers.

H. Binder - Part 2: Operation instruction and maintenance manuals, arranged by system and subdivided by Specification section.

For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

1. List of equipment.

2. Significant design criteria including performance data, dimensions, weights, and capacities.

3. Parts list for each component.

4. Installation instructions.

5. Operating instructions.

6. Maintenance manuals and instructions for equipment and systems including service manuals and wiring diagrams.

7. Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

I. Binder - Part 3: Project documents and certificates, including the following:

1. Shop drawings and product data.

2. Air and water balance reports.

3. Potable water system disinfection reports.

4. Elevator and dumbwaiter test reports and certifications.

5. Other certificates as specified.

6. Photocopies of warranties, guaranties, and bonds.

J. Contractor shall submit one copy of the completed binder volumes in the final form 30 days prior to final inspection at substantial completion. This copy will be returned after final inspection, with the Engineer comments. Revise content of documents as required prior to

final submittal.

K. Within 10 days after final inspection, Contractor shall submit 2 copies of the final revised binder volumes to the Engineer for hand-over to Owner.

1.06 FINAL CLEANING

A. Special cleaning for specific units of work is specified in the various technical specifications.

B. Provide final cleaning of the work at the time indicated, consisting of cleaning each surface or unit of work to the normal "clean" condition expected for a first class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations.

C. Except as otherwise indicated or requested by the Owner, remove temporary protective devices and facilities which were installed during the course of the work to protect previously completed work during the remainder of the construction period.

D. Comply with the safety standards and governing regulations for cleaning operations. Do not burn waste materials at the site, nor bury debris or excess materials on the property, nor discharge volatile or other harmful or dangerous materials into drainage system. Remove waste materials from the site and dispose of in lawful manner.

1.07 WARRANTIES AND BONDS

A. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution. Refer to individual sections of Division 2 through 16 each specific content requirements, and particular requirements for submittal of special warranties.

B. Form warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive A-4 paper.

1.08 CONTINUING INSPECTIONS

A. Where required by special guarantees, warranties, agreements to maintain, workmanship bonds and similar continuing commitments, comply with requests to participate in inspections at the end of each time period of such continuing commitments.

1.09 DELIVERY TURNOVER INVENTORY REQUIREMENTS

A. Upon product delivery, the Contractor shall:

1. Conduct tests and operational checks to ensure serviceability of property to be transferred.

2. Verify cleanliness and overall condition as acceptable.

3. Ensure that manufacturer's operations and maintenance manuals are available for transfer.

4. Ensure that keys to rolling stock, buildings and equipment are ready for turnover to the Owner.

2. PART 2 - PRODUCTS

(NOT USED)

1. PART 3 – EXECUTION

(NOT USED)

END OF SECTION

DIVISION - 2

SITE CONSTRUCTION

SECTION 02110

SITE CLEARING

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Removal and disposal of vegetation, brush, rubbish, loose rocks, large stones and metallic debris occurring within the areas to be cleared as well as removal of roots, matted roots and organic materials to a depth of not less than 300 mm below original surface level of ground or to natural rock elevation.

B. Removal and satisfactory disposal of any structure that obtrude, encroach upon, or otherwise obstruct the Work indicated on Drawings.

C. Remove, Dismantle and satisfactory disposal of concrete foot path, masonry works, metalled roads, electric pools, wiring and all types of flooring, superstructure etc. within the site limit.

1.2. JOB CONDITIONS

A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not use facilities without permission from the Engineer or authorities having jurisdiction.

B. Protection of Existing Improvements (If required): Provide protection as necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect improvements on adjoining properties and on Owner's property.

2. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

2.1. SITE CLEARING

A. General: Remove trees, shrubs, grass and other vegetation, improvements or obstructions interfering with the execution of the new construction. Remove such items elsewhere on site or premises as specifically indicated. Removal includes digging out stumps and roots.

B. Clearing and Grubbing: Remove material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes to a depth of not less than 300 mm below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this Contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface in conformance with the original adjacent surface of the ground.

C. Removal of Improvements: Remove existing above-grade and below-grade improvements necessary to permit construction and other works as indicated on drawings.

2.2. DISPOSAL OF WASTE MATERIALS

A. Transport waste materials and unsuitable topsoil materials to the designated spoil areas and dispose of as directed by the Engineer at no extra cost.

B. Dust Control: Amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions.

2.3. BURNING

A. Use of burning at the Project Site for the disposal of refuse and debris shall not be permitted.

2.4. USE OF EXPLOSIVES

A. Use of explosives shall not be permitted.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Excavation, filling, and compacting as well as site grading as shown on Drawings and as specified herein.

1.2. REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM D 422	Particle Size Analysis of Soils
ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-inch (305-mm) Drop
ASTM D 1556	Density of Soil-in-Place by the Sand-Cone Method
ASTM D 1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2167	Density and Unit Weight of Soil-in-Place by the Rubber Balloon Method
ASTM D 2216	Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil-Aggregate Mixtures
ASTM D 2487	Classification of Soils For Engineering Purposes
ASTM D 2937	Density of Soil in Place by the Drive-Cylinder Method
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4253	Maximum Index Density of Soils Using Vibratory Table
ASTM E 548	Standard Guide for General Criteria Used for Evaluating Laboratory

B. AASHTO - American Association of State Highway and Transportation Officials

AASHTO M 145	Classification of Soils and Soil-Aggregate Mixtures For Highway Construction Purposes
AASHTO T 180	Moisture-Density Relations of soils using a 10 lb (4.54 kg) Rammer and an 18 inch (457 mm) Drop
AASHTO T 191	Test Method for In-Place Density of Compacted Base Courses Containing Large Sizes of Coarse Aggregate

1.3. SUBMITTALS

A. Test Reports (Excavating, Filling and Grading):

1. Submit copies of the following reports:

a. Test reports on soil material conforming to the requirements specified under Quality Assurance.

b. Field density test reports.

c. One optimum moisture-density relationship curve for each type of soil to be used for fill or backfill.

B. Excavations over 1.5 m in depth will be sheeted and shored. Submit drawings and calculations for the design of the sheeting and shoring.

1.4. QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of Uniform Building Code (UBC) and other governing authorities, codes and standards having jurisdiction.

B. Testing Services: Employ a qualified independent testing laboratory approved by the Engineer to perform tests specified herein during earthwork operations as well as the additional tests performed to determine the quality of work, if requested by the Engineer at no extra cost. Perform each test in conformance with the following:

- Compaction Curve: Conform to ASTM D 1557
- Liquid Limit: Conform to ASTM D 4318
- Plastic Limit: Conform to ASTM D 4318
- In-Situ Moisture Content: Conform to ASTM D 2216
- Particle-Size Analysis: Conform to ASTM D 422
- Soil Classification: Conform to ASTM D 2487

C. Quality Testing Compliances: Based on reports of the testing and inspection, if the subgrade, fill, or backfill does not meet the specified requirements these materials shall be considered defective and shall be rejected. Excavate rejected materials and provide new acceptable materials replacing the rejected materials and re-compact the new materials as specified. Retest the re-compacted materials and repeat the procedure as necessary until the specified compaction is obtained.

D. Recommendations of Report for Geo-Technical Studies for the Project shall be followed.

1.5. JOB CONDITIONS

A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil bore holes. It should be expressly understood that the Engineer would not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for the convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. Noise and Dust Control: Utilize reasonable and necessary means to abate dust, dirt rising, and undue noise. Perform necessary sprinkling and wetting of construction site to prevent dust from spreading.

C. Existing Utilities:

1. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

2. Should uncharted or incorrectly charted, piping or other utilities be encountered during excavation; consult the corresponding utility company for directions. Cooperate with the Engineer and utility companies in keeping the respective services and facilities in operation. Repair damaged utilities to the satisfaction of the authorized utility company.

D. Use of Explosives:

1. The use of explosives shall not be permitted.

E. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by the authorities having jurisdiction.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

F. Existing Conditions: Prior to commencing work at site, verify agreement of existing conditions with indicated conditions. Notify the Engineer in writing of discrepancies found. Start of work without notification constitutes acceptance of conditions, with no extra cost.

PART 2 - PRODUCTS

2.1. SOIL MATERIALS

A. Backfill and Fill Materials:

1. Suitable Materials:

a. Materials classified according to ASTM D 2487 as GW, GP, GM, SM, SW and SP, or a combination of these group symbols; free of rock or gravel larger than 75 mm in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

b. Materials conforming to AASHTO M 145 Class A-1, A-2 or A-3.

c. Lime and fly-ash when used as stabilizing agents.

2. Unsuitable Materials:

a. Materials conforming to ASTM D 2487 class CH, CL, MH, PT, OH and OL, or a combination of these group symbols.

b. Materials that are not defined above as suitable materials.

3. Fill materials shall be free of rock or gravel larger than 75 mm in any dimension, debris, waste, organic material and other deleterious matter. The fine content (silt and clay size particles passing US # 200 sieve which is equivalent to a particle diameter of 75 micron) should be less than 15 % by weight. Fill materials shall have a grading with

100% passing the 3/8 inch (9.5 mm) sieve. Follow the recommendations of Report for Geo-Technical Studies.

B. Acceptable Topsoil: Acceptable topsoil includes selectively excavated topsoil material that is representative of local soils that produce heavy growths of crops, grass, or other vegetation, and is reasonably free from underlying subsoil, clay lumps, weeds, litter, brush, matted roots, toxic substances, or any material harmful to plant growth or which would hinder grading, planting, or maintenance operations. Topsoil shall not contain more than 5 percent by volume of stones or other such objects larger than 25 mm in any dimension for field-seeded areas and 12 mm in any dimension for lawn seeded areas.

C. Borrow Material: Where suitable materials are not available in sufficient quantities from required excavations, approved materials shall be obtained from approved sources outside the limits of project at the Contractor's expense. Borrow material shall comply with the requirements specified for **Backfill and Fill Materials**. Borrow material shall be subject to the Engineer's approval based on the test reports performed as described herein.

D. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve. Thickness of drainage layer shall be as shown on drawings.

E. Sub-Base Materials: AASHTO M 147 Grade B naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, and natural or crushed sand.

2.2. EXCAVATED MATERIALS

A. Excavated materials shall not be used for fill under structures and pavements, unless indicated otherwise in Geotechnical Report. Follow the recommendations of Report for Geo-Technical Studies. Excavated materials may be used for general fill after removing oversize stones, unless indicated otherwise in Geotechnical Report.

PART 3 - EXECUTION

3.1. EXCAVATION

A. Excavate materials of whatever nature encountered to the lines and grades as shown. Excavation includes removal and disposal of obstructions on ground surface, underground structures and other materials encountered.

B. Unauthorized Excavation: Consists of the removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation shall be at the Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom without altering required top elevation.

2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations unless otherwise directed by the Engineer.

C. Additional Excavation: When excavation has reached required subgrade elevations, the Engineer will make an inspection of conditions.

1. If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper 300 mm and replace the excavated material with specified sub-base materials and as directed by the Engineer.

2. In areas of unsuitable material where over excavating to 300 mm does not remove the unsuitable bearing material, excavate down as required and construct a working platform using specified sub-base materials for 300 mm in depth then use rockfill material. Bring backfill to 300 mm below the finished subgrade shown on Drawings in layers not exceeding 200 mm in depth. Continue backfilling to subgrade elevation or to final elevation using specified backfill material as shown on Drawings.

D. Stability of Excavations: Slope sides of excavations to comply with the following:

1. Slopes of cuts in natural; 1:1

2. Slopes of compacted fill; 1-1/2:1

3. Slopes of uncompacted fill; 2:1

Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

E. Shoring and Bracing: Designing, providing and maintaining the suitable shoring and bracing system that will support the loads imposed shall be the Contractor's responsibility. Proposed shoring and bracing system shall be subject to approval of the Engineer. Provide materials for shoring and bracing in good serviceable condition.

1. Provide shoring system adequately anchored and braced to resist earth and hydroscopic pressures.

2. Establish requirements for trench shoring and bracing to comply with safe operating procedures.

3. Maintain shoring and bracing in excavations. Carry down shoring and bracing as excavation progresses.

F. Dewatering: Provide adequate dewatering system in order to prevent surface water and

subsurface or ground water from flowing into excavations and from flooding Project site and the surrounding area:

1. Designing, providing and maintaining comprehensive dewatering system throughout excavation and backfilling works. Proposed dewatering system shall be subject to approval of the Engineer. However, such approval shall not relieve Contractor from his responsibility towards the dewatering system. In case, Contractor's proposed dewatering system fails or does not perform efficiently, Contractor shall immediately replace the system at no extra cost to Owner.

2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. Dewatering system shall run 24 hours a day during excavation and backfilling works. Contractor shall provide standby power generators for running the dewatering system, non-stop, in case of power failures.

3. Convey water removed from excavations and rain water to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

G. Material Storage: Stockpile suitable excavated material until required for backfill or fill. Locate and retain soil materials away from edge of excavations. Dispose off excess soil material and waste materials.

H. Excavation for Structures:

1. Conform to elevations and dimensions shown within a tolerance plus or minus 50 mm and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services and other construction as well as for inspection.

2. In excavating for footings and foundations, take care not to disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive concrete.

I. Excavation for Trenches: Conform to the requirements of Section 02225 - TRENCHING AND BACKFILLING.

3.2. BACKFILL AND FILL

A. General: Place soil material in layers to the required subgrade elevations, for each area classification listed below, using materials as specified above.

1. General Fill: Use satisfactory excavated or borrowed material.

2. Under Structures: Use satisfactory excavated or borrowed material.

3. Under Grassed Areas: Use satisfactory excavated or borrowed material.

4. Under Walkways and Pavements: Use subbase material, satisfactory excavated or

borrow material, or a combination.

5. Under Steps: Use subbase material.

6. Under Building Slabs: Use drainage fill material.

7. Under Equipment: Use subbase materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.

8. Trenches for Piping and Conduits: Conform to the requirements of Section 02225 - TRENCHING AND BACKFILLING.

H. Backfill excavations as promptly as work permits, but not until the completion of the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, water-proofing and perimeter insulation.

2. Inspection, testing, approval and recording locations of underground utilities have been performed and recorded.

3. Removal of concrete formwork.

4. Removal of trash and debris from excavation.

5. or temporary horizontal bracing is in place on horizontally supported walls.

3.3. PLACEMENT AND COMPACTION

A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface to depth of 300 mm and compact to required depth as directed by the Engineer.

B. Place backfill and fill materials in layers not more than 200 mm in loose depth for material compacted by heavy compaction equipment and not more than 100 mm in loose depth for material compacted by hand-operated tampers.

C. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy.

D. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

E. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by the Engineer if soil density tests indicate inadequate compaction.

F. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 1557:

1. Under structures, building slabs and steps, and pavements, compact top 300 mm of subgrade and each layer of backfill or fill material at 95 percent maximum density.

2. Under lawn or unpaved areas, compact top 150 mm of subgrade and each layer of backfill or fill material at 90 percent maximum density.

3. Under walkways, compact top 150 mm of subgrade and each layer of backfill/fill material at 95 percent maximum density.

4. General Fill: Compact each layer of backfill or fill material at 90 percent maximum density.

G. Moisture control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Moisture content shall be kept within 2 percent above or below the optimum as determined by ASTM D 1557, Method-D.

H. Unless otherwise approved by The Engineer, heavy equipment for spreading and compacting backfill shall not be operated closer to a wall less than a distance equal to the height of the backfill above the top of footing; the area remaining shall be compacted in layers not more than 150 mm in compacted thickness with power driven hand tamper suitable for material being compacted.

I. Testing of Fill and Backfill: Frequency of field density tests in accordance with ASTM D 1556 (Sand Cone Method) shall be as follows:

1. One test per 30 m^2 of underground pipe trench.

2. One test per 100 m^2 per lift under foundations.

3. One test per 200 m^2 per lift under paved areas.

4. The laboratory tests ASTM D 698 shall be carried out once for every 5 field density tests.

J. Tolerance:

1. Pavements and Walks: Shape surfaces of areas under pavement and walks to line, grade cross-section with finish surface not more than 20 mm above or below the required subgrade elevation.

2. Under Building Slabs: Provide final grades within a tolerance of 12 mm when tested in a 3 m straight edge.

3. Footing: Finish surfaces on which footing shall be placed to within 25 mm or below the required grades.

4. Landscaped Areas and Rough Grading: Finish all areas to within 50 mm above or below the elevations, grades and cross-sections shown.

3.4. BUILDING SLAB DRAINAGE COURSE

A. Placing: Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations. When a compacted drainage course is indicated to be 150 mm thick or less, place material in a single layer. Where thickness of drainage course is indicated to be more than 150 mm, place material in equal layers, not more than 150 mm or less than 75 mm thick for each layer when compacted.

3.5. PREPARATION FOR PAVEMENTS

A. Sub-Grade Preparation:

1. After completion of stripping or excavation operations, as applicable, scarify and compact the natural sub-grade to lines, slopes and levels as shown on the Drawings.

2. The top 300 mm of sub-grade shall be compacted to a minimum density of 95 percent. Density shall be measured in field in accordance with AASHTO T 191 and in the laboratory shall be determined according to AASHTO T 180.

B. Granular Sub-Base:

1. General: For granular sub-base; before placing and spreading operations are started, verify that the sub-grade has been approved and satisfactorily maintained and that it is to levels and of the material specified. Ruts or soft yielding areas shall be filled and compacted to the required density.

2. Placing and Compaction: Sub-base material shall be spread on the finished sub-grade in uniform layer without segregation, to such loose depth that when compacted the layer will have a thickness of maximum 200 mm. Material shall be mixed with blade graders or other equipment until a uniform mixture is obtained. Aggregate shall be within the specified moisture content limits when compacting is started. Variations shall be corrected prior to or during compacting by sprinkling or by aeration. The layer shall be compacted by rolling with a 3-wheel power roller weighing 8 to 10 tons or an approved pneumatic roller. Alternate blading and rolling shall be performed until obtaining smooth, even and uniformly compacted finished top course.

C. Compacting shall not be less than 100 percent of maximum dry density in place for access roads and 95 percent minimum for parking areas. Density shall be measured in field according to AASHTO T 191 and in laboratory shall be determined in accordance with AASHTO T 180. The C.B.R. value of the granular sub-base course after compacting shall be more than 50 percent.

D. Testing Surface: Sub-base shall be true to established grade. Thickness shall not be more or less than 10 mm from that required for the layer being constructed. Surface shall not vary more than 10 mm in 3 m from true profile and cross-section. Thickness of the granular sub-base shall be measured at intervals as directed by the Engineer. Measurements shall be taken at various points through holes not less than 75 mm in diameter.

3.6. MAINTENANCE

A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris and provide temporary drainage as required.

2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape and compact to required moisture and density prior to further construction. Remove saturated or softened soil as directed by the Engineer.

END OF SECTION

SECTION 02204

BASE COURSE

STANDARD SPECIFICATIONS FOR CIVIL ENGINEERING BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and placing one or more layers of aggregate base or leveling course on a prepared surface to the lines and grades shown on the Drawings.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Aggregate base course shall consist of crushed gravel or crushed stone, conforming to the quality requirements of AASHTO M 147. The aggregate shall be free from lumps, balls of clay, or other objectionable matter, and shall be durable and sound.

B. Base course material shall conform to one of the following gradations as specified:

BASE COURSE GRADATIONS

(Percent Passing by Weight)

Sieve Design	A	B	C	C-1	D	D-1	E	E-1
4	100							
2	85-100	100						
1-1/2				100				
1			100	70-100	100	100		
3/4				60-90	100	70-100	100	
3/8				45-75		50-80		100
No.4	30-70	30-70	40-75	30-60	45-80	35-65		45-80
No.8				22-52		20-50		32-80
No.10			25-55		30-65			
No.40				8-30		8-30		
No.200	0-10	3-10	4-10	0-6	4-12	0-6	0-6	0-6

C. For gradings C, D, and E, at least 50% by weight of the particles retained on the No. 4 sieve shall have at least one fractured face as determined by Alaska T-4.

D. For gradings C-1, D-1, and E-1, at least 70% by weight of the particles retained on a No.4 sieve shall have at least one fractured face as determined by Alaska T-4.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to placement of the base course, the underlying surface shall be prepared by dressing, shaping, wetting or drying, and compacting of the underlying material to a minimum density of 95% as determined by AASHTO T 180-D. Surfaces shall be cleaned of all foreign substances and debris.

B. Any ruts or soft yielding spots that may appear shall be corrected by loosening and removing unsatisfactory material and adding approved material as required, reshaping, and recompacting the affected areas to the lines and grades indicated on the Drawings. If required by the ENGINEER, the CONTRACTOR shall proof load questionable areas with a loaded truck or other piece of equipment approved by the ENGINEER.

C. Blue-tops shall be set to the top of base course. They shall be set by the CONTRACTOR at breaks in grade and on even grade at intervals not to exceed 50 feet, with additional stakes at vertical curves.

D. Base course material shall be deposited and spread in a uniform layer to the required grades, and to such loose depth that when compacted to the density required, the thickness will be as indicated on the Drawings. Portions of the layer which become segregated shall be removed and replaced with a satisfactory mixture, or shall be remixed to the required gradation.

E. The maximum compacted thickness of any one layer shall not exceed six inches, except the compacted depth of a single layer may be increased to eight inches if compaction equipment capable of delivering sufficient compactive energy, as determined by the ENGINEER, is used. If the ENGINEER requires the compacted depth to exceed six inches, and if compaction equipment capable of delivering sufficient compactive energy, as determined by the ENGINEER is not used, the base shall be constructed in two or more layers of approximately equal thickness. Each layer shall be shaped and compacted before the succeeding layer is placed.

F. The base course shall be compacted to at least 95% of maximum density as determined by AASHTO T 180-D. In places not accessible to rolling equipment, the mixture shall be compacted with hand-tamping equipment.

G. Blading, rolling, and tamping shall continue until the surface is smooth and free from waves and irregularities. If at any time the mixture is excessively moistened, it shall be

serrated by means of blade graders, harrows, or other approved equipment, until the moisture content is such that the surface can be recompacted and finished as above.

H. The grading operations shall be conducted in a manner that will remove any quarter crowns, or other humps in the cross section of the roadway. The cutting edges of the grading blade shall be replaced if they are found to be worn beyond the tolerances specified for the roadway surface. The finished surface shall not have humps or dips between blue-topped intervals along the roadway alignment that exceed the tolerances given in the following paragraph, I.

I. The surface of the base course, when testing using a ten foot straightedge shall not show any deviation in excess of 3/8 inch between two contact points. The finish surface shall not vary more than 1/2 inch from established grade. Additionally, the algebraic average of all deviations from established grade of the finish base course surface elevations taken at 50-foot intervals shall be less than 0.02 foot.

J. The initial density at any location will be paid for by the CONTRACTOR. If the initial test shows that the material compaction is not as specified, the CONTRACTOR shall modify the compaction methods used, as approved by the ENGINEER, and have the material Retested until the tests show that the compaction meets the Specification requirements. All tests, after the initial test at any given location, shall be paid for by the CONTRACTOR.

END OF SECTION

SECTION 02225

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Trench excavation.

B. Backfilling.

C. Removal and disposal of excess excavation materials as well as importing the required bedding and fill materials if necessary.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-inch (305 mm) Drop
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-inch (457 mm) Drop
ASTM D 1559	Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4253	Test Methods for Maximum Index Density of Soils Using Vibratory Table
ASTM D 4254	Test methods for Minimum Index Density of Soils and Calculation of Relative Density

1.3 SUBMITTALS

B. Submit test reports of backfilling materials and compaction showing compliance with the requirements specified herein.

C. Submit field density test reports.

D. Submit one optimum moisture-density relationship curve for each type of soil to be used for fill or backfill.

1.4 HAZARDS

A. Whenever the Engineer determines that excavation or fill on Owner's property which was created by a Contractor and which is a hazard to life and limb, or endangers property, or adversely affects the safety, use or stability of a roadway or drainage channel, the responsible Contractor, upon receipt of a notice in writing from the Engineer, shall within

the period specified therein repair or eliminate at his own expense such excavation or fill so as to eliminate the hazard occurring.

1.5 DEFINITIONS

B. Bedding Material: Materials utilized for bedding under pipes in trenches.

C. Initial Backfill Material: Materials utilized for backfilling around pipes 150 mm above the top of pipe.

D. Unsuitable Materials:

1. Materials including, but not limited to, silts or clays containing organic materials, soils containing large amounts of roots, grasses, and other vegetation, debris, decomposable materials or as identified by the Engineer.

2. Materials consisting of gypsum, salt deposits, and clayey marl with plasticity index in excess of 20.

PART 2 PRODUCTS

0.1 MATERIALS

E. Clean Sand:

3. Soil material meeting the following gradation containing less than 3 percent weight of organic material, marl or clay:

Sieve Size	Percent Passing
1/4 inch (6.25 mm)	100
No. 10 (2.00 mm)	90 - 100
No. 20 (0.075 mm)	10 or less

F. Marl: A wide variety of inorganic calcareous soil materials which may vary from clay to gravel sizes and may include cobble and boulder sized pieces.

2.2 BEDDING MATERIALS

A. Provide clean sand conforming to the gradation and requirements specified herein.

B. Compact sand bedding to at least 70 percent relative density, or 95 percent proctor density according to ASTM D 698 whichever is applicable and gives greater density.

C. Determine maximum/minimum densities of a representative bedding sample according to ASTM D 4253/ASTM D 4254 for all locations. Obtain field density in accordance with ASTM D 1556, Sand-Cone Method.

2.3 INITIAL BACKFILL MATERIALS

A. Provide clean sand conforming to the gradation and the requirements specified herein.

B. Compact clean sand to 70 percent relative density from the bottom of pipe to 150 mm

above the top of pipe. Maximum lifts of 150 mm are recommended.

2.4 FILL MATERIALS

A. Provide marl or soil materials for backfill from 150 mm above the top of pipe to the top of trench meeting the following requirements:

4. Not more than 3 percent organic or decomposable materials.

5. No debris.

6. A maximum particle size of 150 mm or one-half the lift thickness, whichever is smaller.

7. Minimum compaction shall be in accordance with the following Table:

	Non-Traffic Areas	Motor Vehicle Traffic Areas	Highways with Heavy Truck Traffic
Non-Cohesive Soils (Sand)	65% relative density*	70% relative density*	85% relative density*
Cohesive Soils	85% of maximum density**	95% of maximum density**	95% of maximum density***

* Relative Density: Determined in accordance with ASTM D 4253 and ASTM D 4254.

** Maximum Density: Determined in accordance with ASTM D 698.

*** Maximum Density: Determined in accordance with ASTM D 1557.

8. Compact backfill materials to densities specified in accordance with ASTM D 4253 and ASTM D 4254 or ASTM D 698 whichever is applicable and gives the greater density.

2.5 WARNING TAPE

A. Warning Tape: Metallic core polyethylene color-coded type, 150 mm wide, 100 micron thick.

PART 3 EXECUTION

3.1 GENERAL

B. Unclassified Excavation: Perform excavation as indicated on Drawings in whatever material encountered.

C. Unsuitable Materials:

1. Excavate materials designated as unsuitable for use as fill by the Engineer until suitable material is found.

2. Remove and dispose off site materials excavated during trenching, which is unsuitable for backfill at no extra cost.

3.2 TRENCH EXCAVATION

D. Excavate trenches to the width and depth required and establish the indicated invert elevations.

E. Saw cut asphalt and concrete pavement providing a minimum of 100 mm beyond the required trench including allowances for sheeting and other works, or to a total width of 1 m, whichever is greater.

F. Trench Dewatering: Conform to the requirements of Section 02200 - EARTHWORK. If trench dewatering is necessary, no construction shall start until the approval of design of dewatering system by the Engineer. Dewatering systems shall not discharge into existing sewers, completed sections of new sewers, or into open surface areas. Trench bottom shall be dry before pipe installation. Cap the end of pipes between shifts and weight the pipe to prevent floating.

G. Trench bottom shall be continuous, smooth, free of rocks, and to the lines and grades shown on Drawings. Shape trench beds at joint locations to accommodate the larger outside diameter of joint, so as to provide a continuous support for the pipe. Trench contour shall not cause joint angular deflection or pipe bending radius exceeding the Manufacturer's limit.

H. Depth of trench shall allow a minimum of 150 mm of sand bedding below the pipe. Remove a minimum of 300 mm of unstable soil and replace with a minimum of 150 mm of crushed stone, maximum size of 38 mm (1-1/2 inch) and 150 mm of sand on top of stone.

I. Sheeting or Shoring: Conform to the requirements of Section 02200 - EARTHWORK.

J. Unless live loads, dead loads, pipe deflections, and pipe stresses are calculated by a method acceptable to the Engineer to verify the adequacy of pipe with less cover, and unless Manufacturer's recommendation require deeper burial, the minimum cover over the top of pipe shall be as shown on Drawings and approved by the Engineer.

3.3 BEDDING

A. Provide clean sand bedding, 150 mm thick for trench bottom. Tamp or Compact sand bed to provide uniform bearing.

3.4 BACKFILLING

A. Place the initial backfilling materials in maximum lifts of 150 mm around pipes and to 150 mm above the top of pipes.

B. Compact backfill to the corresponding densities specified above. Within 300 mm of the pipe, backfill shall be hand tamped, or a board shall be used to protect pipe damage from vibratory plate compactors.

C. Sheeting and Shoring:

1. Remove sheeting and shoring gradually as the backfill is placed. Fill voids under and behind sheeting as sheeting is withdrawn.

2. Cut and leave sheeting in place, where in the opinion of the Company Representative, damage to the pipe may occur.

D. Exceptions:

1. Backfill trenches with concrete where trench excavations pass within 450 mm of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing. Backfill trenches after completion of tests and inspections and the Engineer approval. Backfilling shall not damage or displace piping systems.

2. Provide 100 mm thick concrete base slab support for piping or conduits less than 750 mm below surface of roadways. After installation and testing of piping or conduits, provide 100 mm thick encasement (sides and top) of concrete prior to backfilling or placement of roadway subbase.

3.5 COMPACTION TESTING

A. Test Method: To verify that the specified degree of compaction has been achieved, perform in-place density tests by the nuclear method conforming to ASTM D 1556 and ASTM D 2922.

B. Frequency: Perform compaction tests after the compaction of each lift of fill, at a minimum rate of one in-place density test for every 50 linear meters of compacted soil. Spacing between test locations shall be approximately equal.

C. Extra Test: When test results fail to meet the established criteria for testing, perform the remedial Work to the satisfaction of the Engineer. Re-test the repeated Work using same methods and procedures specified herein to confirm achieving the required established criteria.

3.6 WARNING TAPE

A. Place warning tape over utility lines in trenches and to the depths shown on Drawings.

3.7 PAVEMENT REINSTATEMENT

A. Asphalt Concrete Paving: Conform to the requirements of Section 02510 - ASPHALT CONCRETE PAVING.

B. Pavement base course shall be of the same depth and material as the original base course.

C. Prime edges of the existing pavement and base course.

D. Surface course shall be identical to the original surface course.

E. Roll the paved patch in both directions with a 5-ton roller so as to compact the patch to 96 percent of Marshall density in accordance with ASTM D 1559.

END OF SECTION

SECTION 02285

TERMITE CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Soil treatment for termite control as specified herein.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and application instructions.

1.3 WARRANTY

A. Submit written warranty certifying that applied soil poisoning treatment will prevent infestation of the subterranean termites and that if subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation.

B. Provide warranty for a period of 10 years from the date of substantial handover, signed by both, Manufacturer and Applicator.

1.5 QUALITY ASSURANCE

A. Conform to the manufacturer's instructions and recommendations for work, including preparation of substrates and application.

B. Engage a professional pest control operator, licensed in accordance with the regulations of governing authorities for application of soil treatment solution.

1.6 JOB CONDITION

A. Restrictions: Apply soil treatment solution after the completion of excavation, filling and grading operations unless otherwise required in construction operations.

B. To insure penetration, do not apply soil treatment to excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT SOLUTION

A. Soil Treatment Solution:

1. Termiticide active ingredient shall be Permethrin, with minimum percentage of 36.8 percent or chlorpyrifos with minimum percentage of 45.64 percent.

B. Application Rates and Method of Application: As recommended by the manufacturer or his

authorized applicator for the various locations and as approved by the Engineer.

C. Apply soil treatment solution under slab on grade structures, under basement structures, masonry foundations or grade beams, at expansion and control joints as recommended by the manufacturer.

D. Use an emulsive concentrate termiticide for dilution with water, specifically formulated to prevent infestation by termites. The solution shall consist of Permethrin chemical elements and concentrations and shall be diluted as recommended by the manufacturer. Other solutions may be used as recommended by the Applicator and approved by the Engineer as well as local governing authorities. Soil treatment solutions shall not be injurious to planting. Fuel oil will not be permitted as a diluent.

PART 3 - EXECUTION

3.1 APPLICATION

A. Surface Preparation: Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and foundations. Termiticide may be applied before placement of compacted fill under slabs, if recommended by Manufacturer.

3.2 APPLICATION RATES

A. Application rates at the different locations specified herein shall be as recommended by the Manufacturer at the to achieve horizontal and vertical barriers against infestation.

B. Treat soil before concrete slabs are placed using either power sprayer or tank-type garden sprayer and in accordance with the following:

1. Apply termiticide to soil in critical areas under slabs, including entire inside perimeter inside of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab and around interior column footers.

2. Apply termiticide as an overall treatment under slabs and attached slab areas.

3. Apply termiticide along outside edges of the building. Dig a trench 150 mm to 200 mm wide along the outside of foundation to a depth of not less than 300 mm. Mix chemical solution with the soil as it is being replaced in trench.

C. At Hollow Masonry Foundations or Grade Beams: Treat voids with termiticide by pouring directly into the hollow spaces.

D. At Expansion Joints, Control Joints and Grade Areas: Apply termiticide to areas of penetration through the slabs.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

3.3 PRECAUTION

A. Post signs in areas of application to warn workers that termiticide been applied. Remove signs when areas are covered by other construction.

3.4 RE-APPLICATION

A. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

END OF SECTION

SECTION 02515

PAVING AND SURFACING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. External paving units and the related setting materials as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials:

ASTM C 33 Specification for Concrete Aggregates

ASTM C 144 Specification for Aggregate for Masonry Mortar

ASTM C 150 Specification for Portland Cement

ASTM C 207 Specification for Hydrated Lime for Masonry Purposes

ASTM C 270 Specification for Mortar for Unit Masonry

ASTM D 1751 Specification for Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

C. Refer to the applicable Codes and Standards of the following Sections:

1. Section 03300 - CAST-IN-PLACE CONCRETE.

2. Section 07900 - SEALANTS.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for unit pavers including test results and certificates showing that units conform to the specified requirements.

B. Samples: For initial selection of quality, color, finish and texture submit unit paver samples showing full range of colors and textures available as well as compliance with the specified requirements. Furnish samples made up of full-size units.

C. Field Constructed Mock-Up: Provide a mock-up for each type of unit pavers and application required.

1.4 QUALITY ASSURANCE

A. Comply with the applicable requirements specified in Division 2 - SITEWORK and Division 3 - CONCRETE with respect to materials, tests, quality assurance and workmanship.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Precast Concrete Tile Pavers: Units shall have solid construction, manufactured by hydraulic pressing of mortar and concrete in 2 layers; upper layer formed of 10 mm thick 1-1 cement-sand mortar by volume and lower layer formed of 30 mm thick concrete with compressive strength of 30 MPa after curing. Concrete shall comply with Section 03300 - CAST-IN-PLACE CONCRETE. Concrete tiles shall have maximum water absorption of 5 percent. Precast concrete tiles shall be manufactured in a fully automatic plant using latest technique for batching, placing and curing concrete. Finished elements shall be sound in appearance with clean planar surfaces, free from segregation, honey combing, pits, cracks, broken edges or corners. Size of tiles shall be as indicated on Drawings. For concrete stepping stone, provide precast concrete pavers with exposed aggregate finish. Color and texture shall be as selected and approved by the Engineer.

B. Precast Concrete Interlocking Pavers and Steps: Units of a solid construction, shape as indicated on Drawings and manufactured using 30 MPa portland cement concrete under hydraulic pressing and high frequency vibration. Units shall have minimum compressive strength 58 MPa and water absorption of maximum 5 percent. Sizes of pavers shall be as indicated on Drawings. Color and texture shall be as selected and approved by the Engineer.

C. Concrete Paving/Walkways: Comply with the requirements of Section 02500 - CONCRETE WALKWAYS.

D. Brick for Paving, Edging, Steps and Banding: Solid (uncored) light traffic paving red brick complying with ASTM C 902 of Class MX, type I or BS 3921. Brick shall be manufactured from clay and shall be kiln dried at a minimum temperature of 1075°C to produce dense pavers with average crushing strength of minimum 55 MPa and less than 4.5 percent water absorption by weight. Brick shall be deep red in color and hand selected with permissible tolerance for individual brick conforming to ASTM Designation C-90279-A or an equivalent BS Standard. Brick sizes shall be as shown on Drawings.

E. Granite for External Paving, Banding and Edging, Steps and Landings: Comply with Section 09600 - STONEWORK. Unless indicated otherwise, granite for paving shall not be less than 30 mm thick; type, color, size, pattern and finish shall be as shown on drawings or approved by the Engineer.

F. Ceramic Tiles for External Paving and Ceramic Mosaic Tiles for Fountain Finishing: Refer to Section 09310 – CERAMIC TILES for compliance with material and installation requirements. For paving pattern, type, size and color refer to site hardscape drawings

G. Concrete Mowing Strips: Shall be 200 x 100 x 65 mm thick, manufactured using 30 MPa Portland cement concrete under hydraulic pressing and high frequency vibration. Units shall have minimum compressive strength 58 MPa and water absorption of maximum 5 percent. Mowing edge shall be laid over mortar setting bed on cast in place concrete base.

H. Random Stone Pavers: Best quality natural stone, not less than 75 mm thick hand tooled and irregular shapes as indicated on drawings. Surface of stone shall have a maximum variation of 6 mm. Type, sizes, texture and color shall be as approved by the Engineer. Setting bed shall be as indicated on drawings.

I. Heliport Paving and Fittings: Reinforced concrete pad, 250 mm thick on and including granular base and compacted sub-grade as shown on drawings and complying with requirements of Section 03300 – CAST IN PLACE CONCRETE and Section 02200 – EARTHWORK. Provide reflective thermoplastic proprietary paint marking to indicate "TRIANGLE" and "H" characters on landing pad including 450 wide boundary strip, as shown on drawings. Provide all required heliport fittings for a complete operational system including but necessarily limited to the following:

1. Illuminated wind sock.
2. Galvanized steel mast
3. Lighting fixtures
4. Cables and wirings
5. Accessories

J. Expansion Joint Filler: Asphalt saturated fiber board conforming ASTM D 1751.

K. Joint Sealant: Refer to Section 07900 - SEALANTS.

2.2 SETTING MATERIALS

A. Ungrouted Mortarless Setting Materials:

1. Sand for Setting Beds: Fine aggregates complying with ASTM C 33.

2. Sand for Joints: Complying to ASTM C 144, with gradation for unusual thin joints.

B. Mortar Application:

1. Aggregates: ASTM C 144.
2. Portland Cement: ASTM C 150.
3. Hydrated Lime: ASTM C 207, Type S.
4. Water: Clean and potable.

PART 3 - EXECUTION

3.1. INSTALLATION - GENERAL

A. Do not use paving units with excessive chips, cracks, voids, discolorations or other defects which might be visible or cause staining to finished work.

B. Cut paving units with motor-driven saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern shown and to fit adjoining work neatly. Use full units without cutting to maximum extent. Hammer cutting is not acceptable.

C. Set paving units in patterns shown or approved by The Engineer and with uniform joints of width as indicated on the Drawings. Expansion joints shall be provided at returns and interface with other finishes in conformance with the details shown on the Drawings. Provide 6 mm wide expansion joints at intervals not greater than 12 meters.

D. Tolerances: Do not exceed 3 mm unit-to-unit offset from flush, or exceed a tolerance of 3

mm in 600 mm and 6 mm in 3000 mm from level or slope as indicated for finished surface of paving.

3.2. MORTAR-SET PAVING UNITS

A. Install units in setting bed of 20 mm thick mortar with grouted joints as shown on the drawings. Mortar mix for setting bed and grouting shall be Type M complying with ASTM C 270, 1-3 cement-sand mortar and not more than 1/4 part lime per part of cement.

B. Remove excess mortar promptly as work progresses. Lay paving units in pattern shown with straight, uniform joints. Level surface to the elevations shown. Strike joints down from the top surface of paving unit. Cure mortar by maintaining in damp condition for 7 days. Brush dry mix cement sand mortar into joints and lightly water upon completion ensuring there is no shearing of mortar on the finished work.

3.3. SAND-SET PAVING UNITS

A. Place concrete pavers on a sand bed of thickness as indicated on drawings. Set paving units in the indicated patterns placing each paver as close as possible to the adjacent pavers. Vibrate into position to even running levels using plate vibrator capable of 1590 to 2272 kg compaction core. Sweep fine sand over surface to fill joint irregularities after vibration. Surface of pavement shall be true to levels and grades with a tolerance of 5 mm in 3 m.

3.4. REPAIR AND PROTECTION

A. Remove and replace paving units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units with same joint treatment to eliminate evidence of replacement.

B. Pointing: During tooling of joints, completely fill all enlarge voids or holes with mortar and grout. Point-up joints at sealant type joints to provide a neat, uniform appearance, properly prepared for application of sealant.

C. Cleaning: Remove excess mortar or grout from the exposed surfaces then wash and scrub clean.

D. Protect paving work from deterioration, discoloration or damage during subsequent construction and until the final acceptance of work in accordance with the recommendations of the paving unit manufacturer.

END OF SECTION

SECTION 02529

PRE-CAST CONCRETE CURBS AND STOPPERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast concrete curbs and stoppers as indicated on Drawings.

1.2 REFERENCES

A. Conform to the applicable requirements specified in Section 03300 - CAST-IN-PLACE CONCRETE.

1.3 SUBMITTALS

A. Shop drawings indicating all dimensions of modules proposed for use, including composition of the various elements.

B. Copies of all test reports indicating mix components and test results in compliance with specification requirements.

C. The Contractor shall submit samples of precast concrete curbs and stoppers for approval of quality, color, finish and texture.

1.4 QUALITY ASSURANCE

A. Conform to the applicable requirements of the following Divisions:

1. Division 2 - SITEWORK

2. Division 3 - CONCRETE

For the requirements of materials and workmanship, testing and quality assurance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used shall conform to the requirements of Section 03200 – CONCRETE REINFORCEMENT and Section 03300 - CAST-IN-PLACE CONCRETE.

B. Precast Concrete Curbs:

1. Construction: Manufacture precast curbs using Class 30 concrete conforming to the requirements of DIVISION 3 - CONCRETE. Portland cement shall conform to SSA 143 or ASTM C 150.

2. Size: As indicated on Drawings.

3. Fabrication: Concrete curbs shall be manufactured by hydraulic pressing in an

approved machine using concrete produced in a fully automatic batching plant. Finished elements shall be of sound appearance with clean planar faces, free from segregation, honeycombing, pits, broken corners and other defects. Bullnoses and curved faces shall be of constant radius with a smooth change from radius to plan face. Manufacturing tolerances shall be 3 mm in any one dimension and end faces shall be truly perpendicular to the base.

C. Precast Concrete Wheel Stoppers:

1. Construction: Manufactured from 30 MPa concrete using type I cement conforming to the requirements of DIVISION 3 - CONCRETE. Size and shape shall be as shown on the Drawings or as approved by the Engineer. Provide the finished elements with sound appearance and clean planar faces, free from segregation, honeycombing, pits, broken corners and other defects.

2. Grout: As approved by the Engineer.

a. Construction: High strength, non-shrink cementitious grout, ready-to-use, supplied in powder form and requires only on-site addition of water to produce non-shrink grout of predictable performance.

3. Fabrication: Refer to fabrication of reinforced precast concrete curbs for Wadi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Elements shall be set out to lines and grades as shown. Under no circumstances shall levels be set by direct measurement.

B. Foundation shall be excavated to the grades and sections shown and fully compacted and rolled to a smooth surface. Concrete shall not be placed until the foundation has been approved.

C. Elements shall be laid either directly on a wet concrete base or on 1-3 cement-sand mortar bed, 20 mm thick on a previously laid concrete base. Base shall be constructed of Class 20 concrete conforming to the requirements of Section 03300-CAST-IN-PLACE CONCRETE.

D. After elements have been laid, continuous concrete backing shall be poured. Backing concrete shall be of Class 20 conforming to the requirements of Section 03300 - CAST-IN-PLACE CONCRETE.

E. Joints between curbs and paving tiles shall have a width of 4 mm, filled with 1-1 cement-sand mortar with one fifth hydrated lime and sufficient water to make the mixture plastic and easily smoothed and finished.

F. A grooving tool shall be used to produce a smooth semi-circular groove not more than 3 mm deep in all joints.

G. Precast Concrete Wheel Stoppers: Unless otherwise indicated on Drawings, secure wheel stops to the asphalt concrete surfaces using 19 mm diameter galvanized steel dowels

embedded in precast units (minimum 2 dowels/unit). Adjust length of dowels so as not to penetrate the precast double-tee structures. Grout dowels using the approved cementitious grout.

3.2 TOLERANCES

A. Curbs/Wheel Stops: Laid to the lines and grades shown on Drawings with a tolerance of plus or minus 3 mm.

END OF SECTION

SECTION 02580

PAVEMENT MARKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Paint and thermoplastic traffic markings for pavement as shown on Drawings and as specified herein.

1.2 REFERENCES

A. AASHTO - American Association of State Highway and Transportation Officials

AASHTO M 247 Glass Beads Used in Traffic Paint

AASHTO M 249 Thermoplastic Stripping Material, White and Yellow

B. ASTM - American Society of Testing and Materials

ASTM D 1214 Sieve Analysis of Glass Spheres

C. FS - Federal Specification

FS TT-B-1325	Beads (Glass Spheres), Retro Reflective
FS TT-P-110	Paint, Traffic, Black (Non-Reflectorized)
FS TT-P-115	Paint, Traffic Highway, White and Yellow

1.3 SUBMITTALS

A. Copies of manufacturer's complete product specification, technical/performance data, preparation and application instruction and maintenance and repair recommendation for each type of material.

B. Certificate of compliance.

C. Samples of proposed thermoplastic material and glass beads with test reports in accordance with requirements of the Standards for Road Safety Features.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Marking materials and glass beads shall be supplied and delivered to the project in manufacturer's original new and unopened containers, factory sealed and labeled. The containers containing marking materials shall be sealed to preclude contamination and shall have a capacity of not less than 25 kg or more than 100 kg and each container shall be labeled to clearly identify the contents, manufacturer, batch number and date of manufacture.

B. Containers of marking materials shall not be opened except for immediate use. Materials older than the manufacturer's recommended or extended shelf life shall not be used and shall be removed from the site.

C. Provide adequate storage facilities separate from storage of other building materials. Store paint materials at a minimum ambient temperature of 7°C in a well ventilated area. Also, follow manufacturer's written instructions regarding storage and handling.

1.5 QUALITY ASSURANCE

A. Provide manufacturer's best quality trade sale materials. Container not displaying manufacturer's product identification will not be acceptable.

B. Marking materials shall be specifically designed and formulated for pavement work of types required and climate conditions applicable. Materials shall be produced by the manufacturer regularly producing materials of the kinds required, and shall have successful history proven by actual use of similar applications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement Markings: Material used for all traffic stripes and markings shall be reflectorizing thermoplastic type complying with the requirements of AASHTO 249 and MOC Standards. Marking materials shall comprise of synthetic hydrocarbon thermoplastic resins, plasticizer, extenders, pigments, aggregate, and pre-mixed reflectorizing glass beads; and shall have surface applied glass beads to marking material at the time it is applied to the pavement.

B. Marking Material: Designed for dry film thickness of not less than 1.5 mm, exclusive of surface applied glass beads. Color of marking material shall be white and yellow unless otherwise indicated on Drawings.

C. Glass Beads: Reflective feature shall be provided by adding glass spheres to surface of thermoplastic coating. Glass spheres (beads) shall be as recommended by thermoplastic coating manufacturer, shall conform to AASHTO M 247 except as specified herein, and shall be capable of reflectorizing the approved thermoplastic coating effectively. Beads shall be transparent, reasonable spherical and colorless, and shall not impart color to the thermoplastic. Bead sizes shall conform to the following gradation, as determined by ASTM D 1214:

Sieve Size	Percent Passing
0.250 mm	100
0.212 mm	85 - 100
0.106 mm	15 - 55
0.063 mm	0 - 10

PART 3 - EXECUTION

3.3 CONSTRUCTION METHODS

A. Time of Application: Allow at least 30 days curing time for new pavement surfaces before applying paint.

B. Weather Limitations: Perform painting only when the existing surface is dry and clean, when the pavement and air temperatures are above 4°C and below 50°C and when, as determined by The Engineer, weather is not too windy, dusty, or foggy for satisfactory painting.

C. Trial Painting: If required by the Engineer, paint a trial pavement strip of 45 m length at an approved location. The trial shall demonstrate that the materials, equipment, and application methods will provide specified results. Proceed with work only after the methods established in the trial have been approved.

D. Layouts and Alignment: On sections of pavements where no previously applied figures, markings, or stripes are available to serve as a guide, spot the layouts and lines of proposed stripes in advance of the painting thermoplastic stripping. Space control points to ensure the accurate location of all markings.

E. Equipment for Painting:

1. Equipment will be subject to approval of The Engineer, and shall include apparatus for cleaning the existing surface, a mechanical marking machine, and auxiliary hand-painting equipment.

2. Mechanical marker shall be an atomizing spray-type marking machine for applying traffic paint and shall produce a film of uniform thickness at the required coverage rate. Markings shall be of uniform cross-section, shall have clear-cut edges without runs or spatters, and shall be within the specified limits for straightness. When needed, furnish a reflective media dispenser for attachment to the mechanical marker.

3. Provide adjustments on the sprayers of a single machine to paint the width required, or furnish additional equipment.

4. Hydrocarbon thermoplastic traffic strips shall be applied with an approved extrusion machine capable of applying the thermoplastic to the required width in accordance with manufacturer's written recommendations.

F. Preparation of Surface:

1. Immediately before applying paint, clean the pavement by sweeping and blowing as necessary to produce a dry surface free from substances such as dirt, grease, oil, acid, laitance, and other substance which will reduce bond between markers and the pavement. Scrub areas which cannot be satisfactorily cleaned by brooming and blowing, as required, with a 10 percent solution by weight of trisodium phosphate in water or other approved solution. After scrubbing, rinse the solution off and dry the surface before painting or application of thermoplastic.

2. Obliterate to the satisfaction of the Engineer all temporary markings or stripes which are to be abandoned or removed.

3. Spot the layouts and lines of proposed stripes on pavement in advance of the paint application. Space control points to ensure accurate location of all markings.

G. Application of Paint or Thermoplastic:

1. Apply markings in the locations shown and in conformance with the dimensions, spacings, and colors shown, or as required. Do not apply paint until the layouts, indicated alignment, and the condition of the existing surface are approved.

2. Apply single stripes wholly on one side of longitudinal pavement joints. Center double or multiple stripes over such joints.

3. Mix the paint in accordance with the manufacturer's written instructions and apply it to the surface of the pavement with the marking machine at its original consistency without the addition of thinner. Use pneumatic spray guns for hand application in areas where mobile paint applicator cannot be used. Do not use brushes to apply paint. Thermoplastic shall be applied in accordance with manufacturer's recommendations.

4. When reflectorized markings are applied, distribute the reflective media to the surface of the pigmented binder immediately, and imbed at the required rate.

5. Make sure that the paint does not bleed excessively, curl, or discolor when it is applied to bituminous surfaces.

6. When painting straight stripes, obliterate deviations in the edges exceeding 13 mm in 15 m and correct the markings. The widths of the markings shall be as indicated, within a tolerance of plus or minus five percent. Perform painting or application of thermoplastic as approved.

7. Apply paint uniformly with suitable equipment at the rate of not less than 2.60 m^2/l or more than 2.80 m^2/l. Apply glass spheres at the rate of 1.2 kg/l of paint.

8. Hydrocarbon thermoplastic strip shall be extruded to a finished thickness of 2.3 mm by an approved extrusion machine. Glass beads shall be applied in accordance with the MOC standards.

H. Application of Beads:

1. For roadway pavement markings, the amount of beads (glass spheres) in the finished paint shall contain not less than 0.5 kg/l nor more than 0.59 kg/l.

I. Protection of Markings: Protect fresh paint and markings while paint dries. Erect satisfactory warning signs, flags or barricades, protective screens, and coverings as required. Protect surfaces from disfiguration by spatter, spillage, or drippings of paint, thermoplastic, or other materials.

END OF SECTION

SECTION 02900

LANDSCAPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Landscaping work as shown on Drawings and as specified herein but shall not be limited to the following:

1. Site Preparation to receive soil and plant materials.

2. Procurement, protection and importation of plant materials to site.

3. Propagation of plant materials.

4. Soil importation.

5. Soil preparation including soil ameliorants.

6. Finish grading of soil.

7. Installation of plant material, trees, shrubs, ground covers, climbers and grass seeds.

8. Staking and guying of trees.

9. Protection, maintenance and guarantee as specified.

10. Watering during construction and maintenance period.

11. Providing all labor and materials incidental to the satisfactory completion of the work, including clean up of the site.

B. Related Work Items: Refer to the applicable Sections of DIVISION 2 - SITEWORK.

1.2 REFERENCES

A. AAN - American Association of Nurserymen:

AAN Botanical Listing, Tagging and sizes.

B. ACJHN - American Joint Committee on Horticultural Nomenclature:

ACJHN Latest Edition of Standardized Plant Names.

C. ANSI - American National of Standards Institute:

Z60.1 American Standard for Nursery Stock

D. ASTM - American Society for Testing and Materials:

ASTM C 136 Sieve or Screen Analysis of Fine and Coarse Aggregates

E. AOAC - Association of Official Analytical Chemists:

AOAC Official Methods of Analysis.

F. Horticultural Society of Pakistan & Horticultural Directorate of CDA:

Dictionary of Gardening.

1.3 SUBMITTALS

A. Laboratory Analysis: Testing laboratory analysis shall provide specific testings for each item specified herein, expressed in rates and quantities as required.

B. Plant Certificates: Submit plant health and import certificates for review and approval.

C. Plant Supplies: Submit details of sources of supply for trees, shrubs, ground covers, climbers and grass seeds for review and approval. Make necessary arrangements for the Engineer to inspect plant material at the nurseries.

D. Agricultural Soil and Red Sand Supplies: Submit details of supply and certificates for each delivery of bulk material, including soil and sand, stating the source, quantity, and type of material.

E. Furnish complete agricultural soil and sand suitability analysis from an approved Independent Testing Laboratory at intervals as required by the Engineer for approval.

F. Furnish the Client a certificate with each delivery of fertilizers and soil conditioners in containers stating source, quantity and type of material, including manufacturer's statement at testing that the material meets the requirements of the specifications.

G. Miscellaneous Materials: Furnish samples of materials to be used in association with the landscaping works.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Secure permission from the Engineer to store plants on Project site. Ensure that planting materials are protected from damage by sun, wind and construction work.

1.5 WARRANTY AND REPLACEMENT

A. Guarantee executed Work and materials for a period of one year after completion of planting operations. Replace dying or unhealthy plants after conditions become evident.

B. Plants used for replacement shall be of same kind and size as specified in Plant List and shall be furnished, planted, and maintained as specified.

C. Approval and Rejection of Materials:

1. Selection of materials and execution of operations shown on Drawings and Specifications are subject to the approval of the Engineer.

2. The Engineer shall have the right to reject material and work which in his opinion does not meet the requirements of Drawings and Specifications at any stage of the operation.

D. Substitution of Materials: Before submitting bid, locate necessary materials called for and make sure of their availability for use on job. Contract bids shall be based upon providing specified materials, processes, and products identified in Specifications and/or indicated on Drawings. Substitutes will be permitted only upon submission of proof that specified plants are not obtainable and with authorization of the Engineer. Written requests with nearest available size, variety of plant and price adjustments, to be submitted to the Engineer for approval prior ordering substitute(s).

1.6 JOB CONDITIONS

A. Establish lines and levels necessary for the location and erection of landscape construction, excavation, filling, and grading work. Verify site measurements with Drawings, and assure the proper fitting of this portion of completed work. Changes or compensation will not be allowed on account of differences between actual measurements and the dimensions shown on Drawings, but any such differences which may be found shall be submitted to the Engineer for adjustment before proceeding with the work.

B. Provide watering equipment as required for the work at no extra cost to Owner throughout the construction and maintenance period.

C. Provide and maintain substantial and adequate protection as may be required to protect new and existing work and items of equipment and furnishings through the entire duration of the work, to the full satisfaction of the Engineer.

PART 2 - PRODUCTS

2.1 SOIL AMENDMENTS

A. Soil Mixture Materials:

1. Agricultural Soil:

a. Agricultural soil to be from an agricultural source outside the limits of the Project and in compliance with the requirements specified herein.

b. Soil shall have the same relative composition and structure, a friable sandy loam character, and be free of roots, clods and stones larger than 25 mm in greatest dimension, pockets of coarse sand, noxious weeds, sticks, brush and other litter. Soil shall not to be infested with plant disease organisms, nematodes or other insects, and shall be free from all chemicals harmful to plant and animal life.

c. Agriculture soil to meet the following requirements as approved by soil analysis.

1) Salinity: Not more than 2 milli-mhos/cm as measured by the saturation extract method.

2) Sodium Absorption Ratio: Not more than 5.

3) PH Value: From 5.5 to 7.5.

4) Boron Concentration in Saturation Extract: Not more than 1 ppm.

5) Silt and Clay Content: Not more than 16 percent by weight.

6) A minimum of 90 percent by weight to pass a 2 mm round hole sieve.

7) Permeability Rate: Minimum 13 mm/hour when tested in accordance with ASTM D 2434 or other approved methods.

2. Red Sand:

a. Red sand to be from a source outside the limits of the project and in compliance with the requirements specified herein.

b. Sand shall be free of roots, clods and stones larger than 25 mm in greatest dimension, pockets of gravel, fine silt, noxious weeds, sticks, brush and other litter and shall not be infested with plant disease organisms, nematodes or other insects, and shall be free from chemicals harmful to plant and animal life.

c. Red Sand Physical Characteristics:

1) Materials Passing a No. 10 Sieve: 100 percent.

2) Materials Passing a No. 35 Sieve: From 90 to 100 percent.

3) Materials Passing a No. 140 Sieve: From 0 to 10 percent.

4) Materials Passing a No. 270 Sieve: From 0 to 3 percent.

d. Red Sand Chemical Characteristics:

1) Salinity: Not exceeding 2 milli-mhos/cm as measured by the saturation extract method.

2) Sodium Absorption Ratio: Not more than 5.

3) PH Value: From 5.5 to 7.5.

3. Water Retaining Polymer: Non-toxic, bio-degradable polyacrylamide co-polymer which ameliorates the soil by its water storing capacity.

B. Organic Amendments:

1. Submit a written request for approval accompanied by a written report of a testing agency registered by the governing authority for the agricultural evaluation, which states that the proposed source complies with these specifications. Amendments

from sources including, but not limited to, refuse, human or animal waste will be rejected.

2. Organic amendments shall have a consistent composition, moderately acidic, with substantial nitrogen content and low salinity. Amendments shall be free of roots, clods and stones, noxious weeds, sticks, brush and other litter and shall not be infested with nematodes or other insects or plant disease organisms. Organic amendments shall be supplied to improve the organic content of the soil.

3. Organic amendments shall meet the following additional requirements:

   a. Physical Characteristics:

      1) Material passing 9.51 mm sieve: 100 percent

      2) Material passing 6.35 mm sieve: 90-100 percent

      3) Material passing 2.38 mm sieve: 50-60 percent

      4) Material passing 0.50 mm sieve: 0-10 percent

      5) Bulk Density: 300 - 400 kg/m^3

   b. Chemical Characteristics:

      1) Organic Matter: Greater than 85 percent

      2) PH Value: 5 - 6.5

      3) Salinity (ECe x 10^3): 0.5 - 2.0

      4) Total Nitrogen: 0.9 - 2.0

      5) Available Phosphorous: 100 - 500 ppm

      6) CEC (meg/100 g): 80 - 120

      7) Boron (Saturation extract): Less than 5 ppm

      8) Sodium Absorption Ratio: Less than 2.0

C. Fertilizers:

1. Fertilizers shall be commercial, granulated type, uniform in composition, dry and free flowing, and shall be delivered to the site in unopened containers each bearing the manufacturer's name, guarantee, chemical analysis, and weight.

2. Fertilizing materials shall be packaged, first grade, commercial quality products identified as to source, type of material, weight, and manufacturer's guaranteed analysis. Fertilizing materials shall not contain toxic ingredients or fillers harmful to human and animal life or plants. Furnish a certificate of compliance stating that the materials used meet the Specifications when required by the Engineer.

3. Fertilizers for Soil Mixes:

a. Slow release compound fertilizer which shall be incorporated in soil mix at a rate of 300 g per tree/plant conforming to following.

- N: 6.5 percent
- P_oO_5 (soluble): 11.5 percent
- P_oO_5 (insoluble): 33.2 percent
- K_2O: 7 percent
- Mg: 11.8 percent

b. Controlled release fertilizer shall be organic resin coated complete fertilizer with an analysis of 16-17-5+Fe and a release longevity of 12 - 14 months at 21°C soil temperature. Fertilizer planting tablets shall be tightly compressed fertilizer chips forming planting tablets and shall contain the following minimum percentages of plant food by weight:

- Nitrogen: 12 - 20 percent
- Phosphoric acid: 8 - 10 percent
- Potash: 3 - 25 percent

c. Agricultural Grade Sulphur (S): 99 percent sulphur content with 100 percent passing a No. 16 mesh screen.

4. Fertilizer to be included, but not limited to, in the soil mix: Soil Sulphur, Superphosphate, Ammonium Sulphate.

2.2 LANDSCAPE PLANTING MATERIALS

A. General:

1. Landscape planting materials shall conform to the applicable standards and nomenclature of the American Standard for Nursery Stock and the Horticultural Society of Pakistan and Horticultural Directorate of CDA.

2. Refer to the planting schedule and drawings for the complete list of planting materials.

B. Trees, Plants and Ground Covers:

1. Trees, plants, and ground covers shall be nursery grown in accordance with good horticultural practices, and grown under climatic conditions similar to those in the locality of the Project for at least 2 years.

2. Trees shall be typical of their species or variety, with normal growth, sound, healthy, vigorous, well-branched, and densely foliated. They shall be free of diseases, insect pests, eggs or larvae and shall have a well-developed root systems.

3. Trees shall have straight trunks with the leaders intact, undamaged and uncut. Old abrasions and cuts shall be completely calloused over.

4. Standardized Plant Names: Names of the plants shown on the drawings conform with the names given in American Joint Committee on Horticultural Nomenclature

(ACJHN) Latest Edition of Standardized Plant Names. Plant species not listed therein shall conform to plant names accepted in the trade and deliveries shall be accompanied by appropriate patent certification.

5. Plants to be Furnished: Furnish plant material in accordance with that named on the Drawings. Replace plant material deviating from the correct plants at no additional cost. The Engineer reserves the right to inspect plants at place of growth, but such inspection shall not preclude the right of rejection of the planting site before and/or after planting.

6. Quality and sizes: Furnish plants in conformance with the sizes required by the Drawings. The size of the plants measured before pruning shall conform to the measurements specified. Plants larger in size than those indicated may be furnished with the approval of the Engineer, but at no change to the contract price. For larger plants, the ball of earth or spread of roots shall be proportional to the size of the plant.

7. Root Treatment: Immediately after digging, cover roots of bare root plants with a thick coating of mud or puddling, or wrap in a wet straw, moss, or other suitable packing material for protection until delivery.

8. Containerized plant material shall have been growing in their containers for at least one year or sufficiently long enough to develop a root system capable of holding the soil intact after the removal from the container.

9. Minimum Tree Ball Sizes And Shapes: Ball size shall be 300 mm diameter for each 25 mm of trunk diameter measured 300 mm above the ground line. Ball shapes shall be truncated cones; however, root growth structure of designated species and local soil conditions may require variation.

10. Palms shall be of the size as stated on the Drawings and Schedules. Palms planted in a group or on road verges shall be approximately uniform in size unless stated otherwise. Trees shall have neatly trimmed trunks with no frond shrubs or fibrous matting.

11. Options: Plants may be furnished container grown instead of balled and burlaped or bare root, provided size requirements are met and the plant containers are proportional with sizes of plants to be furnished.

12. Substitutions: Plants or cultivars other than those named in the list of plants to be furnished will not be accepted unless specifically approved in writing by the Engineer.

13. Labels: Identify clearly shipments of plants. Durable and legible labels stating correct names and sizes of plants shall be securely attached to individual plants, bundles of like variety and size, as delivered to the site for inspection and planting identification.

C. Grass: Type of grass shall be as indicated on Drawings.

D. Handling of Planting Materials:

1. Heavy balled plants shall be carefully handled to prevent cracked or broken plant

balls.

2. No plant shall be handled by or lifted by the stem or foliage.

3. Handle plants in such a manner as to avoid damage and protect roots from drying at all times.

4. The ball of balled and burlapped plants which cannot be planted immediately upon delivery shall be covered with moist soil, mulch, or other covering to protect from drying, wind and sun. Plants shall be watered as necessary until planted.

5. Spray palms or other bare root or root balled plants with an acceptable trade anti-desiccant spray at the nursery or grove prior to shipping.

E. Shipping of Planting Materials:

1. Notify the Engineer in advance of the time and mode of shipping.

2. Furnish copies of the required custom documents to the Engineer 14 days prior to schedule shipment.

3. Plant materials shall be packed to provide adequate protection against climatic and physical injuries during transit. Plants shall be securely covered to prevent wind-whipping and drying.

4. Freight containers shall be carefully packed and adequately ventilated in accordance with the plant requirements to prevent **sweating** of the plants during transit. Shipments shall be given special attention to insure prompt delivery to job site.

5. Plants shall be treated with required pesticides just prior to shipment or as necessary to comply with local regulations.

6. The required inspection and transportation certificates will accompany each shipment.

F. Delivery to the Planting Site:

1. Supplier shall notify the Engineer of the scheduled delivery dates 30 days prior to the shipping date. Send 2 copies of an itemized plant material list with the delivery notice to insure coordination of the required inspection at the point of delivery. Once delivered, plants shall be cared for and protected from damage and deterioration until they are planted at the locations shown on the drawings. All the palms, trees/shrubs and groundcover material shown on the drawings shall be stored and maintained at the Site Plant Nursery.

2. Plants shall be properly acclimatized to the local site conditions.

2.3 MISCELLANEOUS MATERIALS

A. Tree Stakes: Provide tree stakes for supporting trees as shown on Drawings.

B. Tree Ties: Proprietary reinforced rubber or plastic, fully adjustable 600 x 25 mm clinch type tree ties or plastic buffer through which the tie passes between the tree and the stake.

C. Guy wires and Turnbuckles: Galvanized woven drawn steel wire attached to galvanized turnbuckle assemblies.

D. Guy Wire Covers: To protect the tree against abrasion of the guy wire, flexible reinforced rubber hose shall be threaded over the guy wire in the location where the wire loops around the tree trunk and branches only.

E. Guy Wire Markers: Guy wire shall be covered in 15 mm Schedule 40 white PVC tubing up to 2 meters above ground level.

F. Anti-Desiccant: Emulsion-type, film forming agent designed to permit plant transpiration, but retard excess loss of moisture. Apply according to the manufacturer's instructions.

G. Sub-Surface Drainage Gravel: Anti-capillary drainage layer shall be constructed of 12 - 20 mm nominal size angular gravel with no fines and shall have a minimum thickness of 150 mm.

H. Gravel Mulch: Crushed limestone aggregate from off-site source, well graded, clean, free of organic materials, and screened 10 - 30 mm size.

I. Filter Membrane: Spun-bonded polypropylene fabric manufactured by an integrated process of fiber spinning and bonding and conforming to the following requirements:

- Weight: 136 g/m^2
- Thickness: 0.49 mm
- Multi-Directional Test Strength: 100 N/m^2
- Elongation at Break: 32 percent
- Pore Size: 120 micrometers

J. Hessian: A coarsely woven mixture of hemp and jute, naturally bio-degradable for wrapping palm tree fronds or other protection purposes.

K. Irrigation Water: Water used for irrigation shall be analyzed by a registered institution and the report of which shall be approved by the Engineer. Report shall show conformance with the following standards:

- Maximum total Dissolved Solids: 1,500 ppm
- Electrical Conductivity: 1.8 milli-moh/cm
- Maximum Ph: 8
- Maximum Temperature: 30^oC
- Maximum Specific Intoxicity:
  * Na: 200 ppm
  * Cl: 350 ppm
  * B: 0.75 ppm
  * SO^4: 750 ppm

L. Insecticide and Fungicide: Use insecticide and fungicide if any disease occurs. Identify type of disease as well as the appropriate section of insecticide and fungicide which shall be delivered in the manufacturer's containers and shall be used according to insecticide manufacturer instructions. Materials used shall strictly comply with applicable laws governing their use.

M. Tree Paint: Specifically formulated for the treatment of tree wounds or cut branches, and

shall be free of chemicals which may **burn** the live tissue of the tree.

PART 3 - EXECUTION

3.1 SOIL MIXES

A. General: The following soil mixes shall be used as appropriate.

1. Palm Tree Soil Mix: A two-part mix. Surround palm tree pruned root ball by red sand with no additives. This encasement in red sand only shall be the diameter of one and a half times the root ball in size. The rest of tree pit shall be filled with a soil mix similar in composition to that of trees, shrubs and ground cover.

2. Trees/Shrubs/Ground Cover Soil Mix:

- Agricultural Soil: 20 percent by volume
- Red Sand: 60 percent by volume
- Peat Moss: 20 percent by volume
- Water Retaining Polymer: 2 Kg/m^3
- Fertilizer: As specified

3. Soil Mix for Lawn Areas: Soil mix for lawns of grass areas shall be as follows:

- Agricultural soil: 30 percent by volume
- Red Sand: 70 percent by volume
- Water Retaining polymer: 2 kg/m^3
- Fertilizer: As approved by the Engineer

3.2 SOIL PREPARATION

A. Mix completely and compound the soil mix using approved mechanical methods before placement in tree pits, shrubs and ground cover beds.

B. Add the approved fertilizers to the soil mix at a rate of 450 g/m^3 unless otherwise recommended by the Engineer. Provide additional slow release fertilizer tablets for tree pits at a rate of 20 g per tree to be incorporated in the soil mix.

C. Planting bed shall consist of a soil mix over sub-surface drainage of crushed aggregate or gravel which has been placed to the depth as shown on the drawings.

D. Provide filter membrane where specified with 300 mm overlapping between the soil mix and the sub-surface drainage.

E. Place soil mix in 150 mm lifts, wetted, tamped to fill to finish grade as shown on the drawings. After soil mix has been placed, rake to true lines, free from unsightly variations, bumps, ridges or depressions.

F. Remove sticks, stones, roots and other objectionable materials from the soil which might interfere with formation of finely graded seed bed.

G. No planting shall take place until the plant bed locations and lawn areas are approved by the Engineer.

3.3 INSTALLATION OF PLANTING MATERIALS

A. Irrigation System: Utilize the installed automatic irrigation system and hoses from the quick couplers for the Project. Furnish water hoses and other equipment required for watering the plants.

B. Planting Season: Conduct planting operations under favorable weather conditions during the season which is normally accepted in the locality.

C. Layout: Accomplish the ground layout for planting as approved by the Engineer prior to any planting, and following completion of planting soil installation. Stake location for individual plants, outline planting beds, and mark the location of plants within a planting bed other than ground cover.

D. Planting Obstructions: Remove obstructions encountering excavation of planting pits, such as loose rocks, boulders, or construction debris. Existing underground utility lines, new or in use, shall not be disturbed. When such are encountered or other obstructions appear that are greater in diameter than the diameter of the planting pit being prepared, the position of the plant shall be shifted or relocated as determined by the Engineer. No explosives will be used for the removal or rock or other obstructions. Repair and/or replace damages to structures and/or utility lines at no additional cost.

E. Excavation for Planting:

1. Size planting pits for trees as detailed. Increase pits accordingly in size as required for larger trees.

2. For bare root trees and shrubs, make excavations at least 300 mm wider than root spread and deep enough to allow for setting of roots on a layer of compacted backfill and with collars set at same grade as in nursery.

3. For balled and burlaped trees and shrubs, make excavations at least half again as wide the ball diameter and equal to the ball depth, plus applicable allowance for setting of ball on a layer of compacted backfill.

4. For container grown stock, excavate as specified for balled and burlaped stock, adjusted to size of container width and depth.

5. Mechanical diggers may be used in the excavation of tree pits, however, the vertical sides of the pits, burnished to a hard smooth surface, shall be scarified and/or fractured to eliminate the impervious walls.

6. Where substrate formation inhibit proper drainage, Provide trenches to prevent water collecting in tree pits.

F. Filter Membrane:

1. Install filter membrane directly above the drainage layer ensuring the membrane is laid out to minimize small filler pieces around the edges of the planting area. Membrane shall overlap 150 mm and shall be stapled or woven together at 300 mm

intervals to ensure the membrane joint will not be moved during backfilling.

2. Wrap up the planting pit sides with membrane providing excess above finished grade during backfilling. Once backfilling has been completed and the finished soil levels achieved, trim the membrane neatly to the finished soil level.

G. Backfilling:

1. After backfilling plant pit approximately 60 percent full, in 150 mm lifts, add water and allow soil mix to settle. Add additional soil to finish grade.

2. After settlement, add additional planting mix required to bring pit to finish grade.

3. Removal of containers and/or severing of the sides of plantable containers shall be completed in a manner which will leave the balls of roots and soil intact. Handling methods which result in ball damage will be sufficient reason for rejection of the plant.

H. Setting Plants: Set plants in approved topsoil in pits as shown on the Drawings. After initial watering and settlement, plants shall be at the same ground level grade as the relative grade of the ground from which they are dug. Set plumb upright growing trees and adjust shrubs and spreading type plants to produce their natural form and profile.

I. Balled and Container Grown Plants:

1. Place a minimum of 100 mm of compacted topsoil mixture in the bottom of the pit or to depth necessary to set the plant to required grade.

2. Place planting mixture around ball and carefully compacted to avoid injury to ball and to fill voids.

3. Cut and remove burlap, rope, wire or other wrapping materials away from the top of the ball and out of the pit. Do not remove burlap or ties from sides or bottom of ball.

4. Remove plastic materials from the pit.

5. Cut off broken or frayed roots cleanly and treat the areas cut with the approved tree paint.

J. Bare Root Plants: Roots of bare root plants shall be spread out and carefully worked into root system. Broken of frayed roots shall be cut off prior to planting.

K. Relocating Plants:

1. Prior to uplifting a palm to be relocated, prepare and approve the new location. This will involve placement of the soil mix and red sand in a pre-made hole, together with excavation and burial of the **dead men** or anchors with attached guy wires.

2. Palms to be relocated should be temporarily guyed or propped to prevent collapse prior to excavation of the root ball.

3. The leaf fronds shall be substantially reduced in number leaving only the 20

youngest ones closest to the growing point.

4. Root ball shall be carefully and evenly excavated around the sides gradually working underneath the root ball to the center of the tree. Slings should be attached around the trunk of the tree and the weight taken up by the crane prior to the final excavation below the root ball.

5. Once the root ball is free of the ground the crane shall lower the tree down to ground level, care being taken not to damage the foliage. Spray fronds with anti-desiccant spray to the quantities as in accordance with the manufacturer's recommendations and instructions. Tie up the fronds with hemp rope and the growing point wrapped in hessian from 1 m below the growing point to 1 m above. Tie up the trunk cutting back any untidy leaf midrib stalks ensuring the trunk is trimmed to an even state.

6. Move the tree to its new location. Immediately prior to planting, the roots shall be inspected and cut back to the root ball leaving roots clean cut. Cut away rotting or diseased roots and treat with tree paint.

7. Lift tree into position ensuring the root ball is planted 150 mm deeper than originally grown with reference to proposed finished grade then surround the root ball by red sand. Backfill the soil mix and the red sand to achieve finished grade.

8. Install guy wires with wire markers, covers and turnbuckles, tighten and position the tree to a balanced and vertical position. Due to the growth habit of some of the larger palms to be relocated this may not be precisely vertical, however, the tree shall appear in a structurally correct orientation.

9. For palm trees to be supplied from off-site location the orientation sequence shall be the same, however, the trunk trimming shall be done by the Contractor and not by the supplier.

10. If palms have to be stored, this shall be for the shortest possible time during which they shall be kept in a shaded location with the root ball wrapped in hessian.

L. Trees:

1. Plant trees in pits of diameters as indicated on the Drawings. Use the specified soil mix as a backfill.

2. Water trees each day for the first 3 months.

M. Shrubs and Ground Covers:

1. Plant shrubs, ground covers and climbers in a prepared soil mix bed, 450 mm deep for shrubs and climbers and 300 mm deep for ground covers.

2. Plant shrubs and ground covers after planting the trees. Space as shown on drawings, adjusting as necessary to evenly fill planting bed using specific quantity of plants.

3. Final grade of beds shall be 50 mm below walkways and curbs.

4. No plants shall be taken from the nursery for planting until after the pits or holes for the plants have been properly excavated, watered, and prepared to receive the plant material.

N. Watering and Adjusting:

12. Water plants thoroughly after setting. During and immediately after watering, adjust plants as necessary to ensure correct depth of planting, vertical alignment and/or natural profile.

13. Firm soil around each plant as final adjustments are made. Form the saucer required for holding mulch and water at this time.

14. Dispose excess soil resulting from planting excavation off the site or as directed by the Engineer.

O. Pruning, Staking and Guying:

1. Pruning: To be limited to the minimum. To be used for removing broken twigs and branches and to compensate for the loss of roots dying while transplanting. Paint cuts of 19 mm in diameter using an approved tree wound paint. Trimming performed in excess of, or contrary to, the requirements will not be acceptable, and the plant so pruned shall be replaced with a new one.

2. Staking and Guying: Set trees plumb and brace rigidly in position. Tamp soil mix solidly around ball prior to staking or guying. Complete Staking and guying operations immediately after planting. Perform work in the manner illustrated on Drawings. Care shall be taken to ensure that the stake does not rub against any part of the tree or penetrate root ball. Nail two galvanized clout nails to the stake to prevent slippage.

P. Mulching: Place gravel mulch, of the required thickness, planted areas and where indicated.

Q. Lawns/Grass Areas:

1. The soil mix shall be filled to 30 mm above finished hardscape (if adjacent) to allow for settlement to be level with the top of hardscape. If greater settlement occurs and the top of the soil is below the finished level of the hardscape, the soil area shall be topped up to even grades blending in with the adjacent areas ensuring a level finish with the paving.

2. The prepared soil-filled lawn area shall then be watered for 14 days at normal lawn applications rates to ensure the soil is evenly watered.

3. Prior to seed application the soil shall be fumigated for the elimination of weeds, seeds, insects and other noxious items. This fumigation shall be in the form of methylbromide or equivalent. The Contractor shall submit a work plan stating the chemicals, dosing and method of operation prior to application.

4. Fertilizer shall be applied and incorporated into the top surface of the soil at a rate recommended by seed manufacturer.

5. The soil shall then be finally fine graded and compacted with a 136 Kg water-filled roller to 80% weight compaction. Only after this grading is completed and approved by the Owner's Representative will the Contractor be permitted to sow the seed.

6. Seed Growing: Grass seed shall be sown at the rate recommended by seed manufacturer, unless specified otherwise in the plant schedule. Seed distribution shall be by mechanical method, or in small areas by hand, by experienced workmen to ensure an even distribution of seed, hence establishment. Once sown, the seed shall be lightly raked into the surface. In areas with no existing shade, the Contractor may, at his discretion, cover the soil surface with hessian to assist in germination. The area should then be lightly and evenly irrigated to ensure wetting of the seed.

7. Roll area to smooth, evenly finish and compaction.

8. Soil surface to remain moist at all times during turf establishment period. Any dry areas shall be replanted.

9. If hessian is used, the Contractor shall lift the hessian carefully to limit any damage to the young grass shoots once established.

10. Re-sow or replant all bare areas at intervals necessary to establish a full sward over the entire area.

11. The first cutting of the young grass shall not take place until the average length is 75 mm.

R. Lawn Establishment and Maintenance

1. Lawn establishment period to be approximately 90 days. This period will be extended as necessary until an even sward is achieved.

2. At the time of first cutting and removal of grass cuttings, the grass sward shall be closely inspected for the following:

   a. Low Areas: The Owner’s Representative may require that the sod be lifted in low areas, topsoil added and the sod be re-laid and lightly rolled.

   b. Disease: The sward shall be closely inspected for any insect pests, fungus or other biological organism attack, and treated as necessary.

   c. Fertilizer: The sward color and growth habit should be inspected and a light application of fertilizer given to promote more even growth. Type of fertilizer and quantity shall be as recommended by the sod manufacturer.

   d. Watering: Water application to consist of deep wetting 3 times per week during early morning hours for warm month periods and 1-2 times per week during cool months. Adjust irrigation control timing accordingly to avoid frequent, light applications and daytime irrigation.

3. Once established and the lawn is a continuous green sward, it should be cut as necessary when the average length of the sward is 75 mm, cutting down to 30% with the clippings being removed immediately after cutting; the precise number of cuts depending on growth rate.

S. Maintenance, Guarantee and Replacement:

1. Maintain landscape planting for one full calendar year after completion of the Project. Replace providing new materials similar in specifications to the damaged or dead plants or area of planting judged by the Engineer to be dead or damaged through lack of maintenance or otherwise unsatisfactory within this period at no additional cost to the Owner.

2. Maintenance includes watering, weeding, mulching, cultivating, tightening or replacing stakes, firming in and pruning. Re-plant a minimum quantity of spare plant materials of all species specified in this Project. Occasional site visit of a horticultural specialist shall be the responsibility of the Contractor during the warranty period.

3. Whenever possible, watering will be done at night to minimize evaporation and burning of plants. Do not over-water or allow water to fall on walks, streets, building or other structures.

4. Supplemental Fertilizing: At bi-monthly intervals after planting (starting 1 month after planting), trees, shrubs, ground covers and climbers shall receive supplementary fertilizer applied at the following rates:

   - Trees over 50 mm caliper: 45 g each
   - Trees under 50 mm caliper: 23 g each
   - Shrubs/Ground Covers and Climbers: 23 g each

5. Apply supplemental fertilizer at a distance not closer than 150 mm to trunks of trees or shrubs. Wash off immediately any fertilizer on the foliage of plants. Water fertilized areas in sufficient quantity to wet entire root structure of plants.

6. Herbicides and Pesticides: If it proves necessary to use herbicides or pesticides, submit a schedule of materials to be used containing the constituent chemical, manufacturer application rate, application method and application interval to the Engineer for approval.

7. Stake, Tree Tie and Hessian Removal: Prior to maintenance handover, inspect stakes, tree ties and hessian wrapping and remove materials that are no longer required to support healthy plant growth. Adjust or remove materials that are to be left in place as necessary to ensure proper plant growth.

8. Maintenance Handover: Contact the Engineer 45 days prior to the end of the maintenance period and provide the opportunity for the Owner's personnel to familiarize themselves with the landscaping maintenance work.

9. Submit monthly maintenance reports to the Engineer indicating nature and extent of maintenance work performed, including watering, cultivation, spraying and fertilizing, as well as plant losses and dates of replacement.

3.4 CLEAN-UP

A. Upon the completion of construction, and before final acceptance, broom-clean hard surfaced areas within the contract limits. Remove tools, surplus materials, and equipment as well as debris and leave the site in a neat and acceptable condition meeting the approval of the Engineer.

END OF SECTION

DIVISION - 3

CONCRETE

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. ACI - American Concrete Institute:

ACI 301 Specifications for Structural Concrete for Buildings

ACI 318 Building Code Requirements for Reinforced Concrete

ACI 347 Recommended Practice for Concrete Formwork (ANSI A145.1)

B. APA - American Plywood Association:

APA High Density Overlaid Concrete Form, Class 1

APA Structural 1, Exterior Quality, Class 1

APA Plastic Overlaid Plywood Forms

C. ANSI - American National Standard Institute:

A199.1 Construction and Industrial Plywood

1.3 SUBMITTALS

A. Product's Data: Submit manufacturer's specifications and installation instructions for proprietary materials and items as required, including form coatings, manufactured form systems, ties and accessories.

B. Detail Shop Drawings: Submit data on sequence of the concrete placement, location of construction joints, camber details, bearing values of the soils supporting false-work under wet and dry conditions, the anticipated settlements as well as false-work release sequence.

1.4 QUALITY ASSURANCE

A. Design, construct, erect, support, brace, maintain and remove forms according to ACI 318, Parts 1, 2, and 3 requirements as well as ACI 347 requirements for loads, lateral pressure and allowable stresses; in addition to other design parameters such as wind loads.

1. Construction: Construct formwork so that cast concrete surfaces will conform to the requirements of ACI 301, Chapter 4, Paragraph 4.3 Tolerances.

2. Hydraulic Pressure: Maximum allowable deflection of forming surfaces from concrete pressure will be length/360 between supports.

3. Provide surveys as required to check the lines and levels of the completed formwork for exposed concrete before concrete is placed. Make the required corrections or adjustments to formwork to correct deviations which exceed the specified tolerances.

4. Check formwork during concrete placement to ensure forms, shores, false-work, ties and other features have not been unduly disturbed by concrete placement methods or equipment. Report in writing to the Engineer deviations from the allowable tolerances.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Formwork:

1. Unless otherwise specified construct formwork of plywood, metal, metal-framed plywood-faced or other panel type materials acceptable to Engineer to provide continuous, straight, smooth surfaces. Provide formwork in the largest practice sizes to minimize number of joints and to conform to joint system indicated on Drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Provide wood forms of minimum thickness of 16 mm.

2. Use overlaid plywood complying with U.S. Product Standard PS-1, A-C or B-B High Density Overlaid Concrete Form, Class 1.

B. Forms of Unexposed Finish Concrete: Provide forms of plywood, lumber, metal or glass-fiber reinforced plastic or other acceptable material.

C. Form Ties:

1. Provide factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal. Use Plastic cone type, with threaded steel rod. For water tanks or other water retaining structures use watertight form ties as recommended by the manufacturer.

2. Unless otherwise indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 38 mm from the outer concrete surface. Provide form ties which will not leave a hole larger than 25 mm diameter in the concrete surface.

3. Form ties fabricated on Project Site and wire ties are not acceptable.

D. Form Release: Non-staining, non-reactive, rust-preventive guaranteed not to affect bond of subsequent surface applications to concrete.

2.2 DESIGN OF FORMWORK

A. Design, erect, support, brace and maintain formwork to safely support vertical and lateral loads applied, until such loads can be supported by the concrete structure. Carry vertical and

lateral loads to ground by formwork system and in-place construction that has attained adequate strength for the purpose. Design and construct formwork of concrete members and structures to correct size, shape, alignment, elevation and position.

B. Design form and false-work to include assumed value of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability and other factors pertinent to safety of structure during construction.

C. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

D. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide back-up material at joints as required to prevent leakage and fins.

E. Design forms according to ACI 318, Parts 1, 2, and 3 requirements as well as ACI 347 requirements for loads, lateral pressure, and allowable stresses; in addition to other design parameters.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrate and conditions under which concrete formwork is to be performed. Correct any unsatisfactory conditions. Proceed with the work after unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.2 FORM CONSTRUCTION

A. General:

1. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions indicated and required to obtain accurate alignment, location, grades, level and plumb work in the finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustication, reglets, chamfers, blocking, screed, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain the required finishes.

2. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

3. Provide temporary openings where interior area of formwork is inaccessible for cleanout, inspection before concrete placement and placement of concrete. Securely brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

4. Form intersecting planes to provide true, clean-out corners, with edge grain of plywood not exposed as form for concrete.

B. False-work:

1. Erect false-work and support, brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct false-work so that adjustments can be made for take-up and settlement.

2. Provide wedges, jacks or camber strips to facilitate vertical adjustment. Inspect false-work and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure and make necessary adjustments to produce work of required dimensions.

3. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores cannot be secured.

4. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to an accurate alignment, free from irregularities and within allowable tolerances. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads for long span members without intermediate supports.

5. Provide temporary openings in wall forms and at other locations necessary to permit inspection and clean-out.

C. Forms for Exposed Concrete:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.

2. Do not use metal cover plates for patching holes or defect in forms.

3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.

4. Use extra studs and bracing as required to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material which will produce bow.

5. Assemble forms in a way to be readily removed without damage to exposed concrete surfaces.
6. Form moldings shapes, recesses and projections with smooth finish materials and install in forms with sealed joints to prevent displacement.

D. Corner Treatment:

1. Form exposed corners to produce square, smooth, solid, unbroken lines, except as otherwise indicated.

2. Provide chambers for surfaces where indicated on Drawings.

3. Unless otherwise indicated, form chamfers using wood strips 19 x 19 mm; accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

E. Control Joints: Locate control joints where indicated or as directed. Refer to Section 03300 - CAST-IN-PLACE CONCRETE for control and construction joints treatment.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases required for such work. Accurately place and securely support built-in items into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete placement. Re-tighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.3 FORM COATINGS

A. Coat form contact surfaces with form-coating compound before placing the reinforcement. Provide form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

B. Coat steel forms with a non-staining, rust-preventive form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by the suppliers of these items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screed required.

C. Metal Inserts:

1. Provide metal inserts for anchorage of materials or equipment to concrete construction, as required for the work.

2. Provide adjustable wedge inserts of malleable cast iron, complete with bolts, nuts and washers; 19 mm bolt size unless otherwise indicated.

3. Provide threaded inserts of malleable cast iron, furnish complete with full-depth bolts; 19 mm bolt size, unless otherwise indicated.

4. Provide box-out sections in concrete work as required for installation of equipment or other work.

5. Coordinate location of all required embedded weld plates and other items for attachment of precast concrete to cast-in-place concrete.

3.5 SHORES AND SUPPORTS

A. Shore floor directly under slab being placed so that loads from construction above will safely transfer directly to these shores. Space out shoring below this level in such a manner that no member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimum if required to ensure the proper distribution of loads and the safety of all concrete members.

B. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete, and to assure that the structure supported is not subjected to impact or loading eccentricities. Locate and provide adequate reshoring to safely support the work.

3.6 REMOVAL OF FORMS

A. Formwork not supporting concrete, such as sides of beams, columns, walls, and similar parts of the work (vertical faces) may be removed not less than 24 hours after placing concrete provided that concrete is sufficiently hard and will not be damaged by form removal operations, and provided that curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as slabs and other structural elements must remain in place for the time period shown in ACI 347, Section 3.6.2.3 (assuming design live load is less than dead load) and until concrete has attained design minimum 28 day compressive strength determined by field-cured specimens as defined below. Do not remove forms until the approval has been obtained from the Engineer.

C. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of the concrete location of members, as specified in Section 03300 - CAST-IN-PLACE CONCRETE.

D. Form facing material may be removed not less than 4 days after placement, provided shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports and provided that concrete has achieved adequate compressive strength to safely support the load.

E. Removal of Forms:

1. Use necessary means and precautions to protect workmen, passer-by, the installed work and material of other trades and complete safety of structure.

2. Cut nails as well as form ties off flush leaving surfaces smooth and clean.

3. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surfaces and pointing up and rubbing the resulting pockets to match surrounding surfaces.

4. Flush holes resulting from spreader rods and sleeve nuts, using water, and solidly pack throughout the wall thickness with cement grout applied under pressure by means of grouting gun; grout shall be one part cement to 2-1/2 parts sand; apply grout immediately after removing forms.

3.7 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated or otherwise damage form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

B. When forms are extended for successive concrete placement thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Steel reinforcement for cast-in-place concrete as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. ACI - American Concrete Institute

ACI 315 Details and Detailing of Concrete Reinforcement

ACI 318 Building Code Requirements for Reinforced Concrete

B. ASTM - American Society for Testing and Materials

ASTM A 82 Steel Wire, Plain, for Concrete Reinforcement

ASTM A 184 Fabricated Deformed Steel Bar Mats, for Concrete Reinforcement

ASTM A 185 Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 497 Welded Deformed Steel Wire Fabric, for Concrete Reinforcement

ASTM A 615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement

C. CRSI - Concrete Reinforcing Steel Institute

CRSI MSP-1 Manual of Standard Practice Placing Reinforcing Bars, Chapter 3

D. AWS - American Welding Society

AWS D12.1 Structural Welding Code

AWS D12.4 Structural Welding Code - Reinforcing Steel

1.3 SUBMITTALS

A. Mill Certificates: Submit steel producer's certificates of mill tests for reinforcing steel. Mill certificates will indicate chemical and physical properties of steel bars, including records of tensile and bend tests from Independent Testing Agency.

B. Shop Drawings: Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures showing bars, arrangements and assemblies as required for fabrication and placement. Include special reinforcement required at openings through concrete structures.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver reinforcement to site bundled, tagged and marked. Use metal tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.

B. Store concrete reinforcement materials at site off the ground and in covered storage sheds to prevent damage, rust and accumulation of dirt or deleterious materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Reinforcing bars shall be free of loose or flaky rust and mill scale or coating, including any other substance that would reduce or destroy bond with concrete.

B. Reinforcing Bars: Conform to SASO 2; or ASTM A 615 including supplementary requirement S1; or ASTM A 706. Use Grade 60 (fy = 415 MPa) deformed bars, unless otherwise indicated on Drawings.

C. Steel Tie Wire: Conform to ASTM A 82 plain cold-drawn steel, (fy = 465 MPa).

D. Welded Wire Fabric: Conform to SASO 224 or ASTM A 185, (fy = 500 MPa).

E. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.

1. Use wire bar type conforming to the recommendations of CRSI or precast concrete type supports, and as approved by the Engineer, unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.

2. For exposed concrete surfaces, where legs of supports are in contact with forms, provide supports with plastic spacers.

2.2 FABRICATION

A. General:

1. Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 315.

2. Reinforcement shall be bent cold unless otherwise permitted by the Engineer.

3. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the work:

1. Bar lengths, depths and bends exceeding specified fabrication tolerances.

2. Bends or kinks not indicated on Drawings or final shop Drawings.

3. Bars with reduced cross-section due to excessive rusting or other cause.

4. Bars with surfaces having rust, rust scale or loose mill scale or contaminated with dirt, earth, paints, oils or other deleterious material.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrate as well as the conditions under which concrete reinforcement shall be installed and correct any unsatisfactory conditions. Proceed with the work after correcting unsatisfactory conditions in an acceptable manner to the Engineer.

3.2 INSTALLATION

A. Comply with the specified codes and standards, and **Concrete Reinforcing Institute** recommended practice for placing reinforcing bars, for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement to remove rust, rust scale and loose mill scale, dirt, earth, paints, oils or other deleterious material.

C. Position, support and secure reinforcement against displacement by formwork construction, or concrete placement operations. Locate and support reinforcing by chairs, runners, bolsters, spacers and hangers, as required.

D. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space and securely tie bars and bar supports together with 1.6 mm annealed wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed away from exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces as indicated but at least one full mesh and lace splices with 1.6 mm annealed wire. Offset end laps in adjacent widths to prevent continuous laps.

F. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 50 mm beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

G. Splices: Provide reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Comply with requirements on Drawings for location and lap of splices or, if no requirements are shown or indicated, with ACI 318 for minimum lap of spliced bars.

H. Protect reinforcement when not being worked and until placement of concrete by covering with polyethylene or similar impermeable sheeting.

I. No welding of reinforcement shall be permitted.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Establishing general criteria for materials and mixes of cast-in-place concrete indicated on Drawings.

B. Cast-in-place concrete as indicated on Drawings and as specified herein.

C. Expansion and contraction joints, bearing pads and water stops for cast-in-place concrete works.

1.02 REFERENCES

A. ACI - American Concrete Institute

ACI 117	Standard Tolerances for Concrete Construction Material
ACI 211	Recommended Practice for Selecting Normal and Heavyweight Concrete
ACI 214	Recommended Practice for Evaluation of Compression Test Results of Field Concrete
ACI 301	Specification for Structural Concrete for Buildings
ACI 302	Recommended Practice for Concrete Floor and Slab Construction
ACI 304	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI 305	Recommended Practice for Hot Weather Concreting
ACI 308	Curing Concrete
ACI 309	Recommended Practice for Consolidation of Concrete
ACI 318	Building Code Requirements for Reinforced Concrete
ACI SP-66	ACI Detailing Manual

B. ASTM - American Society for Testing and Materials

ASTM C 31	Practice for Making and Curing Concrete Test Specimens in the field
ASTM C 33	Specification for Concrete Aggregates
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42	Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium sulphate or Magnesium Sulphate
ASTM C 123	Test Method for Lightweight Pieces in Aggregates
ASTM C 138	Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete
ASTM C 142	Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C 143	Test Method for Slump of Portland Cement Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 156	Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	Specification for Sheet Materials for Curing Concrete
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM C 535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 685	Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 881	Specification for Epoxy-Resin-Base Bonding System for Concrete
ASTM D 75	Practice for Sampling Aggregates
ASTM D 1190	Specification for Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1191	Methods of Testing Concrete Joint Sealers
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete

	Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
ASTM D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 11	Specification for Wire Cloth Sieves for Testing Purposes
ASTM E 96	Test Methods for Water Vapor Transmission of Materials
ASTM E 154	Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

C. CRD - US Army Corps of Engineers

CRD-C 119	Flat and Elongated Particles in Coarse Aggregate
CRD-C 120	Flat and Elongated Particles in Fine Aggregate
CRD-C 400	Requirements for Water for Use in Mixing or Curing Concrete
CRD-C 513	Rubber Waterstops
CRD-C 572	Poly-Vinyl-Chloride Waterstops
CRD-C 589	Sampling and Testing Expansive Grouts

D. AASHTO - American Association of State Highway and Transportation Officials

AASHTO M 182	Burlap Cloth Made from Jute or Kenaf

1.03 SUBMITTALS

A. Detailed Drawings and Shop Drawings.

B. Design Analysis and Calculations: Where provision of design is specified in Contract Documents.

C. Product's Data: Submit manufacturer's specifications with application and installation instructions for proprietary materials and items including fusion bonded epoxy coated reinforcing bars, admixtures, bonding agents, waterstops, joint systems, chemical floor hardeners, coal tar epoxy paint, polyvinyl-chloride liner, polyethylene vapor barrier and dry shake finish materials.

D. Samples: Submit samples of materials as specified and as otherwise may be requested by Engineer, including names, sources and description as required.

E. Laboratory Test Reports: Submit copies of laboratory test reports for concrete materials and mix design tests or other certificates for concrete.

F. Material Certificates: Material certificates shall be signed by material manufacturer and the Contractor, certifying that each material item meets or exceeds the specified requirements.

G. Grout to be exposed to or in contact with soil and/or groundwater, substantiating suitability for specified environmental conditions.

H. Concrete mix design.

I. Placement Schedule: Prepare a placement schedule and submit to Engineer for review prior to start of concrete placement operations.

J. Methods of furnishing and delivering concrete in hot weather.

1.04 TRANSPORTATION, HANDLING, STORAGE, AND PROTECTION

A. Cement: Upon delivery at site of work, store cement separately in dry, weathertight, properly ventilated structures, with adequate provision for prevention of absorption of moisture.

B. Aggregates: Store aggregates in a manner to assure good drainage, to preclude inclusion of foreign matter, and to preserve the gradation. Protect fine aggregate from wind-caused segregation.

C. Admixtures: Store admixtures at temperatures and under conditions recommended by the manufacturer. Protect each type of admixtures from contamination and intermingling with other materials as well as other admixtures.

D. Water: Store and transport in a manner to prevent heating of water.

E. Coal Tar Epoxy Paint: Packaging, labeling, delivering, and storing shall be in accordance with manufacturer's published instructions and recommendations.

F. Polyethylene Vapor Barrier: Protect vapor barrier from exposure to sunlight and according to the manufacturer's published instructions.

1.05 QUALITY ASSURANCE

A. Samples and Testing: Perform tests specified herein by an independent testing laboratory meeting the requirements of ASTM E 329 and approved by Engineer. Provide testing and laboratory services at no cost to the Owner.

B. Cement: Submit certified copies of laboratory test reports furnished by cement manufacturer for each lot of cement including test data, results and certification using sampling and testing procedures that are in conformance with the Contract Documents.

Sampled cement shall be tested as required by Engineer. 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 retested before use. Cement found unsatisfactory under test shall be immediately removed from site.

C. Aggregates: Conform to ASTM D 75. Use no aggregates until test results are approved by Engineer.

D. Water: Potable and in conformance with the requirements of the local authorities having jurisdiction.

E. Admixtures: Sampling and testing of admixtures used in concrete mix shall be in

accordance with ASTM C 494. No admixture shall be used until test results are satisfactory.

F. Slump: Conform to ASTM C 143 and shall be performed in field under Engineer's supervision.

G. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing, when acceptable to Engineer. Certificate of compliance must be signed by the material producer and the Contractor.

H. Workmanship:

1. Repair concrete work not conforming to the specified requirements, including strength, tolerances and finishes.

2. Correct deficient concrete as directed by Engineer at no cost to Owner.

When the results of strength tests of specimens shows failure to meet the specification requirements or where there is other evidence that quality of concrete is below requirements, core boring tests shall be made in conformance with ASTM C 42 and ACI 318.

If deficient, a structural analysis shall be made followed by a load test, where applicable at no cost to Owner. Evaluation of results shall conform to ACI 318, Chapter 20.

2. PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Portland Cement: Types indicated herein shall comply with ASTM C 150 or SASO 143. Content of tricalcium aluminate (C_3A) shall not exceed 12% in Type I cement and 5 % in Type V cement.

1. For Concrete Work in Contact with Ground and below Ground Level: Provide concrete using Type I cement conforming to ASTM C150 modified with pozzolan or silica fume or microsilica or approved equal. Silica fume or microsilica, a pozzolanic material shall consist of more than 90% silicon dioxide with average particle size of approximately 0.15 micrometers. Silica fume or microsilica and shall be added to concrete mix at the rate of 8-10% weight of cement as per recommendations of Manufacturer and as approved by the Engineer.

2. For concrete work above ground floor level: Provide concrete using Type I cement.

3. Use only one brand of cement for each required type throughout the project, unless otherwise approved by Engineer.

4. Cement acceptance: Based on manufacturer's mill certificate certifying that furnished cement conforms to physical and chemical requirements of ASTM C 150. Engineer reserves the right, however, to sample and conduct such tests on cement as deemed necessary for compliance with Specification.

B. Water: Water for washing aggregate, mixing and curing concrete shall be free from

injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.

C. Aggregates: ASTM C 33 and as specified herein:

1. Supply aggregates from a source approved by Engineer and capable of supplying a sufficient quantity for the entire contract.

2. Maximum aggregate size:

a. For Suspended Slabs, Beams, Girders, Walls and Columns: 20 mm maximum.

b. For Footings, Thickened Slabs, and Slab on Grade: 40 mm maximum.

D. Fine Aggregates:

1. Fine aggregates: Natural sand or manufactured sand or a combination of the two with a composition of clean, hard, durable spherical or cubical particles

2. Limit the salt content of fine aggregate so as not to exceed limitations set out in Table 1 - TOTAL ALLOWABLE SALTS CONTENT.

TABLE 1 - TOTAL ALLOWABLE SALTS CONTENT

	MAXIMUM ALLOWABLE PERCENTAGE BY MASS		
	IN FINE AGGREGATE BY WEIGHT OF FINE AGGREGATE	**IN COARSE AGGREGATE BY WEIGHT OF COARSE AGGREGATE**	**TOTAL BY WEIGHT OF CEMENT**
Chlorides (NaCl)	0.06	0.05	0.13
Sulphates (SO_3)	0.04	0.50	4.00

Shaded areas includes maximum percentage of salts in cement, water, and in other mix constituents of concrete.

3. Limit deleterious substances in fine aggregate to the amounts shown in Table 2 - ALLOWABLE DELETERIOUS SUBSTANCES IN FINE AGGREGATE.

TABLE 2 - ALLOWABLE DELETERIOUS SUBSTANCES IN FINE AGGREGATE

ITEM	**MAXIMUM ALLOWABLE**

	PERCENTAGE BY MASS
Clay Lumps and Friable Particles	3
Material Fiber less than 75 micron, No. 200 sieve	3
Lightweight Particles (determined in accordance with ASTM C 123)	0.50

Total of deleterious materials shall not exceed 3 percent of the weight of aggregate.

4. Grading of fine aggregate shall be within the limits shown in Table 4 - GRADING LIMITS OF COMBINED FINE AGGREGATE MIX FOR CONCRETE.

E. Coarse Aggregates:

1. Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone or a combination of the two, and shall be composed of clean, hard, uncoated particles.

2. Salt content of coarse aggregate shall not exceed the limitations as set out above in Table 1 - TOTAL ALLOWABLE SALTS CONTENT.

3. Deleterious substances shall be limited in the coarse aggregate to the amounts shown below in Table 3 - ALLOWABLE DELETERIOUS SUBSTANCES IN COARSE AGGREGATE.

TABLE 3 - ALLOWABLE DELETERIOUS SUBSTANCES IN COARSE AGGREGATE

	MAXIMUM ALLOWABLE PERCENT BY MASS			
TYPE OR LOCATION OF CONCRETE	**CLAY LUMPS & FRIABLE PARTICLES (%)**	**MATERIAL FINER THAN 75 MICRON** (%)**	**ABRASION LOSS**	
			500 REVS.	**100/500 REVS.**
Slab subject to traffic abrasion, floors, sidewalks & pavements	1.00	1.00	35	0.25
Other classes of concrete	3.00	2.00	40	0.28

** ASTM Sieve No. 200

4. Coarse aggregate grading shall be set within the limits shown in Table 4 - GRADING LIMITS OF COMBINED FINE AND COARSE AGGREGATE MIX FOR CONCRETE.

TABLE 4 - GRADING LIMITS OF COMBINED FINE AND COARSE AGGREGATE MIX FOR CONCRETE

ASTM SIEVE (mm)	Percentage Passing (by Mass)	
	Grading A	Grading B
50	100	-
38.1	90 - 100	100
19	65 - 85	90 - 100
9.5	35 - 60	55 - 70
4.75	25 - 45	35 - 55
2.36	22 - 40	30 - 45
1.18	18 - 38	25 - 42
0.16	15 - 33	22 - 38
0.30	6 - 17	10 - 20
0.15	0 - 6	0 - 8
75 micron	0 - 2	0 - 2

2.02 MISCELLANEOUS MATERIALS

A. Concrete Admixtures:

1. Use admixtures complying with ASTM C 494 Types A, B, D, F or G provided that they are included in mix design and subject to Engineer's approval. Admixtures containing calcium chloride ions or other ions producing deleterious effect shall not be permitted.

2. Compatibility of admixtures with the brand of cement being used shall be determined by testing samples at temperatures at which materials will be used and over a period of time representative of the proposed mixing and delivery period. Test shall demonstrate that the admixture used shall not cause either short or long term deficiencies in the quality and durability of the concrete.

B. Joint Materials and Bearing Pads:

1. Joint Filler: Provide bituminous fiber joint filler conforming to ASTM D 1751 of thickness and widths as shown on Drawings. Joint filler shall be preformed expansion joint filler board recommended for joints in concrete slabs on grade and pavings manufactured from high grade fibers which are bitumen impregnated and compounded into compressible non-extruding board.

2. Joint Sealing Compound: Two-component polyurethane elastomeric compound complying with the requirements of Section 07900 - SEALANTS unless indicated otherwise.

3. Where required, provide Neoprene bearing pads of durometer hardness: Grade 60.

C. Waterstops:

1. Flat, dumbbell or center bulb type waterstops shall be of high quality poly-vinyl-chloride granules. PVC waterstops size shall be as recommended by manufacturer

for the intended application, unless otherwise shown on Drawings, with minimum 10 mm thickness and not less than 150 mm width. Only butt joints may be made on site using manufacturer's equipment and in accordance with the manufacturer's instructions. Junction pieces must be factory made by manufacturer. PVC waterstops shall have a 100 percent solids content, 13.7 MN/m tensile strength and 285 percent elongation at break with a minimum tear resistance 75 kN/m. Waterstops shall have excellent resistance to sewage, dilute acids and alkalis. Materials shall comply with the requirements of CRD-C 572 or equivalent.

D. Vapor Barrier:

1. Polyethylene sheeting conforming to ASTM D 4397, minimum 200 microns thick having a vapor permeance rating not exceeding 0.063 perms, and shall be laid with 300 mm overlapping.

E. Bonding Agents:

1. Chemical Bonding Agent: Film-forming, freeze-thaw resistant compound suitable for brush or spray application.

2. Epoxy-Resin Bonding Agent: A two-component, mineral filled, epoxy-polysulphide polymer.

F. Concrete Curing Materials:

1. Absorptive Cover: Conform to AASHTO M 182, Class 3; burlap cloth made from jute or kenaf and with a minimum density of 290 gm/m².

2. Moisture-Retaining Cover: Provide one of the following in compliance with ASTM C 171:

a. Waterproof paper.

b. Polyethylene film.

c. White burlap-polyethylene sheet.

3. Liquid Curing Compound: Conform to ASTM C 309, Type 1. Material for use on slabs to which topping is to be bonded shall be a degrading type which shall not inhibit the bond between topping and slab. When non-pigmented compound is used, it shall contain a fugitive dye. Aqueous solution of sodium silicate with non-

acid penetrating agent, reacting chemically with free lime in concrete to form a hard, non-dusting surface.

G. Floor Finish Material:

1. Chemical Floor Hardener: Colorless aqueous solution containing a blend of magnesium flourosilicate and zinc flourosilicate combined with a wetting agent,

containing not less than 240 g of flourosilicate per liter. Apply to exposed concrete slabs not indicated or scheduled to receive subsequent finishes.

2.03 CLASSES OF CONCRETE

A. Water-cement ratios listed in the following table are maximums, cement contents and compressive strengths are minimums. There shall be no increase in water-cement ratio or reduction in cement content based upon attainment of compressive strengths higher than those specified.

CLASSES OF CONCRETE	20	30	35
28-DAYS COMPRESSIVE STRENGTH TEST CYLINDER (N/mm^2)	20	30	35
MINIMUM CEMENT CONTENT - 100 mm SLUMP (Kg/m^3)	250	360	400
MAXIMUM FREE WATER CEMENT RATIO (BY WEIGHT)	0.55	0.43	0.43

2.04 MIX DESIGN

A. If the fine aggregate conforms to ASTM C 33, the mix design shall be in accordance with ACI 301. If the fine aggregate does not conform with ASTM C 33, the mix design shall be based upon trial mixes. Trial mixes shall be proportioned under the supervision of Engineer. Mix design shall be initiated within two months after award of Contract and shall include at least the following:

1. For each specified cement content and the maximum water-cement ratio, develop curves comparing slump to percentage of fine aggregate ratios. Select fine to coarse aggregate ratios to produce mixtures ranging from excess fine aggregate to excess coarse aggregate with insufficient mortar to fill the voids. Optimum fine to coarse aggregate ratio shall be the one at which the higher slumps are produced for the specified water-cement ratio. Record and plot the combined aggregate gradations to reflect limits of acceptable and unacceptable combinations of ingredients. Further testing shall be done at fine to coarse aggregate ratios which will produce adequate workability for the construction for which the mixture is being used while maintaining the lowest possible water-cement ratio.

2. Develop curves of water-cement ratio versus compressive strength for at least five water-cement ratios.

3. Develop curves comparing compressive strength data from at least five different cement contents ranging from 20 MPa to 30 Mpa 28-days cylinder strength for each optimum aggregate ratio and the aggregate ratio judged most workable for general casting.

4. For the mixes judged appropriate for construction, prepare strength gain curves for 3, 5, 7, 14, 28, and 56-day strengths.

5. Provide cement chemical and physical test results for different types of cement used.

6. For each trial batch, record the following:

   a. Weight and absolute volumes of proposed mixtures. Express aggregate weights in saturated-surface-dry condition.

   b. Slump.

   c. Individual aggregate gradations and calculated mixture combined aggregate grading.

   d. Temperatures.

   e. Wet and dry densities.

   f. Aggregate moisture contents.

   g. Water-cement ratio corrected for aggregate absorption.

   h. Test specimen curing procedures.

   i. Compressive strength at each age.

7. Slump Limits:

   a. Proportion and design mixes to result in concrete slump at the point of placement as follows:

      (1) Sloping Surfaces: 75 mm maximum slump.

      (2) Reinforced Foundation Systems: 50 mm minimum, and 75 mm maximum slump.

      (3) Other Concrete: 100 mm maximum slump.

   b. Slump of concrete with super-plasticizer shall not exceed 250 mm.

3. PART 3 - EXECUTION

3.01 BATCHING AND MIXING CONCRETE

A. Concrete may be mixed at batch plants or it may be transit mixed as specified herein. Batch plants must comply with the requirement of ACI 304, with sufficient capacity to produce concrete of the qualities specified in quantities required to meet construction schedules. Plant facilities are subject to testing, laboratory inspection as well as approval by Engineer. Quantities by weight of concrete ingredients, measured separately for each batch with date, time, and mix number shall be recorded.

B. Truck Mixers: When a truck mixer is used to complete mixing of central plant batched

materials, water shall be added at mixing speed before completion of mixing. Retempering of concrete will not be permitted. Each truck shall carry a ticket stamped by time clock to show date and time the loading of each truck was completed. Trucks shall meet the requirements specified in ACI 304.

C. Job site mixing will not be permitted.

D. Ready-Mix Concrete:

1. Comply with the requirements of ASTM C 94, as specified herein, provided the quantity, rate of delivery and unrestricted progress of work permitted, in accordance with placement schedule. During hot weather, and/or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required, as specified below. Proposed changes in mixing procedures other than herein specified, must be accepted by Engineer before implementation.

3.02 FIELD QUALITY CONTROL

A. Employ an approved separate testing laboratory to perform field quality control testing.

B. Quality Control Testing During Construction:

1. Sampling Fresh Concrete: Conform to ASTM C 172, except modified for slump to comply with ASTM C 94.

2. Slump: Conform to ASTM C 143; one test for each concrete load at point of placement and one for each set of compressive strength test specimens.

3. Concrete Temperature: Test daily when air temperature is 26°C. and above, and each time a set of compression test specimens made. Test concrete temperature throughout the pour when the ambient temperature exceeds 30°C.

4. Compressive Strength Tests: Provide one set of 6 standard cylinders for each 20 m^3 or fraction thereof, of each mix design placed in any one day or for each 100 m^2 of surface area placed; 2 specimens tested after 7 days, 3 specimens tested after 28 days, and one specimen retained in reserve for later testing if required. Additional test specimens may be cast for construction progress control and form stripping.

a. When the frequency of testing will provide less than 5 strength tests for a given mix design, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

b. When the strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

5. Testing laboratory shall report test results in writing to Engineer, and Ready-Mix supplier on the same day that tests are made. Reports of compressive

strength tests shall contain Project identification name and number, date of concrete placement, name of Contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength and type of break for both 7-day tests and 28-day tests.

C. Additional Tests:

1. The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strengths and characteristics +have not been attained in the structure, as directed by Engineer. The testing service shall conduct tests to determine the strength and characteristics of the in-place concrete by compression tests on cured cylinders complying with ASTM C 42, or by load testing specified in ACI 318, or other acceptable non-destructive testing methods, as directed.

D. Evaluation of Quality Control Tests:

1. Do not use concrete delivered to the final point of placement which has slump outside the specified values.

2. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of a set of three consecutive compressive strength tests results equal or exceed the 28-day design compressive strength of the type or class of concrete.

   No individual strength test shall fall below the required compressive strength by more than the value of 2.75 N/mm².

   a. Strength tests of specimen cured under field conditions may be required by Engineer to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded by field quality control laboratory at the same time and from the same samples as the laboratory-cured specimens.

   b. Provide improved means and procedures for protecting concrete when the 28-day compressive strength of field-cured cylinders is less than 5% of companion laboratory-cured cylinders.

   c. When laboratory-cured cylinder strengths are higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 2.75 N/mm² even though criterion is not met.

   d. If individual test of laboratory-cured specimens produce strengths more than 2.75 N/mm² below the required minimum compressive strength, or if tests of field-cured cylinders indicate the deficiencies in protection and curing, provide additional measures to assure that the load-bearing capacity of the structure is not jeopardized. If the likelihood of low-strength concrete is confirmed and computations indicate the load-bearing capacity may have been significantly reduced, tests of cores drilled from the area in question may be required.

e. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to correction at no extra cost to the Owner.

3.03 CONCRETE PRE-PLACEMENT INSPECTION

A. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and securely install all required inserts, anchors, sleeves, conduits and other items specified under other sections to be embedded or cast-in.

B. Where concrete is placed on ground or sub-course, the foundation upon which concrete is placed shall be clean, damp, and free from standing or running water. Prior to placing concrete, the earth foundation shall have been satisfactorily compacted and all subgrades approved by Engineer prior to placing concrete.

C. Soil at bottom of foundation systems are subject to testing for soil bearing value by the testing laboratory, as directed by Engineer. Place concrete immediately after approval of foundation excavations.

D. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

E. Polyethylene vapor barrier shall be placed between concrete blinding and concrete footing leaving extra width on both sides which shall then be tucked up to wrap the concrete footing after the form removal.

3.04 CONCRETE PLACEMENT

A. General: Place concrete in compliance with the practices and recommendations of ACI 301 and ACI 304 and as specified herein:

1. Deliver concrete from central plant to the place of final deposit in a continuous manner and without segregation or loss of ingredients. Suspend placing when the sun, heat, wind, or limitation of facilities prevent proper finishing and curing of the concrete. Place concrete in the forms or excavation as close as possible in final position, in uniform, approximately horizontal layers, not over 600 mm deep unless otherwise directed.

   Do not drop concrete freely for more than 1.5 m, nor allow it to drop freely through congested rebarring areas which could cause segregation. This drop distance may be increased by Engineer at his discretion where it can be shown by Contractor that a greater drop will not result in segregation. Tremies or other approved means shall be employed to eliminate segregation. Conduits and pipes shall not be embedded in concrete unless specifically indicated or specified. Do not place concrete in any form until forms have been inspected by Engineer and permission has been given to proceed.

2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete

from the project site and dispose of it off site at no extra cost to Owner.

B. Transportation Time Internal:

1. Concrete mixed in central plant and transported by non-agitating equipment shall be placed in the forms within 30 minutes. Concrete transported in truck mixers or truck agitators shall be delivered to the site and placed in the forms within 60 minutes. This time limitation may be increased by Engineer at his discretion when additional super-plasticizer is added to the concrete mix so as to retard the initial set for greater periods. In no case will additional water be added to the mix (tempering) after the concrete leaves the batching plant.

C. Conveying Concrete:

1. Concrete may be conveyed by chute, conveyor, or pump if so approved by Engineer. Aluminum chutes or pipelines shall not be used for conveying concrete. Approvals will not be given for chutes or conveyors requiring changes in the concrete design mix for desired operation. Conveying equipment shall be cleaned when not in use.

2. Chutes and Conveyors: Chutes shall be rounded in cross section, rigid in construction, protected from overflow and slopes not exceeding one vertical to three horizontal. Conveyors shall be designed to operate assuring uniform flow of concrete without segregation of ingredients, loss of mortar, or change in slump.

3. Pumps: Placing concrete by pumping methods shall conform with ACI 301 Chapter 8. Operate and maintain pumps so that a continuous stream of concrete is delivered into the forms without air pockets, segregation, or change in slump exceeding 5 cm. Use pumps which can pump mixes as designed. Mixes shall not be adjusted to accommodate smaller pumps.

D. Placing Concrete into Forms:

1. Deposit concrete in the forms for horizontal slabs in horizontal layers not deeper than 60 mm unless additional thickness is permitted by Engineer, and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

2. Consolidate concrete placed in forms with mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcements will not be permitted.

3. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 150 mm into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without

causing segregation of the mix.

4. In order to allow for shrinkage or settlement, at least 2 hours shall elapse after placing concrete in walls, columns or stems of deep T-beams before depositing concrete in girders, beams and slabs supported thereof, unless otherwise specified or shown on the plans.

5. Place concrete in girders, slabs and shallow T-beam construction in one continuous operation for each span, unless otherwise detailed. Deposit concrete uniformly for the full length of the span then bring up evenly in horizontal layers.

6. Place concrete in columns in one continuous operation to the bottom of the deepest super structure member framed over the column.

7. No concrete shall be placed in the super-structure until the column forms have been stripped sufficiently to determine the character of the concrete in the columns. Loads of superstructure shall not be allowed to come upon abutments, piers brackets and column bents until they have been in place at least 7 days, unless otherwise permitted by Engineer.

8. Maximum vertical drop in placing concrete shall not exceed 1.5 m.

E. Placing Concrete Slabs:

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

2. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

3. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

4. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in the remainder of slabs by vibrating bridge screed, roller pipe screed, or other acceptable methods. Limit the time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.

5. Bring slab surfaces to the correct level with a straightedge and strike off. Use bull floats to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on plastic surfaces. Do not disturb slab surfaces prior to finishing operations.

F. Bonding:

1. Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent, and clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and do not leave laitance, loose particles of

aggregate, or damaged concrete at the surface.

2. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:

   a. At joints between footings and walls or columns, and between walls or columns and beams or slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.

   b. At joints in exposed work: At vertical joints in walls; at joints in girders, beams, supported slabs and other structural members; and at joints designed to contain liquids, dampen, but do not saturate, the roughened and cleaned surface of set concrete and apply a liberal coating of neat cement grout.

   c. Use cement grout consisting of equal parts Portland cement and fine aggregate by weight and not more than 24 liters of water per sack of cement. Apply with a stiff broom or brush to a minimum thickness of 2 mm. Deposit fresh concrete before cement grout has attained its initial set.

   d. In lieu of neat cement grout, bonding may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instruction of the bonding material manufacturer.

   e. Prepare for bonding of fresh concrete to fully-cured hardened concrete by using an epoxy-resin bonding agent as follows:

      (1) Handle and store epoxy-resin adhesive binder in compliance with the manufacturer's printed instructions, including safety precautions.

      (2) Mix the epoxy-resin adhesive binder in the proportions recommended by the manufacturer, carefully following directions for safety of personnel.

      (3) Before depositing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy-resin grout not less than 2 mm thick. Place fresh concrete while the epoxy-resin material is still tacky, without removing the in-place grout coat, and as directed by the epoxy-resin manufacturer.

G. Hot Weather Placing:

1. Unless otherwise approved, concreting shall be considered Hot Weather Concreting, as defined by ACI 305, and shall be in accordance with the recommended practice of ACI 305. Ample water supply, hoses, and foggers shall be available at all concrete placements.

2. At the time of placement, the temperature of the concrete shall not exceed 32°C. Concrete exceeding the specified temperature shall be rejected and

dumped at a designated disposal area.

3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 32°C. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water. Ice shall be completely melted prior to completion of mixing of concrete.

4. Reinforcing steel and forms shall be protected from direct sun rays and shall be cooled with water immediately before concrete placing so that the concrete temperature specified can be maintained.

5. The temperature of the concrete shall be determined immediately before placement.

6. Provide means to limit the temperature rise of mass concrete to reduce undesirable thermal stresses and cracking. Such means shall include limitation of rate of placement, placement of concrete during cool weather, precooling concrete ingredients, artificial cooling, or other approved methods.

3.05 JOINTS

A. Construction Joints:

1. Clean surface of concrete construction joints and remove laitance.

2. Immediately before new concrete is placed, wet construction joints and remove standing water.

3. Locate construction joints in floors within the middle third of spans of slabs, beams and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams.

4. Place beams, girders and haunches monolithically as a part of a slab system, unless otherwise required.

5. Beams, girders or slabs supported by columns or walls shall not be cast or erected until concrete in the vertical support members is no longer plastic.

6. Locate and install construction joints so as not to impair strength and appearance of the structure, as acceptable to Engineer. Locate construction joints, if required, as follows:

a. In walls, at top of footings; at top of slabs on ground, at top and bottom of door and window openings or as required to conform to the architectural details and as directed by Engineer; and at the underside of the deepest beam or girder framing into wall.

b. In columns, at the top of footing and at the underside of the deepest beam or girder framing into the column.

c. Place wall construction joints at 18 m maximum, and wall control joints at 6 m maximum.

B. Expansion Joints:

1. Provide expansion joints to permit both horizontal and vertical differential movements. Place expansion joints at locations shown on the Drawings.

2. Reinforcement or other embedded metal items bonded to the concrete (except dowels in floors bonded only on one side of joints) shall not be permitted.

3. Place premoulded joint filler at locations shown on Drawings, follow manufacturer installation details.

C. Waterstops:

1. Provide waterstops in joints where shown on drawings. Install waterstops to form a continuous diaphragm in joint. Make provisions to support and protect waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joints.

D. Isolation Joint in Slab-on-Grade:

1. Provide isolation joints in slab-on-grade at points of contact between slabs and vertical surfaces and elsewhere as indicated.

E. Control Joints in Slab-on-Grade:

1. Provide control joints in slab-on-grade to form panels or pattern. Use inserts, 6 mm wide by 1/5 to 1/4 of slab depth or 1/10 to 1/8 of slab depth with bottom crack inducer. Joints may be saw cut or crack inducers may be used in conjunction with sawing.

2. Form control joints by inserting a premolded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with slab surface. After concrete curing for at least 7 days, remove inserts and clean groove of loose debris. Apply joint sealant material in the manner recommended by the manufacturer.

3.06 FINISH OF FORMED SURFACES

A. Rough Form Finish:

1. As-cast rough form finish is permitted for formed concrete surfaces that are to be concealed in the finish work or by other construction, unless otherwise indicated.

B. Smooth Form Finish:

1. Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view, or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, dampproofing, painting, or other similar system.

2. Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrical with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise indicated.

3.07 MONOLITHIC SLAB FINISHES

A. Finished floor and roof slab surfaces shall be true plane surfaces with no deviation in excess of 3 mm when tested with a 3 m straightedge. Surfaces shall be pitched to drain.

1. Steel Trowelled (Hand) Finish: Slabs shall be screeded and floated with straightedges to bring the surface to the required finish level with no coarse aggregate visible. Concrete while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be wood floated to a true, even plane. Floor surfaces, after the surface moisture has disappeared, shall be steel trawled to a smooth, even, dense finish free from blemishes including trowel marks. Steel trowelled finish shall be provided for resilient flooring, thin-set ceramic tile, carpeting, where liquid waterproofing is to be applied, and where no other finish is specified.

2. Power Machine Finish: In lieu of hand finishing, an approved power finishing machine may be used. The preparation of surfaces for finishing by machine shall be in general as herein before specified for hand finishing. Finished surfaces shall be free of machine marks, ridges, or other blemishes.

3. Rough Slab Finish: Tamp concrete to force aggregates away from surface, then screed with a straightedge to produce a uniform surface. Rough slab finish surfaces shall be provided for ceramic tile except thin-set installation, quarry tile, floor toppings, insulation, built-up roofing, travertine, precast pavers with waterproof membrane, or terrazzo.

4. Broom Finish: Concrete shall be screeded and floated to the required finish level with no coarse aggregate visible. While concrete is still green, steel or wood trowel to an even, smooth finish and then broom with a fiber bristle brush in a direction transverse to that of the main traffic. Broom finish surfaces shall be provided for driveways and ramps and all exterior slabs, and walks not otherwise shown or specified. Finishing shall comply with the requirements of ACI 345, Chapter 10.

3.08 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2. Start curing procedures as soon as free moisture has disappeared from concrete surface. Continue curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at the end of final curing period.

B. Curing Methods:

1. Perform curing of concrete by moist curing, or by moisture-retaining cover curing, by membrane curing, or by combination thereof, as specified below:

a. For curing, use only water that is free of impurities which could etch or discolor exposed, natural concrete surfaces.

b. Provide moisture curing by any of the following:

(1) Keeping the surface of the concrete continuously wet by covering it with water.

(2) Continuous water-fog spray.

(3) Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 100 mm lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows:

a. Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete, placed in the widest practicable width with sides and ends lapped at least 76 mm and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

3. Provide liquid curing-hardening compound as follows:

a. Apply to horizontal surfaces when concrete is dry to touch by means of power spray, or hair broom in accordance with manufacturer's directions.

b. Apply to vertical surfaces immediately after forms are stripped and where form coating other than oils have been used, in accordance with manufacturer's directions.

C. Curing Formed Surfaces:

1. Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are

removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces:

1. Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing, whenever possible.

2. Final cure unformed surfaces, unless otherwise specified by any of the methods specified above, as applicable.

3. Final cure concrete surfaces to receive finish flooring by use of moisture-retaining cover, unless otherwise acceptable to Engineer.

E. Temperature of Concrete During Curing:

1. When the atmospheric temperature is 26 degrees C. and above or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or moisture-retaining covering. Protect the concrete continuously for the concrete curing method. Provide hot weather protection complying with the requirements of ACI 305.

2. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete which exceed 2 degrees C in any one hour and 10 degrees C in any 24-hour period.

F. Protection for Mechanical Injury:

1. During the curing period, protect concrete from damaging mechanical disturbances, including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.09 SETTING OF MISCELLANEOUS ITEMS

A. Miscellaneous materials in connection with concrete construction shall, where practicable, be placed and secured in position when the concrete is placed. These materials include but are not limited to:

1. Anchors and anchor bolts.

2. Frames or edging.

3. Hanger, inserts and metal ties.

4. Door bucks.
5. Pipe supports and pipes passing through walls.

6. Pipe sleeves, conduits and drains.

7. Flashing reglets.

8. Masonry dovetail anchor slots.

B. Anchor bolts for machines shall be set to templates.

1. Bolts shall be plumbed carefully.

2. Location and elevation checked with instrument.

3. Held in position rigidly to prevent displacement while concrete is being placed.

C. Place embedded items prior to concreting.

D. Position embedded items accurately and provide supports against displacement.

E. Aluminum shall not be embedded in concrete except where aluminum is protected from direct contact with the concrete.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams. Maintain the accurate location of reinforcing steel during concrete placement.

B. Filling-In: Fill-in holes and openings left in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.

C. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-trowelling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

D. Equipment Bases and Foundations: Provide machine and equipment bases and foundations. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

3.11 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. Repair and patch defective areas with cement mortar immediately after removal of forms, but only when directed by Engineer.

2. Cut out honeycomb, rock pockets, voids over 12 mm diameter, and holes left by tie rods and bolts, down to solid concrete but in no case, to a depth of less than 25 mm. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to Engineer.

3. For exposed to public view surfaces, blend white Portland cement and standard Portland cement so that when dry, the patching mortar will match the color of

the surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

4. Fill holes extending through concrete by means of a plunger-type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

B. Repair of Formed Surfaces:

1. Repair exposed-to-view formed concrete surfaces, where possible, that contain defects which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of Engineer.

   Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.

2. Repair concealed formed concrete surfaces, when possible, that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces.

   At watertight structures, cracks shall be repaired using flexible grout injection (polyurethane or approved equal).

   Surface defects include cracks and surface deficiencies which penetrate to reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts and spalls.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as specified herein.

3. Repair finish unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, including crazing, cracks which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

4. Correct high areas in unformed surfaces by grinding after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.

5. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Proprietary patching compounds may be used when acceptable to Engineer.

6. Repair defective areas, except random cracks and single holes not exceeding 25 mm diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 19 mm clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with a neat cement grout coating, or use concrete bonding agent.

   Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over 25 mm in diameter by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with a neat grout coating. Place dry pack before the cement grout takes its initial set. Mix dry pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

8. Repair methods not specified above may be used, subject to the acceptance of Engineer.

END OF SECTION

DIVISION - 4

MASONRY

SECTION 4150

SIDEWALKS, PATHWAYS, DRIVEWAYS, ENTRANCES AND RAMPS

PART 1- GENERAL

1.1 SCOPE:

A. This work consists of the construction of PCC sidewalks, paths, driveways, entrances and ramps for both new construction as well as rehabilitation improvements.

B. Place, construct, and install PCC structures as specified herein in accordance with Standard Details:

PART 2- PRODUCTS

2.1 AGGREGATE BASE FOR GRADING:

A. Aggregate base material shall be 1-inch minus crushed rock and conform to the requirements of Section 2300 of the Standard Construction Specifications.

2.2 PORTLAND CEMENT CONCRETE (PCC):

A. Shall conform to Section 2000 of the Standard Construction Specifications.

B. Use high early strength concrete to obtain 3,500-psi compressive strength at the age of 3-days for existing driveway rehabilitation work so residents may access their driveways in 3-days or less.

2.3 BITUMINOUS HOT MIX ASPHALT (HMA):

A. Bituminous HMA shall conform to Section 2400 of the Standard Construction Specifications.

2.4 EXPANSION/CONTRACTION JOINT MATERIALS:

A. Joint materials, when required, shall conform to Section 2000 of the Standard Construction Specifications.

2.5 CURING MATERIALS:

A. Curing materials shall conform to Section 2000 of the Standard Construction Specifications.

2.6 STEEL REINFORCEMENT:

A. When required for commercial and industrial sidewalks and driveway approaches use steel conforming too and placed in accordance with Section 2100 of the Standard Construction Specifications.

PART 3 - EXECUTION

3.1 DEMOLITION AND REMOVAL OF EXISTING:

A. All concrete and asphalt to be removed for installation of replacement structure shall be vertically saw cut to ensure neat vertical face to adjoin new.

B. Debris (i.e., concrete, asphalt, unclassified excavations and etc.) shall be removed from site to a state approved landfill.

C. Removal of existing concrete driveways, pathways and the like shall be incidental to the unit price of constructing new.

3.2 EARTHWORK:

A. Earthwork shall conform to the requirements of Section 3100 of the Standard Specifications.

B. Clearing and grubbing, excavation, haul of waste material, and import of subgrade material shall be incidental to placement of sidewalks and driveways.

3.3 AGGREGATE BASE:

A. Aggregate base shall be placed in a uniform manner to the thickness shown on the plans and compacted to a cohesive mass to provide best aggregate interlock and deter unnecessary saturation of concrete, and to limits herein;

1. Under Sidewalks & Paths	92%	AASHTO T-180
2. Under Driveways & Entrances	95%	AASHTO T-180

B. The aggregate base shall be thoroughly dampened prior to placing PCC.

3.4 FORMING:

A. Forming shall conform to Section 2000 of the Standard Construction Specifications.

3.5 MIXING AND DELIVERY OF PCC:

A. Mixing and delivery of PCC shall conform to Section 2000 of the Standard Construction Specifications.

3.6 PLACING PCC:

A. Placing of PCC shall be in conformance to Section 2000 of the Standard Construction Specifications.

B. Where weep holes are called out on the plans and run under sidewalks and/or any other concrete pathways the carrier pipe shall have a min. of 2/3 the thickness as cover.

3.7 FINISHING OF PCC:

A. Broom finish all exposed surfaces and in the direction(s) shown on the Plans.

B. Provide a 3-inch shine on all edges and at joints.

3.8 CURING OF PCC:

A. Curing of PCC shall conform to Section 2000 of the Standard Specifications.

3.9 PROTECTION OF PCC:

A. Contractor shall protect PCC in conformance to Section 2000 of the Standard Construction Specifications.

3.10 DRIVEWAYS AND ENTRANCES:

A. Driveways and entrances shall be as shown on the Plans and listed as follows;

1-inch minus crushed aggregate base	4-inches thick
PCC	6-inches thick
#4 def. bar reinforcement	None

B. See Standard Detail No.4150-1.

3.11 ALL OTHER DRIVEWAYS AND ENTRANCES:

A. All other driveways and entrances shall be as shown on the Plans and listed as follows;

1-inch minus crushed aggregate base	6-inches thick

PCC	8-inches thick
#4 def. bar reinforcement	12-inches O.C.

B. See Standard Detail No. 4150-1.

3.12 SIDEWALKS:

A. Construct Sidewalks of PCC as specified in Section 2000 and with a 28-day compressive strength of 3,500-psi.

B. Sidewalks that cross through all driveways and vehicular traffic paths shall be of the same structural dimensions as the driveway.

C. Sidewalks in all other cases shall be as shown on the Plans and listed as follows;

1-inch minus crushed aggregate base	4-inches thick
PCC	4-inches thick

D. Broom finish sidewalks in a transverse direction to normal travel, as shown on plans, and provide a 3-inch edge shine and at joints.

E. Provide expansion/contraction joint filler material, as specified in Section 2000, when new constructed sidewalks encounter different structures and as directed by the Engineer.

F. See Standard Detail Nos. 4150-3, 4150-4, 4150-7 and 4150-8.

3.13 RAMPS:

A. CONFLICT IN REGULATIONS: Ramps shall conform to the latest Federal and State of Oregon regulations and the American's with Disabilities ACT and shall supersede these specifications.

B. WARNING PANELS AND TILES: Precast engineered warning panels shall be safety yellow in color. Catalog cut sheets and samples shall be submitted to the Engineer prior to construction for approval. The Engineer will make final judgment in the acceptability of the product for the application.

C. GRADE AND DIMENSION: constructed ramps in accordance to the Plans, unless in conflict with 3.13(A) then to the more stringent requirement, and the same as adjoining sidewalk requirements for each case and in accordance with the Standard Details.

D. MATERIAL: Construct ramp (except warning panel/tile) out of PCC as specified in Section 2000 with a 28-compressive strength of 3,500-psi.

E. See Standard Detail Nos.4150-5 and 4150-6.

3.14 DRIVEWAY & ACCESS APPROACH REAHABILITATIONS:

A. Overall width of approach rehab. repairs shall be 24-inches as measured from the face of the curb, min. Depth of driveway replacement can be greater if required by the Engineer, and acceptable to property Owner, to accommodate drainage, grade and/or construction to adjacent structure.

B. Construct approach rehab. out of PCC as specified in Section 2000 using Type III or IIIA (high early strength) and achieving a compressive strength of 3,500-psi in 3-days. Local traffic shall be able to have access back within 3-days, max.

C. See Standard Detail No. 4150-2

3.15 MEASUREMENT AND PAYMENT:

A. EXISTING DRIVEWAY, SIDEWALK, RAMP AND APPROACH REMOVAL - Payment shall be made at the contract unit price for each, itemized separately. The contract price shall be full compensation for saw cutting, excavation, hauling and disposal of removed structure to include throat(s) and inclined wing(s). Adjacent curb shall not be included in this payment item, however, monolithic curb attached at the throat of the driveway is included in thearea measurement. This pay item shall be for demo of existing structures not being replaced by new. New structures will include demo in the unit price of the new.

B. NEW SIDEWALKS - Payment shall be made at the contract unit price for Sidewalks - complete. The contract price shall be full compensation for demolition of existing concrete sidewalk structures, unclassified excavation, sub-base preparation, base aggregate installation and preparation, forming, PCC placement, finishing and curing. This shall not include the section of sidewalk, which is described in 3.15(C), of this Section, through the driveway. Adjacent curb shall not be included in this payment item.

C. NEW DRIVEWAYS - Payment shall be made at the contract unit price for driveways. The contract price shall be full compensation for demolition of existing concrete driveway structures, unclassified excavation, sub-base preparation, base aggregate installation and preparation, forming, concrete placement, finishing and curing. This shall include the section of sidewalk through the driveway and inclined wings on both sides of the throat of the driveway. Adjacent curb shall not be included in this payment item.

D. NEW RAMPS - Payment shall be made at the contract unit price for Access Ramp(s) - complete. The contract price shall be full compensation for demolition of existing concreted ramps, unclassified excavation, sub-base preparation, base aggregate installation and preparation, forming, concrete placement, finishing and curing. This shall include the section of sidewalk through the ramp and inclined wings on both sides of the throat of the ramp. Adjacent curb shall not be included in this payment item.

E. NEW DRIVEWAY APPROACH REHABILITATION - The contract price shall be full compensation for demolition of existing concrete approach structures, unclassified excavation, sub-base preparation, base aggregate installation and preparation, forming, concrete placement, finishing and curing. This shall include the section of driveway slab measuring 18-inches behind the curb cut and inclined wings on both sides of the throat of the driveway. Adjacent curb shall not be included in this payment item.

PART 4 - TESTING

4.1 EARTHWORK:

A. When requested by the Engineer, earthwork shall be sampled and tested in accordance with Section 3100 of the Standard Specifications.

4.2 AGGREGATES:

A. When requested by the Engineer, aggregates shall be sampled and tested in accordance with Section 2300 of the Standard Specifications.

4.3 CONCRETE:

A. Concrete cylinders shall be prepared by a certified laboratory for testing along with slump, air entrainment, yield, and unit weight in accordance with ASTM C138 and ASTM C143.

4.4 EXPANSION JOINT FILLER:

A. When required, joint filler shall be tested in accordance with ASTM D1752.

4.5 TOLERANCE:

A. Line and grade my not vary more the 0.02-foot when tested with a 10-foot straight edge except at grade changes or vertical curves.

END OF SECTION

SECTION 04200

BRICK MASONRY

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Brick masonry and related accessories for walls and partitions as indicated on Drawings.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials:

ASTM A 82 Specification for Cold-Drawn Steel Wire for Concrete Reinforcement

ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM C Specification for Brick Masonry Units

ASTM C 144 Specification for Aggregate for Masonry Mortar

ASTM C 150 Specification for Portland Cement

ASTM C 207 Specification for Hydrated Lime for Masonry Purposes

ASTM C 270 Specification for Mortar for Unit Masonry

ASTM C 426 Drying Shrinkage of Concrete Block

ASTM E 149 Bond Strength of Mortar to Masonry Units

B. ICBO - International Conference of Building Officials:

UBC Uniform Building Code

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data, including laboratory test reports for each type of concrete masonry unit, accessories and other manufactured products, as well as certifications of compliance with the specified requirements for each type.

B. Shop Drawings: Submit cutting and setting drawings for trim units showing sizes, profiles and locations of each unit required.

C. Samples: Submit concrete unit masonry samples showing color and texture as well as ties and anchors for the Engineer selection and approval.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver masonry materials to site in an undamaged condition marked with name of manufacturer and identification of contents. Store masonry materials under waterproof covers on planking clear of ground and protected from damage, dirt, stain, water and wind.

1.5 QUALITY ASSURANCE

A. Engage a commercial testing laboratory approved by the Engineer to perform tests as specified below at no extra cost to Owner. Submit information regarding testing laboratory and qualifications of technical personnel to the Engineer for approval.

B. Tests: Testing laboratory shall test mortar materials, mortar and masonry panels as specified. Certified test reports shall identify materials by type, brand name and manufacturer and/or by origin. Use no mortar materials until laboratory test reports are approved by the Engineer. After tests have been made and materials approved, no changes shall be made without additional test and approval of the Engineer.

C. Testing: Materials proposed for use shall be tested for compliance with specifications in accordance with test methods contained in the referenced specifications and as follows:

1. Mortar Type N: Test for compressive strength and water retention. Mortar Type N shall have a compressive strengths at 7 days and 28 days as follows:

- 3.10 MPa at 7 days
- 5.17 MPa at 28 days

2. Brick Masonry: Test for compressive strength, weight and water absorption.

D. Mock-Up: Before starting masonry work, construct sample panel 3 m long by 2 m high for the Engineer's approval.

1.6 JOB CONDITIONS

A. Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least 600 mm down both sides of walls and anchor securely in place.

2. PART 2 - PRODUCTS

2.1. MATERIALS

A. Brick Masonry:

1. Manufacturer: Obtain brick masonry from one manufacturer, of uniform texture and color for each kind required for each continuous area and visually related areas.

2. Sizes: Manufacturer’s standard sizes with thickness as indicated on drawings.

B. Mortar and Grout Materials:

1. Portland Cement: ASTM C 150, Type I. Provide natural color cement as required to produce the required mortar color.

2. Hydrated Lime: ASTM C 207, Type S.

3. Sand (for Mortar): ASTM C 144, except for joints less than 6 mm use aggregate

graded with 100 percent passing the No. 16 sieve.

4. Fine Grout: Consist of fine aggregate conforming to ASTM C 404, size No. 1. Use fine grout in cells containing pipes and conduits.

5. Coarse Grout: Consist of fine and coarse aggregates conforming to ASTM C 404, size No. 89.

6. Water: Clean, potable and free of deleterious materials.

C. Mortar and Grout Mixes:

1. Measurement: Use methods which will ensure that required proportions are controlled and accurately maintained. Measure aggregate materials in a damp, loose condition.

2. Mortar: Comply with ASTM C 270, Type N for interior and Type S for exterior.

3. Grout: Comply with ASTM C 476; grout to be used in cores where reinforcements are placed.

4. Mixing: Combine and mix cement, lime, water, and aggregates for a minimum of 5 minutes in a mechanical batch mixer.

5. Do not add air-entraining agents or other admixtures to mortar or grout materials unless otherwise indicated on Drawings or instructed by the Engineer.

6. Do not use calcium chloride in mortar or grout.

D. Reinforcing Bars:

1. Reinforcing bars shall conform to ASTM A 615, Grade 60, deformed; sizes as indicated on Drawings.

E. Masonry Accessories:

1. Joint Reinforcement and Ties for Masonry:

a Provide welded wire units from cold-drawn steel wire complying with ASTM A 82, with deformed continuous side rods and plain cross-rods, and a unit width of 38 mm to 50 mm less than thickness of wall or portion. Reinforcement shall be hot-dip galvanized after fabrication with 22 grams zinc-coating conforming to ASTM A 116, Class 3. Provide type of reinforcement as follows with 3.76 mm single pair of side rods:

1) Ladder design with perpendicular 3.76 mm cross rods spaced not more than 400 mm on center.

2) Truss design with 3.76 mm continuous diagonal cross rods spaced not more than 400 mm on center.

2. Anchoring Devices for Masonry: Provide straps, bars, bolts and rods fabricated from

not less than 3.76 mm sheet metal or 10 mm diameter rod stock, unless otherwise indicated.

3. Inserts for Masonry:

a Unit Type: Furnish cast iron or malleable iron inserts of the type and size shown, hot-dip galvanized after fabrication with 44 grams zinc coating, ASTM A 153, Class B 2.

b Dovetail Slots: Where shown, furnish dovetail slots with filler strips, hot-dip galvanized as above.

c For installation of concrete inserts refer to the concrete Sections of these Specifications as well as the specific requirements of the concrete installer regarding placement of inserts which are to be used by the masonry installer for anchoring of masonry work.

4. Pre-molded Control Joint Strips: Solid rubber strips with a durometer hardness of 60 to 80 as determined by ASTM D 2240, designed to fit standard sash block and maintain lateral stability in masonry wall, size and configuration as indicated.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation: Conform to the requirements of UBC 85 or ACI 531-83.

B. Thickness: Build masonry construction to full thickness shown on Drawings. Build single-width walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 200 mm of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

D. Cut masonry units with motor-driven saws to provide clean, sharp, un-chipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

E. Units erected when the ambient air has a temperature of more than 42°C in the shade and a relative humidity of less than 5% shall be protected from direct exposure to wind or sun for 48 hours after construction. Absorption rates of masonry units shall be adjusted by previously wetting to ensure a good solid bond with the mortar.

F. Bond Pattern for Exposed Masonry: Lay exposed masonry in the bond pattern shown, or if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Bond and interlock each course of each width at corners, unless otherwise shown.

G. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

H. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces for set masonry, and remove loose masonry units and mortar prior to laying fresh masonry.

I. Built-In Work: As construction progresses, build-in items specified under this and other sections of the specifications. Fill in solidly with masonry around built-in items.

1. Fill space between hollow metal frames and masonry solidly with mortar.

2. Where built-in items are to be embedded in the cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

J. Non-Bearing Interior Partitions Walls: Build full height of story to underside of structure above, unless otherwise shown.

K. Mortar Bedding and Jointing:

1. Mortar Mixes: ASTM C 270, Proportion Specifications Type N.

2. Mix mortar ingredients for minimum of 5 minutes in a mechanical batch mixer. Use water clear and free of deleterious materials which would impair the work. Do not use mortar which has begun to set, or if more than 1 hour has elapsed since initial mixing. Re-temper mortar during 1 hour period as required to restore workability.

3. Lay masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

4. Joints: Maintain joint width as shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 10 mm joints. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials. Tool exposed joints slightly concave. Rake out mortar in preparation for application of caulking or sealant where shown.

5. Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

L. Horizontal Joint Reinforcement:

1. Provide continuous horizontal joint reinforcement as shown and as specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 15 mm on exterior side of wall and 12 mm at other locations. Lap reinforcement a minimum of 150 mm at ends of units. Do not bridge control and expansion joints with reinforcing except at wall openings. Provide continuity at corners as well as wall intersections by using prefabricated L-sections and T-sections. Cut and bend unit as directed by manufacturer for continuity at returns, offsets, and other special conditions.

2. For single-width walls, space continuous horizontal reinforcement at 400 mm on center, unless otherwise indicated on Drawings.

3. Reinforce masonry openings greater than 300 mm wide, with horizontal joints approximately 200 mm apart, above the lintel and below the sill of the opening. Extend reinforcement a minimum of 600 mm beyond jambs of the opening, bridging control joints where provided.

M. Control Joints:

1 Provide control joints in brick partitions, finished or unfinished at not more than 6 m on centers unless indicate otherwise on Drawings.

2 Control joints shall be vertical unbonded joints, maximum 9.5 mm wide, extending full height of the masonry work. Bond shall be broken with building paper placed against one face of joint with no mortar placed in continuous height of void.

3 Control joint material shall be expandable closed cell neoprene conforming to ASTM D 1056, 38 mm deep and 25 percent thicker before compression than joint width.

4 Top dress control joints with a sealant conforming to the requirements of Section 07900 - SEALANTS. Color of sealant shall be as selected and approved by the Engineer.

O. Anchoring Masonry Work:

1. Provide anchoring devices of types shown and as specified. If not shown or specified, provide standard type for facing and back-up involved.

2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:

a Provide an open space not less than 12 mm in width between masonry and structural member, unless otherwise shown and keep space free of mortar or other rigid materials.

b Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise shown.

c Space anchors at no more than 600 mm on center vertically and 900 mm on center horizontally.

P. Lintels:

1. Provide masonry lintels where shown and wherever openings of more than 300 mm for brick size units and 600 mm for block size units are shown without structural steel or other supporting lintels.

2. Provide precast or formed-in-place masonry lintels. Thoroughly cure precast lintels before handling and installation.

3. Support formed-in-place lintels temporarily.

4. Unless otherwise shown, provide one reinforcing bar for each 100 mm of wall

thickness and of a size number not less than three times the number of meter of opening width.

5. Provide minimum bearing at each jamb of 200 mm or as indicated on the Drawings.

3.2 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, cracked, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking sealant compounds.

C. Clean exposed concrete masonry units by dry brushing at the end of each day and after final pointing to remove mortar spots and drippings.

3.3 CURING

A. When temperature exceeds 25°C and where construction of a masonry wall is complete, cure mortar by covering the wall unit with wet burlap, jute sack or similar material for a minimum of two days.

END OF SECTION

DIVISION - 5

METALS

SECTION 05500

METAL FABRICATIONS

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal fabrications of iron and steel shapes, plates, bars, strips, tubes, pipes and castings as well as other metal systems as indicated on Drawings and as specified herein.

B. Handrail and Railing.

C. Entry Gates (Sliding and Swing Types)

D. Steel Fence

E. Bollard

F. Louvers and Grilles

G. Manhole Covers and Frames

H. Grating and Trench Drainage Covers

I. Ladders

J. Access Panels

K. Tree Cast Iron Grating.

L. Car Shade Structure.

M. Crescent

N. Catwalk

O. Column, Skylight and Cabinet Metal Claddings

P. Overhead Coiling Doors

Q. Non-Insulated Roof Panels

R. Control Barrier

S. Trench Cover Steel Plate

T. Detention and Security Windows

1.2 FABRICATION

A. Shop fabricate metal fabrication units as far as practicable. Use materials of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on shop Drawings using

proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Ease exposed edges to a radius of approximately 1 mm.

1.3 REFERENCES

A. AAMA - American Architectural Manufacturer Association

AMMA 603.8 - Pigmented Organic Coating on Extruded Aluminum.

AMMA 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

B. ANSI - American National Standards Institute:

ANSI A 14.3 Safety requirements for Fixed ladders

ANSI A 202 Metal Bar Grating Manual

C. ASTM - American Society for Testing and Materials

ASTM A 27 - Steel Castings, Carbon, for General Application

ASTM A 36 - Structural Steel

ASTM A 48 - Gray Iron Castings

ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 307 - Carbon Steel Externally Threaded Standard Fasteners

ASTM A 325 - High Strength Bolts for Structural Steel Joints

ASTM A 446 - Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

ASTM A 526 - Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality

ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

D. AWS - American Welding Society

AWS-B3.0 - Welding Procedure and Performance Qualification

AWS-D1.1 - Structural Welding Code-Steel

E. SSPC - Steel Structures Painting Council

SP-10 - Near-White Blast Cleaning

PS-12.00 - Guide for Selecting Zinc-Rich Painting Systems

F. SASO –Standards Organization

SASO 79 Aluminum and aluminum alloys products for architectural application Part 1: Sheets, strips, bars and structural Sections.

SASO 80 Testing methods for aluminum and aluminum alloys products for building purposes Part 1: Sheets, strips, bars and structural Sections.

SASO 39 Mechanical Testing of Welded Joints

SASO 1012 Test Methods of Welded Plain – End Steel Tubes and Pipes for General Use

SASO 1013 Welded Plain End Steel Tubes and Pipes for General Use.

SASO 1415 Zinc coating on hot-dipped galvanized steel pipes.

SASO 1416 Testing methods of zinc coating on hot-dipped galvanized steel pipes

1.4 SUBMITTALS

A. Product Data: Submit Manufacturer's product information, specifications and installation instructions for the miscellaneous metal fabrications.

B. Shop Drawings: Submit complete shop drawings, including details of fabrication, assembly and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and connections. Show anchorage and accessory items.

C. Samples: Submit samples of representative materials, finishes and finished products as required by the Engineer. Samples shall be full size, taken from Manufacturer's stock and complete as required for installation.

1.5 TRANSPORTATION, HANDLING AND STORAGE

A. Crate and pack material as required to prevent damage, corrosion and other forms of deterioration. Stack material out of mud and dirt and provide for proper drainage. Exercise care to avoid abrasions and other damage to finish coating. Protect from damage or soiling by adjacent construction operations. Keep material off ground by using pallets, platforms, or other supports. Protect material against corrosion and deterioration.

1.6 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of the work. Coordinate fabrication schedule with construction progress to avoid delay of work.

B. Shop Assembly: Preassemble items in the shop to greatest extent possible, so as to minimize field splicing and assembly of units at site.

C. Fabricator's Qualifications: A firm having a minimum of 5 years successful experience in producing metal fabrications similar to that required for this Project. The fabricator shall be subject to approval of the Engineer.

D. Installer's Qualifications: A firm having a minimum of 5 years successful experience in the installation of metal fabrications similar to that required for this project, and that has been licensed by the Manufacturer of the metal fabrications. The installer shall be subject to approval of the Engineer.

E. Welding Work: Comply with the requirements of American Welding Society (AWS) - **Standard Code for Arc and Gas Welding in Building Construction** as well as AWS D1.1 - **Structural Welding Code** for welding procedures. Welders shall be subject to approval of the Engineer.

2. PART 2 - PRODUCTS

2.1. MATERIALS

A. General: Material shall conform to the requirements specified for the particular item(s), and where these requirements are not specified in detail, the material shall be suitable for the intended use, and as approved by the Engineer.

B. Metal Surfaces: For fabrication of miscellaneous metal work which shall be exposed to view, materials shall be smooth and free of surface blemishes such as pittings, seam marks, roller marks, rolled trade names, and roughness.

C. Structural steel shapes, plates and bars: Conform to ASTM A 36 or A 529.

D. Steel Plates to be Bent or Cold-Formed: Conform to ASTM A 283, Grade C.

E. Steel Bars for Grating: Conform to ASTM A 569 or ASTM A 36.

F. Cold-Formed Steel Tubing: Conform to the requirements of ASTM A 500, Grade B.

G. Hot-Formed Steel Tubing: Conform to the requirements of ASTM A 501.

H. Steel Pipe: Conform to the requirements of ASTM A 53, Type E or S, Grade B; or ASTM A 501.

I. Members Fabricated by Cold Forming: Conform to requirements of ASTM A 607, Grade 50.

J. Galvanized Cold-Formed Members: Conform to requirements of ASTM A 446, Grade D; galvanized to ASTM A 525 Designation G-90.

K. Steel Casting: Conform to requirements of ASTM A 27, Grade 65-35, medium-strength carbon steel.

L. Gray Iron Castings: Conform to ASTM A 48, Class 30.

M. Malleable Iron Castings: Conform to ASTM A 47.

N. Cold-Rolled Carbon Steel Sheets: Conform to ASTM A 366.

O. Galvanized Steel Sheet: Conform to the requirements of ASTM A 446 Grade C, galvanized to ASTM A 525, Designation G-90.

P. Bolts for Structural framing: High strength bolts shall be heavy duty hexagonal structural bolts with heavy duty hexagonal nuts conforming to ASTM A 307, A 325 or A 490 as necessary for design loads and connection details.

Q. Concrete Inserts: Threaded or wedge type, galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Bolts, washers and shims shall be hot-dip galvanized, ASTM A 153.

R. Anchor Bolts: Conform to ASTM A 307.

S. Structural Steel Primer Paint: SSPC-Paint 2, red lead iron oxide, oil alkyd.

T. Finish Paint: Refer to Section 09900 - PAINTING.

U. Non-Shrink Grout: Premixed, non-corrosive, non-staining, non-gaseous, ready to use natural aggregate product requiring only the addition of water to produce flowable grout material having no drying shrinkage or settlement at any age. Compressive strength (50 mm cube) shall not be less than 500 kg/cm² at 28 days.

V. Aluminum Extruded Bars, Rods, Shapes and Tubes: Conform to ASTM B 221, 6063-T6; aluminum sheets and plates to ASTM B 209, alloy 5052-H32; structural pipes and tubes (extruded) to ASTM B 429.

W. Stainless Steel:

1. Bar stock: Conform to ASTM A 276, Type 304.

2. Plates and Sheets: Conform to ASTM A 167, Type 304.

3. Pipes: Conform to ASTM A 312, Type 304.

X. Copper Alloys, Brass:

1. Extruded Shapes: ASTM B 249, alloy UNS No. C36000 (free-cutting brass).

2. Seamless Tube: ASTM B 135, alloy UNS No. C26000 (cartridge brass, 70 percent copper).

3. Sand Castings: ASTM B 584, alloy UNS No. C85200 (high copper yellow brass).

4. Plates and Bars: ASTM B 36, alloy UNS No. C26000 (cartridge brass, 70 percent copper).

Y. Copper Alloys, Bronze:

1. Extruded Shapes: ASTM B 455, alloy UNS No. C38500 (architectural bronze).

2. Seamless Pipe: ASTM B 43, alloy UNS No. C23000 (red brass, 85 percent copper).

3. Seamless Tube: ASTM B 135, alloy UNS No. C23000 (red brass, 85 percent copper).

4. Composition Bronze castings: ASTM B 62, alloy UNS No. C83600 (85-5-5-5 or No.1 composition commercial red brass).

5. Sand Castings: ASTM B 584, alloy UNS No. C86500 (No. 1 manganese bronze).

6. Plates and Bars: ASTM B 36, alloy UNS No. C28000 (Muntz metal, 60 percent copper).

Z. Fasteners:

1. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select the fasteners for the type, grade and class required.

2. Bolts and Nuts: Regular hexagonal head type, conforming to ASTM A 307, Grade A.

3. Lag Bolts: Squared head type.

4. Machine Screws: Cadmium plated steel.

5. Wood Screws: Flat head carbon steel.

6. Plain Washers: Round carbon steel.

7. Masonry Anchorage Devices: Expansion shields.

8. Toggle Bolts: Tumble-wing type.

9. Lock Washers: Helical spring type carbon steel.

10. Power Actuated Fasteners:

a. Provide fasteners of special spring steel alloy conforming to ASTM A 227, Class 1 with a hardness of 52 - 56 Rockwell C, zinc-plated meeting ASTM A 164, Type RS.

b. Drive pin or threaded stud types as required.

2.2. FABRICATED ITEMS

A. General: Use materials of size and thickness indicated on Drawings. Where not indicated, use sizes and thickness required to achieve strength and durability in finished product. Work to the dimensions indicated or approved on shop drawings, using proven details of fabrication and support. Fabrication shall be done in shop to fullest extent as possible with only assembly and installation works to be done on site.

B. Form exposed work to the lines and levels with accurate angles and surfaces and straight sharp edges. Form the bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

C. Railings and Handrails: Fabricate railings and handrails assemblies which when installed shall be capable of withstanding a concentrated load of 0.9 kN (200 lbf) applied at any point in any direction, and uniform load of 0.73 kN/m (50 lbf/ft) applied simultaneously in both vertical and horizontal directions.

1. Aluminum Handrail and Railing: Manufacturer standard system conforming to the following requirements:

a. Extruded pipes: Alloy and temper for extrusions shall be 6063-T6 conforming to ASTM B 429.

b. Size and shape: As indicated on the Drawings.

c. For wall-mounted handrails provide same railing with manufacturer standard aluminum castings and fixing hardware as required for wall mounting.

d. Fasteners: Aluminum, non-magnetic stainless steel, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum components.

e. Finish: Anodized, conforming to AA C22A42, minimum thickness 22 micron and color as approved by the Engineer. Shop-apply protective coating of clear acrylic lacquer or any coating in accordance with AAMA 602.2, not less than 0.5 mil dry film thickness, over anodized finish.

2. Stainless Steel Handrail and Glass Railing:

a. Construction: Manufacturer's standard stainless steel handrail conforming to the following:

1) Tubing: ASTM A 554, grade MT 304.

2) Pipe: ASTM A 312, grade TP 304.

3) Castings: ASTM 743, grade CF 8 or CF 20.

4) Plate: ASTM A 167, type 304.

b. Size and Shape: As indicated on Drawings.

c. For wall-mounted handrails provide same railing with manufacturer standard brass castings and fixing accessories as required for wall mounting.

d. Finish of Handrail: As indicated on Drawings and in accordance with the following:

1) Bright, Directional Polish: AISI No. 4 finish.

2) Satin, Directional Polish: AISI No. 6 finish.

e. Glass Railing System:

1) Construction: Glass railing panels shall be fitted into continuous shoe moldings along curb at base of railing and into handrail from top of railing.

2) Mounting: Flush-mounted type.

3) Glass for the Railing: Clear tempered glass conforming to safety requirements of ANSI Z97.1. Size and thickness of glass panels shall be as recommended by the manufacturer, unless indicated otherwise on Drawings. Glass shall also comply with requirement of Section 08800 - GLAZING.

4) Shoe Molding: Extruded aluminum section, Alloy 6063-T52 and shall be suitable for bending, where required. Shoe molding shall be installed as indicated on Drawings.

f. Miscellaneous Materials:

1) Handrail Accessories: Provide elbows and bends as well as end caps for the handrail using same material and finish as that of the handrail specified herein.

2) Fittings: Fittings shall be concealed and fabricated of wrought aluminum or bronze. Exposed fittings, when approved by the Engineer, shall have a finish similar to that of the adjacent components.

3) Glazing Accessories:

Setting Blocks: Provide resilient setting block supports, U-shaped, at the lower glass edge inside the shoe moldings to cushion the

glass edge and maintain it centered along the shoe molding. Setting block supports shall be neoprene or PVC. Spacers

Spacers: Provide concealed PVC spacers, 6 mm thick between the adjacent glass panels along the shoe moldings.

4) Mechanical Fasteners: Stainless steel or cadmium-plated steel as recommended by the Manufacturer.

5) Filler Cement: Hydraulic type, conforming to the requirements of ASTM C 595. Cement shall be factory-prepared with accelerator. Filler cement shall be used to fill the gaps between the glass panels and the shoe molding.

3. Wooden Handrail: Shall be solid Teak wood, architectural grade, clear all heart; sizes and shapes as shown on drawings. Finish shall be natural clear lacquer complying with the requirements of Division 09900 - PAINTING. Refer to I.D. drawings for details and types of wooden handrail.

4. Glass Balustrade with Stainless Steel Handrail: Handrail shall be of stainless steel pipe conforming to ASTM A312, Grade TP304 with bright mirror polish finish. Provide tubular steel rail support with powder coated finish; 80 micron thick with color as approved by the Engineer. Balustrade shall be minimum 10 mm thick clear tempered glass, butt-jointed using clear silicone structural sealant. Glass and other glazing materials shall comply with the requirements of Section 08800 –GLAZING. Sizes shall be as shown on drawings.

5. Steel Pipe Guard Rail and Handrail: Shall be of galvanized steel pipe, cold formed, conforming to ASTM A500, with galvanized steel balusters of same quality, all having painted finish complying with the requirements of Division 9 - FINISHES, color as approved. Provide wall brackets where indicated on drawings; material same as railings. Size and shape shall be as shown on the drawings.

D. Wrought Iron Railing: Wrought iron conforming to ASTM A 47, grade as recommended by fabricator for type of use indicated. Design, shape and size shall be as shown on the Drawings or as approved by the Engineer. If required, submit various decorative designs for the Engineer's selection and approval. Painted in accordance with Section 09900 - PAINTING, color as shown on the drawings.

1. Handrail:

a. Wooden Handrail: Handrail shall be of solid wood, architectural grade, clear all heart, type as shown on drawings. Fabricate to size and shape as shown on the drawings. Finish shall be clear lacquer finish in accordance with Section 09900 - PAINTING.

E. Entry Gates (Sliding and Swing Types):

1. Gates: Fabricate entry gates, vehicular and pedestrian, using galvanized steel, tubular sections and shapes conforming to ASTM A 36, hot-dip galvanized in accordance with ASTM A 123, coat designation G-90. Fasteners and accessories shall be zinc-coated and manufacturer’s standard products. Pedestrian gate shall be manually operated. Vehicular gates shall be electrically operated (sliding and swing)

types, as indicated on drawings.

2. Shapes, Details and Sizes: As shown on Drawings.

3. Fabrication:

   a. Fabricate gates in accordance with approved shop drawings. Submit various decorative designs for the Engineer's selection and approval.

   b. Hardware: Provide complete heavy duty masonry hinges, gate latches, wheels, guide rail, locking devices, decorative latch assembly, and control system as recommended by the manufacturer.

4. Vehicular Sliding Gate Operators:

   a. Vehicular sliding gate operator shall be suitable for size and intended function of the gate. Operator shall have quick release knob for manual operation of gates during power failure.

   b. Equipment shall be able to support weight of gate.

   c. Installation: Gate operating system shall be installed by manufacturer's authorized workmen experienced in the trade. Installation of system shall conform to manufacturer's written instructions and approved drawings.

   d. Warranty: Gate operating system shall be warranted against defects for one year from the date of substantial handover.

5. Swing Gate Operators (for pair, one operator per gate):

   a. Swing gate operator shall be heavy duty gear unit, suitable for outdoor installation, size and intended function of the gate. Operator shall have emergency release knob for manual operation of gates in the event of power failure.

   b. Electric operator shall be built into a compact unit mounted on steel base consisting of a low speed high torque right angle combination gearhead reversing motor, NEMA rated starter, a safety disc clutch, an emergency release, fully automatic limit switches and heavy duty crank and connecting arm assembly. Unit shall have 90 degrees swing unless otherwise shown on drawings.

   c. Operation: Electric operation opens and closes the gate with a simple crank arm and connecting arm movement.

   d. Speed: 13 to 14 seconds to open/close.

6. Finish: Gates shall have manufacturer’s standard painted finish in accordance with Section 09900 - PAINTING. Color shall be as selected by the Engineer.

F. Steel Fence:

1. Fabricate perimeter steel fence using galvanized steel sections and shapes conforming to ASTM A 36, hot-dip galvanized in accordance with ASTM A 123, coat designation G-90.

2. Shapes, Size and Configuration: As shown on Drawings.

3. Provide custom-made Ministry logo attached to fence at designated points indicated on Drawings. Provide prototype samples for selection and approval by the Engineer. Logo shall be of cast-brass material, 300 mm diameter, complying with the requirements of ASTM B 584, alloy UNS No. 85200 (high copper yellow brass), as shown on Drawings. Finish: CDA M21 (Mechanical finish: buffed, smooth specular).

4. Finish: Fence shall have a painted finish in accordance with Section 09900 - PAINTING. Color shall be as selected by the Engineer.

G. Louvers and Grilles:

1. Metal Louvers and Frames: Provide manufacturer's standard metal louvers suitable for the application indicated on Drawings:

   a. Fabricated Metal: Formed metal stationary louvers and frames, 12 gauge (2.80 mm thick). Provide stiffening members where required.

   b. Fasteners and Anchors: Galvanized steel type.

   c. Hardware: Provide all hardware complying with requirements of Section 08710 - FINISH HARDWARE.

   d. Bird Screen: 12.7 mm mesh x 1.60 mm diameter galvanized steel in folded frame.

2. Fixed, Extruded-Aluminum Louvers and Frame (Horizontal)

   a. Louver Depth: 100 mm.

   b. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 2.0 mm for blades and 2.0 mm for frames.

   c. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

3. Sand Trap Louvers:

   a. Refer to drawings for details of sand trap louvers.

   b. Sand trap louvers shall separate sand from intake air and self emptying base, and shall be constructed from extruded aluminum, with 1.5 mm thick, 2.0 mm thick casing and shall be provided with galvanized wire bird screen and washable filters.

   c. The media change can be carried out either from the right or left-hand side, according to the installation position. If two units are installed adjacent to

each other, the media change is carried out from the left and right-hand sides.

4. Foil-shaped Louvers at Atriums of B11: Custom designed foil-shaped aluminum louvers fabricated of extruded aluminum with minimum 2 mm wall thickness for blades and tubular frames as shown on drawings.

5. Grilles: Provide manufacturer's standard decorative metal grilles suitable for the application indicated on Drawings and in accordance with the requirement specified herein.

   For HVAC grille work, refer to relevant details in HVAC drawings.

6. Design and Fabrication: Submit various decorative designs for the Engineer's selection and approval. Fabricate louver and grille screen elements in accordance with approved shop drawings. Submit shop drawings showing design pattern and fixing details for the Engineer's approval. Provide bird screen and insect screen as indicated on Drawings.

7. Louvered Metal Doors: Refer to Section 08100 – HOLLOW METAL DOORS AND FRAMES

7. Finishes: Provide manufacturer standard finish as indicated on Drawings and in accordance with the following:

   a. Powder-Coated Finish: Standard finish of thickness range 60 - 80 microns. Color shall be as approved by the Engineer.

   b. Anodized Finish: Conform to AA C22A42; 22 micron thick; with shop-applied protective coating of clear acrylic lacquer or any coating in accordance with AAMA 602.2, 0.5 mil dry film thickness, over anodized finish. Color shall be as approved by the Engineer.

H. Bollards:

1. Construction: Fabricate bollards using standard weight 150 mm dia. galvanized steel pipes, Schedule 80, conforming to ASTM A53.

   a. Fill pipes with concrete as indicated on Drawings.

   b. Cap bollards with rounded concrete.

2. Fixation: Base plate and bollard fixation shall be as approved by the Engineer.

3. Finish: Painted, for all exposed surfaces in accordance with Section 09900 - PAINTING.

I. Manhole Covers and Frame: Gray cast iron casting, heavy duty, complying with ASTM A 48 or BS 497; Appendix A. Size shall be as shown on Drawings.

J. Grating and Trench Covers:

1. Cast-Iron Grating and Trench Covers: Grating, trench and frames shall be of gray

cast iron casting, heavy duty, complying with the requirements of ASTM A 48 or BS 497; Appendix A. Size shall be as shown on Drawings.

2. Aluminum Grating: Pressure locked, Recessed type, flush top grating, assembled using manufacturer standard aluminum grating, bearing bars and cross bars with a plain surface.

K. Ladders:

1. Fabricate and install ladders with dimensions, shape, details and anchorages at locations as shown on Drawings and approved by the Engineer.

a. Aluminum Ladders: Extruded aluminum bars and shapes shall be ASTM B 221 with riveted aluminum rungs. Provide 32 mm x 32 mm serrated aluminum grab bars and rungs spaced at 300 mm on centers including continuous side railing, brackets and 40 mm dia. ladder hook as shown on Drawings.

b. Finish: Anodized, conforming to AA C22A42, minimum thickness 22 micron and color as approved by the Engineer. Shop-apply protective coating of clear acrylic lacquer or any coating in accordance with AAMA 602.2, not less than 0.5 mil dry film thickness, over anodized finish.

L. Access Panels (for Wall and Ceiling): Provide access panels where required, of material, size and shape as shown on Drawings.

M. Roll-Up Doors: Refer to Section 08335 – OVERHEAD COILING DOORS.

N. Non-Insulated Roof Panels: Shall be manufacturer's standard prefinished galvanized steel ribbed panels complying with SDI Specifications. Panel material shall be structural quality 0.50 mm thick galvanized sheet steel (minimum 42,000 psi yield strength) conforming to ASTM A446, Grade C; hot-dipped galvanized to ASTM A525, Class G90 (275 kg/m²). Panels shall be prefinished with baked-on silicone-modified polyester enamel coating with minimum dry film thickness of 1.0 mil on front side and 0.5 mil on reverse side.

Shop prime all structural framing members and accessories with manufacturer's standard primer. All exposed metal surfaces shall painted finish complying with the requirements of Section 09900 - PAINTING, color as approved by Engineer.

O. Control Barrier: Barrier shall be electrically operated complete with aluminum boom 80 mm x 20 mm section (length as shown on drawings), electric motor, oil sealed gear box, limit switches control box, built-in flashing light and other required accessories necessary for the operation of the barrier from the guard room also provide an emergency release in case of any power failure.

Gate Barrier: Gate barriers shall have the following features and components:

1. Arm: Aluminum extrusion striped with red and white “Scotchcal” and carrying a double sided STOP target and safety device to protect the mechanism from accidental impact. Arms shall rise in 8 to 10 seconds.

2. Cabinet: 3mm thick steel, shot blasted, primed and finished with manufacturer's standard finish as selected and approved by the Project Manager. Color shall be in Traffic Yellow.

3. Mechanism: Geared motor unit with manual clutch for use during power failure.

4. Card Reader (Where required): Solid state microprocessor controlled reader having the following features:

   a. Capacity: up to 4000 cards.

   b. Battery back-up in case of power failure to retain memory.

   c. Hand held programmer.

   d. High security unalterable pass cards or proximity read heads.

P. Roof Hatch:

1. Manufacturer's standard single leaf roof hatch to fit the opening as indicated on Drawings, complete with curbs, anchorage system, gaskets, roof flashing and other accessories required for a complete installation.

2. Door and curbs shall be of aluminum sheets (sandwich panel) with not less than 50 mm thick rigid polyurethane insulation. Roof hatch shall be provided with manufacturer's standard hardware including safety post.

Q. Car Shed Steel Structure: Refer to Section 05120 – STRUCTURAL STEEL.

R. Crescent:

1. Construction: A structural steel framing suitable for supporting the shape as well as achieving the design indicated on Drawings. Structural steel shall have a bronze cladding forming the final shape of the crescent.

2. Steel Frame: Galvanized structural steel metal furring conforming to ASTM A 36 and ASTM A 529 with a galvanized finish in compliance with ASTM A 525 Designation G-90.

3. Bronze Cladding: Provide CDA (Copper Development Association) copper alloy of type and form complying with the following requirements:

   a. Extruded Shapes: Conform to ASTM B 455, alloy UNS No. C38500 (architectural bronze).

   b. Plates and Bars: Alloy UNS No. C2800 (Muntz Metal), composed of 58 to 61 percent copper; maximum 0.35 percent lead; maximum 0.25 percent tin; maximum 0.15 percent iron; 0.10 percent maximum other elements; and remainder: zinc.

c. Castings: Provide bronze castings, copper alloy UNS C83600 (alloy 836), complying with the requirements of ASTM B 584.

4. Finish: Provide NAAMM-M31-06X finish (fine satin directional textured mechanical finish with clear a organic coating). Type of organic coating shall be as recommended by manufacturer and approved by the Engineer.

S. Catwalk:

1. Suspension Members, Beams, Joists, Balusters, Railing and Framing: Structural Steel, ASTM A 36.

2. Floor Grating: Steel bars for grating shall conform to ASTM A 569 or ASTM A 36. Rods for grating crossbars shall be ASTM A 510.

3. Floor Plates: Galvanized steel checkered plates conforming to ASTM A446 Grade C with a minimum thickness of 6 mm.

4. Welding: Conform to requirements of ANSI/AWS-D1.1 – continuous type welding.

5. Finish for Catwalk: Galvanized exposed finish.

T. Column, Skylight and Cabinet Cladding:

1. Column Cladding: Shall be a custom formed shape from 16 gauge stainless steel sheet conforming to ASTM A-167, Type 304, # 8 polished stainless steel finish with concealed fasteners from same metal. All other concealed accessories shall be of aluminum. Column cladding with butt joints shall be vertically divided into not more than two (2) sections.

2. Aluminum Cladding for Skylight: Shall be custom-formed shape from 3/16″ thick aluminum plate with 80 micron thick powder coated finish; color as approved by the Engineer. All concealed fasteners and accessories shall be fabricated of aluminum. Sizes, shape and configuration claddings shall be as shown on Drawings.

3. Reception Counter Cladding: Shall be from 16 gauge stainless steel sheet conforming to ASTM A-167, Type 304, # 8 polished stainless steel finish with concealed fasteners from same metal.

U. Tree Grating (Where required): Cast iron, manufacturer's standard product of dimension, size, weight and pattern as shown on drawings. Finish shall comply with requirements of Section 09900 – PAINTING.

V. Pool Gutter: Manufacturer's standard product, stainless steel austenitic grade 304 suitable for intended application and conforming to ASTM A 276, as shown on drawings and approved by the Engineer.

W. Heavy Duty Steel Cover Plate for Trenches: Galvanized steel checkered plates conforming to ASTM A446 Grade C with a minimum thickness of 6 mm.

X. Detention and Security Windows: Fabricated of security grade galvanized steel complying

with ASTM F1915 and ASTM F1233 for forced-entry resistance and laminated bullet-resistant glazing complying with UL752 as shown on drawings. Provide horizontal detention bar as required. Fabricate framing from minimum 2.5 mm thick, cold-rolled steel sheet and glazing stops from 3.2 mm thick, cold rolled steel sheet as shown on drawings.

1. Speaking Apertures: Fabricate security glazing designed to allow passage of speech at normal speaking volume without distortion.

2. Hardware: Provide manufacturer's standard nonremovable hardware fabricated from steel, of sufficient strength to perform the function for which it is intended.

3. Finish: Baked enamel finish complying with requirements of Section 09900 – PAINTING. Color and gloss shall be as selected by the Engineer from manufacturer's full range.

4. Security Glazing: Refer to Section 08800 – GLAZING.

2.3. FABRICATION

A. Shop fabricate metal fabrication units as far as practicable. Use materials of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on shop Drawings using proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Ease exposed edges to a radius of approximately 1 mm unless otherwise shown.

D. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

E. Weld corners and seam continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

F. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown or, if not shown, use Phillips flathead (countersunk) screws or bolts.

G. Provide for anchorage of the type shown, coordinated with the supporting structure and the progress schedule. Fabricate and space anchoring devices to provide adequate support for the intended use of the work.

H. Cut, reinforce, drill and tap metal fabrications indicated to receive finish hardware and similar items of work.

1. Exposed fastenings: Compatible materials, generally matching in color and finish, and shall harmonize with the material to which fastenings are applied.

2. Provide the necessary rebates, lugs and brackets to assemble the work in a neat and

substantial manner. Turn edges of flanged items to form plaster keys where plaster occurs. Drill and/or punch holes for bolts and screws. Conceal fastening where practical.

3. Provide thickness of metal and details of assembly or supports to give ample strength and stiffness. Form joints exposed to weather in a way to exclude water.

4. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood or absorptive materials subject to wetting, protect the surfaces with a coat of bituminous paint, unless otherwise specified, to prevent galvanic or corrosive action.

I. Galvanizing: Provide a zinc coating for those items shown on the Drawings and specified to be galvanized using the hot-dip process after fabrication in accordance with the following:

1. ASTM A 153 for galvanizing of iron and steel hardware.

2. ASTM A 123 for galvanizing of rolled, pressed and forged steel shapes, plates, bars and strip, 3 mm thick and heavier.

3. ASTM A 386 for galvanizing of assembled steel products.

J. Shop Prime Painting:

1. Shop prime paint metal fabrications, except those members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded and galvanized surfaces, unless otherwise indicated.

2. Remove scale, rust and other deleterious materials before the shop coat of paint is applied. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 Hand Tool Cleaning, or SSPC SP-3 Power Tool Cleaning or SSPC SP-6 Commercial Blast Cleaning. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 Solvent Cleaning.

3. Immediately after surface preparation, brush or spray on primer in accordance with the paint manufacturer's instructions, at a rate to provide a uniform dry film thickness of 0.05 mm for each coat. Use painting methods resulting in full coverage of joints, corners, edges and all exposed surfaces.

4. Apply one shop prime coat to fabricated metal items, except apply two coats of paint to surfaces not accessible after erection. Change color of second coat to distinguish it from the first.

3. PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which metal fabrication items are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting Drawings, diagrams, templates, instructions and directions for installation of anchorage such as concrete inserts, anchor bolts and miscellaneous items having integral anchors which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the affected trades for installation.

B. Take field measurements prior to fabrication and delivery of metal fabrications to ensure proper fit of work.

C. Apply bituminous mastic coating to concealed surfaces of metal fabrications where metal will be in contact with dissimilar material, set in concrete or masonry, and potentially damp conditions to prevent corrosion of metal.

3.3 INSTALLATION

A. Install units to allow for expansion and contraction from a minimum ambient temperature range of 0 - 49 degree C without causing deformation of units and over-stress of welds and fasteners.

B. Set metal fabrications accurately in locations, alignments and elevations shown, plumb, level, true and free of rack, measured from established lines and levels.

C. Fastening to In-place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrication items to in-place construction including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, wood screws and other connectors as required.

D. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

E. Cutting and Fitting:

1. Perform cutting, drilling, welding and fitting required for the installation of the metal fabrications.

2. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coats.

3. Do not weld, cut or abrade exposed surfaces which cannot be completely restored in the field.

4. Drill holes for bolts and screws. Conceal fasteners where possible. Mill exposed ends and edges smooth, with corners slightly rounded.

F. Field Welding: Conform to AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made and methods used in correcting welding work.

G. Soldering: Conform to the recommendations of AWS Welding Handbook, Volume 2, Chapter

12 - Soldering. Use only for filling or sealing joints and not for mechanical strength. Where exposed to view, soldered joints shall be finished to match adjoining finish metal and made as unnoticeable as practicable.

3.4 INSTALLATION OF SPECIFIC METAL ITEMS

A. Setting Loose Plates:

1. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.

2. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts, do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout.

3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 PAINTING

A. Touch-up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas in shop applied paint. Paint damaged areas with the same paint used for shop prime painting. Apply by brush or spray to provide a minimum dry film thickness conforming to that specified in Section 09900 - PAINTING.

B. Finish Painting: Painting of unfinished and prime coated metal fabrications required to be field painted shall conform to Section 09900 - PAINTING.

END OF SECTION

DIVISION - 6

WOOD AND PLASTIC

SECTION 06400

ARCHITECTURAL WOODWORK

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Kitchen Cabinets

B. Reception and Internet Counters, Countertops and Closets

C. Standing and Running Trim

D. Lavatory Counter

E. Wooden Shade Structure (Octagonal)

F. And other similar items as shown on drawings and specified herein

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials:

ASTM A 36 Specification for Structural Steel.

ASTM A 307 Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners.

ASTM A 209 Specification for Aluminum Alloy Sheet and Plate.

B. PS - National Bureau of Standards, Product Standards:

PS 1 Construction and Industrial Plywood With Typical APA Grade-Trademarks.

PS 51 Product Standard Concerning Standards for the Manufacture of Plywood with Flame Spread Ratings.

C. ANSI - American National Standard Institute:

A156.9 Cabinet Hardware.

A616.2 Performance Standards for Fabricated High Pressure Decorative Laminate Counter-top.

A208.1 Mat-Formed Wood Particle-board.

D. NEMA - National Electrical Manufacturer's Association:

LD 1 - Standard Publication Laminated Thermosetting Decorative Sheets.

LD 3 - High Pressure Decorative Laminate.

E. AWI - Architectural Woodwork Institute:

AWI Architectural Woodwork Standards, Guide Specifications and Quality Certification Program.

F. CS - Department of Commerce, Commercial Standards:

CS 236 Mat-Formed Wood Particle Board.

G. BHMA - Builder's Hardware Manufacturer's Association:

Standard 201 - Product Standard.

Section B - Cabinet Hardware.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each product and process specified as work of this Section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storage, installation and finishing treated materials as follows:

1. Non-Pressure Preservative Treatment: Include certification stating chemical solution and submersion period used and affirming compliance with indicated treatment standards.

2. Pressure Preservative Treatment: For each type of treatment and wood species indicated, include certification of treating plant stating type of preservative solution, amount of preservative retained, depth of penetration and compliance with indicated standards.

3. Fire-Retardant Treatment: Include certification by treatment plant that treated materials comply with requirements.

C. Quality Certification: Submit woodwork manufacturer (fabricator) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.

D. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.

E. Samples: Submit samples of wood finish and plastic laminates for color and pattern selection, and exposed cabinet hardware (one unit of each type and finish).

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork until painting, wet work grinding and similar operations that could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.5 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications: A firm experienced in successfully producing architectural woodwork similar to that required for this project. Manufacturer and the Installer shall be subject to approval of the Engineer.

B. Work shall comply with applicable requirements of **Architectural Woodwork Quality Standards** published by Architectural Woodwork Institute (AWI), except as otherwise indicated.

2. PART 2 - PRODUCTS

2.1 BASIC MATERIALS AND FABRICATION METHODS

A. General: Provide quality grade specified except where work of higher quality is indicated.

B. Wood Moisture Content: Provide kiln-dried lumber and maintain optimum moisture content in solid wood (hardwood and softwood) through fabrication, installation and finishing operations of interior work. Moisture shall be 10 percent for Interior Woodwork and ranging from 9 to 13 percent for Exterior Woodwork.

C. Wood for Transparent Finish: Unless otherwise indicated on the Drawings, provide premium grade plain sawn oak, redwood or approved equal specie.

D. Wood for Painted Finish: Comply with quality standards for selection of species, grade and cut (fabricator's option, except as otherwise indicated).

E. Plastic Laminate: Comply with NEMA LD 3, type, thickness, color, pattern and finish as indicated for each application, or if not indicated, as approved by the Engineer.

F. Quality Standards: For the following types of architectural woodwork, comply with the indicated standards as applicable:

1. Standing and Running Trim: AWI Section 300.

2. Casework and Counter-tops: AWI Section 400.

3 Shelving: AWI Section 600.

4. Miscellaneous Work: AWI Section 700.

G Design and Construction Features: Comply with the details shown for profile and construction of architectural woodwork and, where not otherwise shown, comply with applicable quality standards with alternate details as fabricator's option.

H. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, wherever possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth the edges of cutouts and, where located in counter-tops and similar exposures, seal the edges of cutouts with a water-resistant coating.

I. Wood Treatment:

1. Preservative Treatment by Non-Pressure Method: Comply with requirements of referenced woodworking standard for non-pressure treatment of woodwork with non-aqueous water repellent solution, except as indicated. Treat units of woodwork after cutting, machining, sanding, gluing and assembling have been completed to the greatest extent possible. Coat surfaces cut after treatment with heavy brush coating of same preservative.

2. Pressure Preservative Treatment: Use only preservative solutions and treating process demonstrated through successful experience and recommended by manufacturer of preservative chemicals and wood treatment plant as being suitable for woodwork of type, species, and finish indicated.

3. Fire-Retardant Treated Wood: Where wood is indicated as **FRTW**, provide materials complying with applicable standards for pressure impregnation with fire-retardant chemicals and with AWPA C-20 for lumber and AWPA C-27 for plywood, and flame spread rating of 25 as per ASTM E 84.

J. Fabrication and assembly techniques used by the woodworker shall be those established by AWI; and items indicated shall be shop-fabricated and finished to the fullest extent possible.

2.2 KITCHEN AND STORAGE CABINETS:

Cabinets shall be shop-fabricated complying with AWI Section 400 and its Division 400B or equivalent standards, size and shape as shown on Drawings. Doors shall be 18 mm thick plywood with PVC plastic laminate finish; color as approved by the Engineer. Rest of cabinet structures including doors, shelves, drawer, worktop and panels shall be fabricated from minimum 18 mm thick hardwood/plywood with plastic laminate finish, color to match doors. High-pressure decorative plastic laminate, premium grade, complying with NEMA LD1 shall be minimum 1.50 mm thick for worktops and 0.5 mm thick for other areas, and shall be applied on 18 mm hardwood/plywood. Manufacturer's standard stainless steel hardware complying with ANSI/BMHA A156.9, subject to approval of Engineer, shall be provided.

Cabinet doors shall be 18 mm thick hardwood/plywood with minimum 0.9 mm thick natural Teak wood veneer and clear lacquered or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Manufacturer's standard stainless steel hardware complying with ANSI/BMHA A156.9, subject to approval of Engineer, shall be provided. Counters shall be supported on galvanized steel supports and anchored rigidly to structural floor slab.

2.3 RECEPTION COUNTER, COUNTERTOPS AND CLOSETS:

A. Construction: Shall be shop-fabricated complying with AWI Section 400 and its Division 400B and constructed as per details shown on Drawings. Counter shall be constructed of solid natural hardwood with natural Teak wood veneer facings with brushed stainless steel cladding and base. Doors, shelves and drawers shall be fabricated of 18 mm thick chipboard

with minimum 0.9 mm thick Twak wood veneer and clear lacquered or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Manufacturer's standard stainless steel hardware complying with ANSI/BMHA A156.9, subject to approval of Engineer, shall be provided. Counters shall be supported on galvanized steel supports and anchored rigidly to structural floor slab.

B. Marble Countertops: Shall be polished marble approved color with minimum 30 mm thick and complying with requirements of Section 09600 - STONEWORK and fabricated as per details shown on drawings. For plastic laminate countertop and shelves, provide a high-pressure decorative plastic laminate complying with NEMA L-D3, minimum 1.50 mm thick for worktops and not less than 0.5 mm for sides and shall be applied on 30 mm and 25 mm chipboards. Color of laminate and pattern shall be as selected and approved by the Engineer.

C. CORIAN Countertops: Shall be a special formulation of natural minerals and high performance acrylic; having a high impact resistance, non-porous, solid with color all the way through the material section. Corian shall comply with NEMA LD 1 - 2.13, 2.06 and 2.16. Surface spread of flame test shall be in accordance with BS 476: Part 7. Color shall be as shown on drawings or as approved by Engineer.

2.4 LAVATORY COUNTERS

A. Shop-fabricated, premium grade quality complying with AWI Section 400 - Divisions A, B & C.

B. Construction: Lavatory counters shall be constructed of 18 mm solid chipboard. Submit detailed shop drawings showing the different construction details as well as samples of the materials and finishes involved including color of laminate, type of veneer and their patterns for the Engineer's review and approval.

1. Marble countertop: Type of marble shall be as indicated on Drawings, complying with requirements of Section 09600 - STONEWORK.

C. Sizes: As shown on Drawings.

D. Finish:

1. Where indicated on Drawings, provide wood veneer of type as shown on Drawings and a minimum thickness 0.9 mm. Veneered areas shall have a clear lacquered or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Color of finish and grain matching shall be as selected and approved by the Engineer.

E. Hardware: Provide the manufacturer's standard hardware complying with ANSI/BMHA A156.9.

2.5 STANDING AND RUNNING TRIM

A. Standing and running trim shall include trim for openings and casings.

B. Wood used shall be 20 mm thick, hardwood, AWI quality, premium grade, type be as indicated on Drawings or approved by the Engineer.

C. Match species and cut indicated for other types of transparent finished architectural woodwork located in same area of building, unless otherwise indicated.

D. Sizes and Shapes: Unless otherwise indicated on Drawings, baseboards shall be 20 x 100 mm high of solid Teak hardwood and profile shown on Drawings.

E. Finish: Wood baseboard indicated to be painted shall have alkyd enamel paint finish, semi-gloss in accordance with Section 09900 - PAINTING. Provide premium grade plain sawn oak, redwood or approved equal specie for wood base with clear lacquer finish conforming to the requirements of Section 09900 - PAINTING.

2.6 WOOD PANELLING (WD2 -TYPE 2, WD3 - TYPE 3 AND WD4 - WAINSCOT)

A. General: Refer to I.D. drawings and specifications for details of paneling.

B. Shop-fabricated, premium grade quality complying with AWI Section 500 - Division A. Type of wood and veneers used for paneling shall be as indicated on Drawings. Paneling to be constructed of solid hardwood framing and 19 mm plywood with a final natural Teak wood veneer of minimum 0.9 mm thickness. Veneered areas shall have a clear lacquered, or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Construction details, color of finish, pattern and grain matching shall be as approved by the Engineer.

C. Railings, Moldings and Baseboards: Shall be premium grade solid Teak cut to details and configuration shown on drawings. Provide clear lacquer finish complying with Section 09900 – PAINTING.

D. Where indicated on Drawings, provide fire-retardant construction having the following surface burning characteristics in accordance with ASTM E 84; flame spread 75 or less and smoke developed 40 or less.

2.4 WOODEN HANDRAILS AND RAILINGS:

A. General: Fabricate railings and handrails assemblies which when installed shall be capable to withstand a concentrated load of 0.9 kN applied at any point in any direction, and uniform load of 0.73 kN/m applied simultaneously in both vertical and horizontal directions.

B. Fabricate railings and handrails from the best quality solid Teak wood, type and details as shown on drawings. Railing and handrails shall have a clear lacquer finish in accordance with Section 09900 - PAINTING.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. Only the most skilled of workmen shall be used to install the products specified herein. The quality of workmanship in installation shall match the quality of the product specified.

B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 3 mm in 2400 mm for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.

E. Tops: Anchor securely to base units and other support systems as indicated.

F. Prefabricated Woodwork: Install, where shown, securely anchored in accordance with the manufacturer's shop Drawings and instructions.

G. Fire Retardant Coating: Where required, apply by roller, brush or spray to conform to the manufacturer's application recommendations and instructions.

H. Plastic Laminates: Apply over substrates indicated in accordance with the manufacturer's instructions.

3.2 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. 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.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

D. Complete the finishing work specified as work of this section, to whatever extent not complete at the shop or prior to installation of woodwork.

E. Protection: Protect architectural woodwork and maintain conditions necessary to ensure that the work will be without damage or deterioration at the time of acceptance.

F. Anti-Corrosion Measure:

1. Incompatible materials are to be isolated with approved materials which can withstand compression.

2. Use only non-ferrous fixing where applicable.

3. Use approved rust inhibitors as pre-primers after primary preparation.

END OF SECTION

SECTION 06400

ARCHITECTURAL WOODWORK

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Kitchen Cabinets

B. Reception and Internet Counters, Countertops and Closets

C. Standing and Running Trim

D. Lavatory Counter

E. Wooden Shade Structure (Octagonal)

F. And other similar items as shown on drawings and specified herein

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials:

ASTM A 36 Specification for Structural Steel.

ASTM A 307 Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners.

ASTM A 209 Specification for Aluminum Alloy Sheet and Plate.

B. PS - National Bureau of Standards, Product Standards:

PS 1 Construction and Industrial Plywood With Typical APA Grade-Trademarks.

PS 51 Product Standard Concerning Standards for the Manufacture of Plywood with Flame Spread Ratings.

C. ANSI - American National Standard Institute:

A156.9 Cabinet Hardware.

A616.2 Performance Standards for Fabricated High Pressure Decorative Laminate Counter-top.

A208.1 Mat-Formed Wood Particle-board.

D. NEMA - National Electrical Manufacturer's Association:

LD 1 - Standard Publication Laminated Thermosetting Decorative Sheets.

LD 3 - High Pressure Decorative Laminate.

E. AWI - Architectural Woodwork Institute:

AWI Architectural Woodwork Standards, Guide Specifications and Quality Certification Program.

F. CS - Department of Commerce, Commercial Standards:

CS 236 Mat-Formed Wood Particle Board.

G. BHMA - Builder's Hardware Manufacturer's Association:

Standard 201 - Product Standard.

Section B - Cabinet Hardware.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each product and process specified as work of this Section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storage, installation and finishing treated materials as follows:

1. Non-Pressure Preservative Treatment: Include certification stating chemical solution and submersion period used and affirming compliance with indicated treatment standards.

2. Pressure Preservative Treatment: For each type of treatment and wood species indicated, include certification of treating plant stating type of preservative solution, amount of preservative retained, depth of penetration and compliance with indicated standards.

3. Fire-Retardant Treatment: Include certification by treatment plant that treated materials comply with requirements.

C. Quality Certification: Submit woodwork manufacturer (fabricator) certification, stating that fabricated woodwork complies with quality grades and other requirements indicated.

D. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.

E. Samples: Submit samples of wood finish and plastic laminates for color and pattern selection, and exposed cabinet hardware (one unit of each type and finish).

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork until painting, wet work grinding and similar operations that could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.5 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications: A firm experienced in successfully producing architectural woodwork similar to that required for this project. Manufacturer and the Installer shall be subject to approval of the Engineer.

B. Work shall comply with applicable requirements of **Architectural Woodwork Quality Standards** published by Architectural Woodwork Institute (AWI), except as otherwise indicated.

2. PART 2 - PRODUCTS

2.1 BASIC MATERIALS AND FABRICATION METHODS

A. General: Provide quality grade specified except where work of higher quality is indicated.

B. Wood Moisture Content: Provide kiln-dried lumber and maintain optimum moisture content in solid wood (hardwood and softwood) through fabrication, installation and finishing operations of interior work. Moisture shall be 10 percent for Interior Woodwork and ranging from 9 to 13 percent for Exterior Woodwork.

C. Wood for Transparent Finish: Unless otherwise indicated on the Drawings, provide premium grade plain sawn oak, redwood or approved equal specie.

D. Wood for Painted Finish: Comply with quality standards for selection of species, grade and cut (fabricator's option, except as otherwise indicated).

E. Plastic Laminate: Comply with NEMA LD 3, type, thickness, color, pattern and finish as indicated for each application, or if not indicated, as approved by the Engineer.

F. Quality Standards: For the following types of architectural woodwork, comply with the indicated standards as applicable:

1. Standing and Running Trim: AWI Section 300.

2. Casework and Counter-tops: AWI Section 400.

3 Shelving: AWI Section 600.

4. Miscellaneous Work: AWI Section 700.

G Design and Construction Features: Comply with the details shown for profile and construction of architectural woodwork and, where not otherwise shown, comply with applicable quality standards with alternate details as fabricator's option.

H. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, wherever possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth the edges of cutouts and, where located in counter-tops and similar exposures, seal the edges of cutouts with a water-resistant coating.

I. Wood Treatment:

1. Preservative Treatment by Non-Pressure Method: Comply with requirements of referenced woodworking standard for non-pressure treatment of woodwork with non-aqueous water repellent solution, except as indicated. Treat units of woodwork after cutting, machining, sanding, gluing and assembling have been completed to the greatest extent possible. Coat surfaces cut after treatment with heavy brush coating of same preservative.

2. Pressure Preservative Treatment: Use only preservative solutions and treating process demonstrated through successful experience and recommended by manufacturer of preservative chemicals and wood treatment plant as being suitable for woodwork of type, species, and finish indicated.

3. Fire-Retardant Treated Wood: Where wood is indicated as **FRTW**, provide materials complying with applicable standards for pressure impregnation with fire-retardant chemicals and with AWPA C-20 for lumber and AWPA C-27 for plywood, and flame spread rating of 25 as per ASTM E 84.

J. Fabrication and assembly techniques used by the woodworker shall be those established by AWI; and items indicated shall be shop-fabricated and finished to the fullest extent possible.

2.2 KITCHEN AND STORAGE CABINETS:

Cabinets shall be shop-fabricated complying with AWI Section 400 and its Division 400B or equivalent standards, size and shape as shown on Drawings. Doors shall be 18 mm thick plywood with PVC plastic laminate finish; color as approved by the Engineer. Rest of cabinet structures including doors, shelves, drawer, worktop and panels shall be fabricated from minimum 18 mm thick hardwood/plywood with plastic laminate finish, color to match doors. High-pressure decorative plastic laminate, premium grade, complying with NEMA LD1 shall be minimum 1.50 mm thick for worktops and 0.5 mm thick for other areas, and shall be applied on 18 mm hardwood/plywood. Manufacturer's standard stainless steel hardware complying with ANSI/BMHA A156.9, subject to approval of Engineer, shall be provided.

Cabinet doors shall be 18 mm thick hardwood/plywood with minimum 0.9 mm thick natural Teak wood veneer and clear lacquered or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Manufacturer's standard stainless steel hardware complying with ANSI/BMHA A156.9, subject to approval of Engineer, shall be provided. Counters shall be supported on galvanized steel supports and anchored rigidly to structural floor slab.

2.3 RECEPTION COUNTER, COUNTERTOPS AND CLOSETS:

A. Construction: Shall be shop-fabricated complying with AWI Section 400 and its Division 400B and constructed as per details shown on Drawings. Counter shall be constructed of solid natural hardwood with natural Teak wood veneer facings with brushed stainless steel cladding and base. Doors, shelves and drawers shall be fabricated of 18 mm thick chipboard

with minimum 0.9 mm thick Twak wood veneer and clear lacquered or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Manufacturer's standard stainless steel hardware complying with ANSI/BMHA A156.9, subject to approval of Engineer, shall be provided. Counters shall be supported on galvanized steel supports and anchored rigidly to structural floor slab.

B. Marble Countertops: Shall be polished marble approved color with minimum 30 mm thick and complying with requirements of Section 09600 - STONEWORK and fabricated as per details shown on drawings. For plastic laminate countertop and shelves, provide a high-pressure decorative plastic laminate complying with NEMA L-D3, minimum 1.50 mm thick for worktops and not less than 0.5 mm for sides and shall be applied on 30 mm and 25 mm chipboards. Color of laminate and pattern shall be as selected and approved by the Engineer.

C. CORIAN Countertops: Shall be a special formulation of natural minerals and high performance acrylic; having a high impact resistance, non-porous, solid with color all the way through the material section. Corian shall comply with NEMA LD 1 - 2.13, 2.06 and 2.16. Surface spread of flame test shall be in accordance with BS 476: Part 7. Color shall be as shown on drawings or as approved by Engineer.

2.4 LAVATORY COUNTERS

A. Shop-fabricated, premium grade quality complying with AWI Section 400 - Divisions A, B & C.

B. Construction: Lavatory counters shall be constructed of 18 mm solid chipboard. Submit detailed shop drawings showing the different construction details as well as samples of the materials and finishes involved including color of laminate, type of veneer and their patterns for the Engineer's review and approval.

1. Marble countertop: Type of marble shall be as indicated on Drawings, complying with requirements of Section 09600 - STONEWORK.

C. Sizes: As shown on Drawings.

D. Finish:

1. Where indicated on Drawings, provide wood veneer of type as shown on Drawings and a minimum thickness 0.9 mm. Veneered areas shall have a clear lacquered or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Color of finish and grain matching shall be as selected and approved by the Engineer.

E. Hardware: Provide the manufacturer's standard hardware complying with ANSI/BMHA A156.9.

2.5 STANDING AND RUNNING TRIM

A. Standing and running trim shall include trim for openings and casings.

B. Wood used shall be 20 mm thick, hardwood, AWI quality, premium grade, type be as indicated on Drawings or approved by the Engineer.

C. Match species and cut indicated for other types of transparent finished architectural woodwork located in same area of building, unless otherwise indicated.

D. Sizes and Shapes: Unless otherwise indicated on Drawings, baseboards shall be 20 x 100 mm high of solid Teak hardwood and profile shown on Drawings.

E. Finish: Wood baseboard indicated to be painted shall have alkyd enamel paint finish, semi-gloss in accordance with Section 09900 - PAINTING. Provide premium grade plain sawn oak, redwood or approved equal specie for wood base with clear lacquer finish conforming to the requirements of Section 09900 - PAINTING.

2.6 WOOD PANELLING (WD2 -TYPE 2, WD3 - TYPE 3 AND WD4 - WAINSCOT)

A. General: Refer to I.D. drawings and specifications for details of paneling.

B. Shop-fabricated, premium grade quality complying with AWI Section 500 - Division A. Type of wood and veneers used for paneling shall be as indicated on Drawings. Paneling to be constructed of solid hardwood framing and 19 mm plywood with a final natural Teak wood veneer of minimum 0.9 mm thickness. Veneered areas shall have a clear lacquered, or a stained finish as indicated on Drawings and in accordance with Section 09900 - PAINTING. Construction details, color of finish, pattern and grain matching shall be as approved by the Engineer.

C. Railings, Moldings and Baseboards: Shall be premium grade solid Teak cut to details and configuration shown on drawings. Provide clear lacquer finish complying with Section 09900 – PAINTING.

D. Where indicated on Drawings, provide fire-retardant construction having the following surface burning characteristics in accordance with ASTM E 84; flame spread 75 or less and smoke developed 40 or less.

2.4 WOODEN HANDRAILS AND RAILINGS:

A. General: Fabricate railings and handrails assemblies which when installed shall be capable to withstand a concentrated load of 0.9 kN applied at any point in any direction, and uniform load of 0.73 kN/m applied simultaneously in both vertical and horizontal directions.

B. Fabricate railings and handrails from the best quality solid Teak wood, type and details as shown on drawings. Railing and handrails shall have a clear lacquer finish in accordance with Section 09900 - PAINTING.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. Only the most skilled of workmen shall be used to install the products specified herein. The quality of workmanship in installation shall match the quality of the product specified.

B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 3 mm in 2400 mm for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.

E. Tops: Anchor securely to base units and other support systems as indicated.

F. Prefabricated Woodwork: Install, where shown, securely anchored in accordance with the manufacturer's shop Drawings and instructions.

G. Fire Retardant Coating: Where required, apply by roller, brush or spray to conform to the manufacturer's application recommendations and instructions.

H. Plastic Laminates: Apply over substrates indicated in accordance with the manufacturer's instructions.

3.2 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. 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.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

D. Complete the finishing work specified as work of this section, to whatever extent not complete at the shop or prior to installation of woodwork.

E. Protection: Protect architectural woodwork and maintain conditions necessary to ensure that the work will be without damage or deterioration at the time of acceptance.

F. Anti-Corrosion Measure:

1. Incompatible materials are to be isolated with approved materials which can withstand compression.

2. Use only non-ferrous fixing where applicable.

3. Use approved rust inhibitors as pre-primers after primary preparation.

END OF SECTION

DIVISION - 7

THERMAL AND MOISTURE PROTECTION

SECTION 07100

WATERPROOFING

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HYGRIP water proofing membrane elastomeric sheet waterproofing for the following:

1. General waterproofing for basement(s), Drains, toilets, washrooms, tearoom and other below grade areas as indicated on Drawings and specified herein.

2. Planters boxes, Water tanks, Elevator Pits and Fountains.

B. Lining for the following:

2. Water tanks (for Potable, Irrigation, Raw Well Water), Fountains and other Water Features.

2. Elevator pits and sump pits.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM D 471	Test Method for Rubber Property - Effect of Liquids
ASTM D 570	Test Method for Water Absorption of Plastics
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 828	Test Method for Tensile Breaking Strength of Paper and Paperboard
ASTM D 1004	Test Method for Initial Test Resistance of Plastic Film and Sheeting
ASTM E 96	Standard Method of Test for Water Vapor Transmission of Materials
ASTM E 154	Test Method for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on walls, or as Ground Cover

1.3 SUBMITTALS

A. Submit product data, samples, and general recommendations from manufacturer, for types of waterproofing required. Include data showing that materials comply with the specified requirements.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials in manufacturer's unopened, labeled packing and in compliance with the manufacturer's storage, handling, installation and protection requirements.

1.5 WARRANTY

A. Provide written warranty, agreeing to replace and repair defective materials and workmanship. Warranty includes responsibility for removal and replacement of other work which conceals sheet waterproofing. Warranty period is 10 years after date of substantial completion.

1.6 QUALITY ASSURANCE

A. Manufacturer: Obtain primary waterproofing materials of each type required from a single manufacturer, to the greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.

1.7 JOB CONDITIONS

A. Substrate: Proceed with waterproofing after completing substrate construction, openings and penetrating works.

B. Weather: Proceed with waterproofing and associated works only when existing and forecast weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

2. PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. HY-GRIP Sheet Waterproofing: Technical data is as under:-

Size of roll	1.0 nm wide x 10 m long	
Nominal Thickness	4mm	ASTM D751, UEAtc
Upper Surface	Polyethylene film See 'other finishes' also	
Lower Surface	Polyethylene film See 'other finishes' also	
Type of coating	APP modified bitumen	
Reinforcement	Non-woven Polyester	UEAtc
Tensile strength	Longitudinal 1000 N/5 cm Transversal 1000 N/5 cm	ASTM D 146, UEAtc
Elongation at break	Longitudinal 50% Transversal 50%	ASTM D 146, UEAtc
Softening point of the coating	> 150 ^{0}C	ASTM D 36, UEAtc
Cold flexibility	- 10 ^{0}C (No cracks)	ASTM D 146, UEAtc
Heat Resistance Method A, 2 hours	130 ^{0}C (No flow)	UEAtc
Chemical resistance	Resistance to water, salt solution, dilute acids and alkalis	

1. Thickness: Minimum 4 mm, nominal.

2. Exposed Face Color: White-on-black, unless otherwise noted on drawings.

Waterproofing membrane shall be applied in accordance with the following:

1. Horizontal and Vertical Waterproofing Applications for basement, tunnels, swimming pool, fountains, potable and non-potable water tanks, elevator and sump pits and other areas below grade as shown on Drawings: Single layer HY-GRIP sheet waterproofing fully adhered to substrate.

2. Wet Areas (Kitchens, Tea Room, Toilets and Wash Areas): Single layer HY-GRIP sheet waterproofing fully adhered to substrate.

B. Planter Boxes: Single layer HY-GRIP sheet waterproofing fully adhered to substrate.

C. Lining for Potable Water Tanks:

1. A two-component epoxy resin based, non-toxic, high build solvent-free coating applied in two coats, 200 micron thick each, with glass-fiber reinforcement grade 110 g/m² (between coats) on the internal surfaces of the tank unless recommended otherwise by the lining Manufacturer.

D. Lining for Swimming Pool, Water feature and Fountain:

1. A single component pitch modified polyurethane coating conforming to ASTM C 836 or BS 3900 applied in a single coat, 1.3 mm thick on the internal surfaces as per the recommendations of the lining manufacturer and suitable for ceramic tile application.

E. Lining for Lift Stations, Sewage Holding Tanks, Sewer Manholes, Elevator Pits and Sump Pits:

1. A three-component system consisting of epoxy resin without solvents and chemical resistant fillers applied in 2 coats, 300 microns thick each on internal surfaces unless recommended otherwise by the lining manufacturer. Lining shall be trowel-applied to the substrate.

F. Liquid waterproofing (For Dome and Vault):

1. Acrylic elastomeric waterproofing coating, spray-applied, non-toxic and non-flammable, applied in 2 coats to minimum 1 mm dry film thickness. Coating shall have heat and solar reflecting properties. Coating shall be approved by the Engineer.

2. Color: Satin white, gray or as approved by the Engineer.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by elastomeric waterproofing manufacturer for intended use and compatible with HY-GRIP sheet membrane.

B. Sheet Flashing: Minimum 4-mm thick HY-GRIP partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive.

D. Seaming Material: Manufacturer's standard synthetic-rubber polymer primer and 75mm wide minimum, butyl splice tape with release film.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. Miscellaneous Accessories: Provide lap sealant, water cutoff mastic, metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 MISCELLANEOUS MATERIALS

A. Primers (If required): Provide the type of primer as recommended by the waterproofing material manufacturer.

B. Protection Board: Provide minimum 2.5 mm thick multi-layer pressure bonded board with asphaltic impregnation as a protection for the waterproofing where indicated on the Drawings.

C. Separation Layer: Non-woven polyester fabric, minimum density of 180 g/m² and to be laid above the membrane where shown on Drawings.

D. Vapor Barrier: Polyethylene sheeting conforming to ASTM D 4397, minimum 200 microns thick having a vapor permeance rating not exceeding 0.063 perms, and shall be laid with 300 mm overlapping.

3. PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing manufacturer.

2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

3. Notify Architect in writing of anticipated problems using waterproofing over substrate.

4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrate. Remove dust and dirt from joints and cracks according to ASTM D 4258.

F. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.4 INSTALLATION

A. General: Waterproofing works shall be executed by a specialized Sub-Contractor recommended by the waterproofing and/or lining manufacturer and approved by the Engineer.

B. Fully Adhered Sheet Installation:

- Install fully adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions and recommendations in ASTM D 5843.
- Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- Apply bonding adhesive to substrates at required rate and allow to partially dry.
- Apply bonding adhesive to sheets and firmly adhere sheets to substrates. Do not apply bonding adhesive to splice area of sheet.

C. Comply with waterproofing and/or lining manufacturer's recommendations regarding installation details, surface preparation, as well as the overlapping.

D. Substrate shall be smooth, hard dry and free from high spots and depressions. Substrate shall be swept clean and free from dust, loose cement scale, oil, grease, foreign substances and debris.

E. Starting at the low point of the slab, apply the waterproofing membrane with minimum 50 mm overlap. All the joints shall be welded with hot air. Lay non-woven polyester fabric separation layer over waterproofing membrane prior to application of other finishing.

F. On vertical areas, apply the waterproofing membrane mechanically fixed to walls with minimum 50 mm overlap. Use waterproofing manufacturer's standard fasteners with PVC covering for welding to the membrane. All the joints shall be welded with hot air. Apply protection board prior to backfilling.

G. Test the work after completion by water flooding to a minimum height of 75 mm for a period of 48 hours.

H. For the application of waterproof lining and liquid waterproofing, follow manufacturer's written instructions.

I. Submit 10 years guarantee for the waterproofing works done and the associated works covering the failure of materials or workmanship. Guarantee shall be signed by waterproofing Sub-Contractor and shall indicate which (Contractor or Sub-Contractor) has assumed the responsibility for the removal and the replacement of the works concealing the waterproofing work in case of failure of material or workmanship.

3.5 SHEET FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to waterproofing manufacturer's written instructions.

B. Form wall flashings using exposed sheet flashing.

C. Cover expansion joints and discontinuous deck-to-wall or deck-to-deck joints by extending deck sheet waterproofing over joints.

D. Terminate and seal top of sheet flashings with mechanically anchored termination bars.

END OF SECTION

SECTION 07150

DAMPPROOFING

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bituminous dampproofing over surfaces of:

1. Structural concrete surfaces

2. Non-structural concrete surfaces

below grade as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM E 96 Standard Method of Test for Water Vapor Transmission of Materials

ASTM E 154 Test Method for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on walls, or as Ground Cover

B. BSI - British Standards Institution

BS 5493 Code of Practice for Protective Coating of Iron and Steel structures against Corrosion

1.3 SUBMITTALS

A. Product Data and Samples: Submit manufacturer's product samples and technical data including the application instructions and recommendations for each dampproofing material required.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials in manufacturer's unopened, labeled containers, and comply with the manufacturer's storage, handling, application and protection requirements.

2. PART 2 - PRODUCTS

2.1 DAMPPROOFING MATERIAL

A. Vertical and Horizontal Dampproofing for Concrete and Masonry Work below Grade:

1. Construction: An epoxy-tar based high performance resin coating, consisting of thixotropic pitch extended epoxy resin formulation with reinforcing inert fillers and a special blend of solvents. Resin coating shall be supplied as a two-component system comprising a special blend of pitch and epoxy resins and a separate low viscosity amine hardener.

2. References: Resin coating shall conform to the requirements of BS 5493 - Reference KF3B.

3 Application: 2 coats unless otherwise recommended by the manufacturer.

4. Dry Film Thickness: 350 micron for 2 coats.

2.2 MISCELLANEOUS MATERIALS

A. Primers: Where required, provide the type of primer as recommended by the dampproofing material manufacturer.

B. Protection Board: Provide 2.5 mm thick multi-layer pressure bonded board with asphaltic impregnation as a protection for the dampproofing where shown on the Drawings.

C. Vapor Barrier: Polyethylene sheeting conforming to ASTM D 4397, minimum 200 microns thick having a vapor permeance rating not exceeding 0.063 perms, and shall be laid with 300 mm overlapping.

3. PART 3 - EXECUTION

3.1 PREPARATION OF SUBSTRATE

A. Clean substrate of projections and substances detrimental to the work. Comply with the recommendations of materials manufacturer.

B. Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.2 APPLICATION

A. General: Comply with the manufacturer's instructions, except where more stringent requirements are shown or specified and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

B. Extend vertical dampproofing down walls from finishes grade line to top of footing, extend over top of footing and turn down minimum of 150 mm over outside face of footing. Extend 300 mm onto intersecting walls and footings but do not extend onto surfaces which will be exposed to view when project is completed.

C. Surface must be thoroughly cleaned and free from dirt, debris, loose gravel, scale and dry. Prime the surfaces with manufacturer's standard primer as per recommendation and allow to cure to tack free.

D. Apply two coat of liquid dampproofing material by brushing with a minimum dry film thickness of that specified herein unless otherwise recommended by the manufacturer.

E. Allow time for complete drying between the different coats.

END OF SECTION

SECTION 07210

BUILDING INSULATION

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Thermal insulation as indicated on Drawings.

B. Fire barriers as indicated on Drawings.

C. Acoustical insulation as indicated on Drawings.

D. Thermal and acoustical insulation accessories.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM C 518	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the HEAT Flow Meter Apparatus
ASTM C 578	Specification for Preformed, Cellular Polystyrene Thermal Insulation
ASTM D 1621	Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
ASTM E 119	Test Method for Fire Tests of Building Construction and Materials
ASTM E 136	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

1.1 SUBMITTALS

A. Product Data and Samples: Submit manufacturer's product data and samples for the Engineer’s approval as well as installation procedures.

1.2 TRANSPORTATION, HANDLING AND STORAGE

A. Store insulation materials in weather tight enclosure.
B. Protect insulation from damage from handling, weather and construction operations before, during and after installation.

1.3 QUALITY ASSURANCE

A. Thermal Resistance: Where thermal resistance properties of insulating materials are designated by R-values they represent the rate of heat flow through a material of thickness indicated, measured by test method included in referenced material standard or otherwise indicated.

B. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which

insulation is a part, have been determined by testing, in accordance with the methods indicated below:

- Surface Burning Characteristics: ASTM E 84
- Fire Resistance Ratings: ASTM E 119
- Combustibility Characteristics: ASTM E 136

2. PART 2 - PRODUCTS

2.1 INSULATION MATERIALS - GENERAL

A. General: Provide insulating materials to comply with the requirements indicated for materials and compliance with referenced standards, in sizes to fit applications indicated, selected from the manufacturer's standard products for size and thickness.

2.2 WALL THERMAL INSULATION

A. General: Wall insulation shall be rockwool boards or extruded polystyrene boards.

B. Rockwool: Shall comply with the following requirements:

1. Construction: Rockwool fiber thermal insulation material produced by fusing basalt and bonded with thermosetting resin to produced semi-rigid board, complying with ASTM C 612.

2. Rockwool insulation board shall be minimum 80 mm thick, unfaced with a density of not less than 70 kg/m^3.

3. Size: Manufacturer’s standard.

4. Moisture Absorption: Water repellant, non-hydroscopic, and non-capillary. Moisture absorption shall be less than 1% by volume when tested in accordance with BS 2972.

5. Fire Rating: Non-combustible with zero flame spread and zero ignitability when tested in accordance with BS 476: Part 4, 5 and 6.

C. Rigid Extruded Polystyrene: Shall comply with the following requirements

1. Construction: Closed-cell, extruded polystyrene rigid foam with integral high density skin, colored throughout, conforming to ASTM C 578 or DIN 18164 Part 1; flame spread rating of 25 or less when tested in accordance with ASTM E 84; 5-year aged average thermal conductivity of 0.032 W/mK when tested at 24°C in accordance with ASTM C 518; water vapor permeability of 1.00 perm-inch average; average water absorption of maximum 1 percent by volume; with rebate details on four edges of board.

2. Rigid wall insulation boards shall have compressive strength of 210 kPa average when tested according to ASTM D 1621 and minimum density of 26 kg/m^3. Insulation boards shall be minimum 25 mm thick, unless indicated otherwise on Drawings.

2.3. ROOF THERMAL INSULATION: Rigid insulation boards shall comply with the following requirements:

A. Construction: Closed-cell, moulded polystyrene rigid foam with integral high density skin, colored blue throughout, conforming to ASTM C 578 or DIN 18164 Part 1; flame spread rating of 25 or less when tested in accordance with ASTM E 84; 5-year aged average thermal conductivity of 0.032 W/mK when tested at 24°C in accordance with ASTM C 518; water vapor permeability of 0.60 perm-inch average; average water absorption of maximum 1 percent by volume; with rebate details on four edges of board.

B. Rigid roof insulation boards shall have compressive strength of 300 kPa average when tested according to ASTM D 1621 and minimum density of 32 kg/m³. Insulation boards shall be minimum 50 mm thick, unless indicated otherwise on Drawings.

2.4 BLANKET (LOOSE) INSULATION: Blanket insulation shall comply with the following requirements:

A. Insulation shall be fiberglass blanket composed of stable and uniformly textured inorganic glass fibers bonded together by a non-water soluble and fire retardant thermosetting resin with manufacturer's standard foil reinforced facing. Thickness shall be minimum 50 mm, unless otherwise indicated on drawings.

B. Density shall be 10-12 kg/m^3 with thermal conductivity of 0.047 – 0.041 W/M ^{0} C, at mean temperature of 25 ^{0}C.

2.5. ACOUSTICAL INSULATION (Where Required):

A. Acoustical Rockwool Insulation: Shall conform to the following requirements -

1. Construction: Rockwool fibers insulation produced from molten basalt rock and bonded with thermosetting resin to produce semi-rigid insulation boards complying with ASTM C 612 or wired matt (blanket) conforming to ASTM C 592.

2. Size: Manufacturer Standard.

3. Thickness: Not less than 80 mm thick.

4. Density: As recommended by the manufacturer to achieve required STC ratings of 45 to 50, but not less than 100 kg/m³.

5. Moisture Absorption: Water repellant, non-hydroscopic, and non-capillary. Moisture absorption shall be less than 1% by volume when tested in accordance with BS 2972.

6. Fire Rating: Non-combustible with zero flame spread and zero ignitability when tested in accordance with BS 476: Part 4, 5 and 6.

2.6 FIRE BARRIER

A. Rockwool Fire Barrier: Shall conform to the following requirements

1. Construction: Fire barrier shall be thermosetting synthetic resin bonded, high density rockwool boards complying with ASTM C 612.

2. Size: Manufacturer Standard.

3. Thickness: As recommended by manufacturer for the intended application, but not less than 100 mm thick.

4. Density: Not less than 100 kg/m³.

5. Moisture Absorption: Water repellant, non-hydroscopic, and non-capillary. Moisture absorption shall be less than 1% by volume when tested in accordance with BS 2972.

6. Fire Rating: Non-combustible with zero flame spread and zero ignitability when tested in accordance with BS 476: Part 4, 5 and 6.

2.7 MISCELLANEOUS ITEMS

A. Adhesives, tapes, mechanical fastening devices and items necessary for installation of insulation system shall be of types as recommended by the manufacturer.

3. PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas scheduled to receive insulation and space allocated for insulation for proper depth to receive material.

3.2 INSTALLATION

A. Apply insulation units to substrate by methods complying with manufacturer's recommendation.

B. If no specific methods are indicated, bond units to the substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

3.3 CLEAN UP

A. Leave work areas in a clean condition after the completion of installation. Remove and dispose off site all excess materials, litter and debris.

END OF SECTION

SECTION 07500

ROOFING

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Inverted roofing system and the integral accessories related to the system installation as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM C 495	Test Method for Compressive Strength of Lightweight Insulating Concrete
ASTM D 471	Test Method for Rubber Property - Effect of Liquids
ASTM D 570	Test Method for Water Absorption of Plastics
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 828	Test Method for Tensile Breaking Strength of Paper and Paperboard
ASTM D 1004	Test Method for Initial Test Resistance of Plastic Film and Sheeting
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	Test Methods for Water Vapor Transmission of Materials
ASTM E 119	Test Method for Fire Tests of Building Construction and Materials
ASTM E 136	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
ASTM E 154	Test Method for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on walls, or as Ground Cover

1.3 SUBMITTALS

A. Product Data: Submit specifications, installation instructions, and general recommendations from the roofing materials manufacturer for each type of roofing product required. Include the manufacturer's data substantiating that the materials used are in compliance with the requirements.

B. Samples: Submit samples of each roofing system material for the Engineer's approval.

C. Shop Drawings: Submit complete shop drawings showing roof configurations and sheet layout, perimeter details as well as special conditions.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials in the manufacturer's unopened, labeled packing, and conform to the manufacturer's storage, handling, installation and protection requirements.

1.5 WARRANTY

A. Provide a written warranty, signed by the Manufacturer of the primary roofing materials and the Installer, agreeing to replace and repair defective materials and workmanship for a period of 10 years starting from date of substantial completion.

1.6 QUALITY ASSURANCE

A. Manufacturer: Provide primary products for the roofing system produced by a single manufacturer to the greatest possible extent. Provide secondary products which are acceptable to the manufacturer of primary products.

B. Installation: Work under this Section shall be performed by a specialized Sub-Contractor approved by the Engineer, recommended by the waterproofing membrane manufacturer, and having at least 10 years experience in successfully completed projects.

C. Thermal Resistance: Where thermal resistance properties of insulating materials are designated by the R-values they represent the rate of heat flow through a material of thickness indicated, measured by the test method included in the referenced material standard or as otherwise indicated.

D. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing according to the methods indicated below:

1. Surface Burning Characteristics: ASTM E 84 or equivalent standards.

2. Fire Resistance Ratings: ASTM E 119 or equivalent standards.

3. Combustibility Characteristics: ASTM E 136 or equivalent standards.

1.7 JOB CONDITIONS

A. Weather: Proceed with roofing work when the existing and forecasted weather conditions permit work to be performed in accordance with the manufacturer's recommendations and warranty requirements.

2. PART 2 - PRODUCTS

2.1 INVERTED ROOFING SYSTEM

A. Roof Screed: Lightweight concrete with Type 1 cement conforming to ASTM C896 with oven dry density of around 640 Kg/m³ when tested as per ASTM C 796, minimum compressive strength 2.8 MPa, when tested in accordance with ASTM C 796 or ASTM C 495 and water absorption of maximum 25% when tested as per ASTM C 796. Foaming agent shall be as recommended by the Manufacturer. Mix design shall be as recommended by the manufacturer and approved by the Engineer. Thickness as recommended by the

manufacturer (but not less than 50 mm thick), and shall be applied to roof to maintain the required slope.

B. Roofing Membrane:

1. EPDM elastomeric sheet waterproofing: Refer to Section 07100 – WATERPROOFING.

2. Roofing Membrane Accessories shall include but not limited to the following:

a. Primer for Application to Concrete Surfaces: As recommended by the roofing membrane manufacturer.

b. Fillet: Use preformed extrusions of size as mentioned on Drawings, coated with self-adhesive compound to provide an angle fillet between walls and slab.

c. Mastic Sealer: Manufacturer's standard elastomeric compound, heated in accordance with manufacturer's installation procedure to seal waterproofing membrane around projections and irregularities such as gullies and small diameter openings.

C. Roof Thermal Insulation: Refer to Section 07210 -BUILDING INSULATION:

D. Separation Layer: Non-woven polyester fabric of a minimum density of 180 g/m² and to be laid above the roof insulation.

E. Protection Layer: High density polyethylene sheeting conforming to ASTM E 154, 250 microns (10 mils) thick. Similar material having a vapor permeance rating not more than 0.3 perm as determined by ASTM E 96, Procedure E will be considered suitable when approved by the Engineer.

F. Flashing Materials: Manufacturer's standard extruded aluminum system compatible with the roofing membrane.

G. Roof Topping: Provide one of the following roof toppings as indicated on Drawings:

1. Gravel Surfacing: Where indicated on Drawings, provide round edge pea gravel aggregates with diameter size of 15 - 30 mm, and total thickness of 50 mm only for areas shown on the Drawings.

2. Precast Concrete Tiles: Where indicated on Drawings, provide concrete tiles, manufactured by hydraulic pressing; an upper layer of minimum 10 mm thickness formed of 1-1 cement-sand mortar and a lower layer of 30 MPa concrete; and water absorption of maximum 5 percent. Tile shall have a smooth trowel finish. Tile size shall be as indicated on Drawings.

3. PART 3 - EXECUTION

3.1 GENERAL:

A. Roof waterproofing works shall be executed by a specialized Sub-Contractor recommended by the waterproofing membrane manufacturer and approved by the Engineer.

3.2 INVERTED ROOFING SYSTEM

A. Preparation of Substrate:

1. After completion and curing of roof screed, inspect condition of substrate to receive roofing system, and conditions under which work will be performed. Correct unsatisfactory conditions including inadequate provisions in substrate for bonding roofing. Do not proceed with roofing work until unsatisfactory conditions have been corrected.

2. Install cant strips, fillets, and accessory items as indicated, or as recommended by the manufacturer even though not shown on Drawings.

B. Roofing Membrane Installation:

1. Installation Details: Perform external and internal corners, upstands, drainage and pipes penetrations strictly in accordance with details shown on the Drawings and as recommended by the manufacturer.

2. Substrate shall be smooth, hard dry and free from high spots and depressions. Substrate shall be swept clean and free from dust, loose cement scale, oil, grease, foreign substances and debris.

3. Starting at the low point of the slab, apply the waterproofing membrane loosely laid for horizontal areas with minimum 50 mm overlap. All the joints shall be welded with hot air.

4. On vertical areas, apply the UV stabilized waterproofing membrane fully adhered to exposed areas of parapet walls with minimum 50 mm overlap. Use waterproofing manufacturer's standard system for adhesion of the membrane. All the joints shall be welded with hot air.

5. Test roof membrane after completion by flooding 75 mm water height for a period of 48 hours.

C. Insulation Installation:

1. Comply with insulation manufacturer's written instruction for particular conditions of installation. Lay polyethylene sheet protection layer over waterproofing membrane prior to installation of insulation boards.

2. Extend insulation full thickness over entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projection interfering with placement.

3. Lay non-woven polyester fabric separation layer over insulation prior to installation of roof topping.

D. Roof Topping:

1. After completing waterproofing membrane, composite flashing and set-on accessories, as well as laying the insulation on each substantial area of roofing, cover the area with the separation layer.
2. Provide one of the following roof toppings as indicated on Drawings and as follows:

a. Aggregate Surfacing: Loose-fill the surface with a uniform layer of pea gravel 50 mm thick.

b. Concrete Tiles: Lay concrete tiles over 20 mm thick mortar bed.

3.5 PROTECTION OF ROOFING

A. Protect roofing upon completion of roofing work and during the remainder of construction period. At the end of construction, or at the time when remaining construction work will in no way affect or endanger the roofing, make a final inspection of roofing and prepare a written report describing the nature and the extent of deterioration or damage found in work.

B. Repair or replace the deteriorated or the defective work found at time of final inspection. Repair or replace the roofing and associated work to a condition free of damage and deterioration at time of substantial completion.

END OF SECTION

SECTION 07900

SEALANTS

1. PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Sealants required to make the entire buildings weather and watertight as shown on Drawings and as specified herein.

1.2. REFERENCES

A. ASTM - American Society of Testing and Materials

ASTM C 834	Specification for Latex Sealing Compounds
ASTM C 920	Specification for Elastomeric Joint Sealants
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

B. FS - Federal Specifications

FS-SS-S-200D-3	Sealing Compounds, Two Component, Elastomeric, Polymer Type, Jet Fuel Resistant Cold Applied.
FS-TT-S-00227E-3	Sealing Compound, Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Building Construction
FS-TT-S-00230	Sealing Compound, Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
FS-TT-S-001543	Sealing Compound, Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures
FS-TT-S-001657	Sealing Compound Single Component, Butyl Rubber Based, Solvent Release Type (for Buildings and Other Types of Construction

1.3. SUBMITTALS

A. Product Data: Submit manufacturer’s technical data for each joint sealer required, including instruction for joint preparation and joint sealer application.

B. Samples for Initial Selection Purposes: Submit the manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available for each product exposed to view.

C. Samples for Verification Purposes: Submit samples of each type and color of joint sealer required. Install joint sealer samples in 12 mm wide joints formed between two 150 mm long strips of materials matching the appearance of exposed surfaces adjacent to joint

sealers in the work.

D. Certificates: Submit certificates from manufacturers of joint sealers attesting that products comply with specification requirements and are suitable for the use indicated.

1.4. TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials to Project site in original unopened containers or bundles with labels showing manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.5. QUALITY ASSURANCE

A. Mock-Ups: Prepare a mock-up of each different type of sealant installation shown. For each different condition shown, display in mock-up materials on each side of joint and sealant type installed. Approved mock-ups shall establish installation standards required for actual corresponding sealant work.

1.6. JOB CONDITIONS

A. Do not proceed with installation of joint sealants unless requirements and manufacturer's instructions are satisfactory and applicable. Do not proceed with the installation of sealants under extreme temperature conditions which would cause joint openings to be at either maximum or minimum width or when such extreme temperatures or heavy wind loads are forecast during the period required for initial or nominal cure.

2. PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by the sealant manufacturer based on testing and field experience.

2. Provide colors as indicated or, if not otherwise indicated, as selected by Engineer from the manufacturer's standard colors to comply with color board.

3. Where exposed to foot traffic, select marketed materials of sufficient strength and hardness to withstand traffic without damage or deterioration of sealant system.

B. Types of Sealants:

1. **Sealant No.1** - Multi-Component Polyurethane Sealant: Polyurethane-based, 2-part elastomeric sealant (non-sag), conforming to ASTM C 920, Type M, Grade NS, Class 25 or FS-TT-S-0227E, Type II, Class A.

2. **Sealant No.2** - One-Component Polyurethane Sealant: Polyurethane-based, one

part elastomeric sealant (non-sag), conforming to ASTM C 920, Type M, Grade NS, Class 25.

3. **Sealant No.3** - One-Component Acrylic Sealant: Acrylic ter-polymer, solvent-based, one-part, thermo-plastic sealant complying ASTM C 834; solids not less than 95 percent acrylic as recommended by the manufacturer for general use as an exposed building construction sealant.

4. **Sealant No.4** - Two-Component Polyurethane Sealant: Pourable polyurethane-based, 2-part elastomeric sealant (self-leveling), conforming to ASTM C 920, Type M, Grade P, Class 25, or FS-TT-S-0220, or FS TT-S-0227.

5. **Sealant No.5** - Mildew-Resistant Silicone Rubber Sealant: Silicone rubber-based, one part elastomeric sealant, conforming to ASTM C 920, Type S, Grade NS, Class 25 or FS TT-S-1543, Class A; specifically for mildew resistance and recommended by the manufacturer for interior joints in wet areas, passing ANSI A 136.1 test for mold growth.

6. **Sealant No.6** - One-component construction silicone sealant: Conforming to ASTM C 834 and ASTM C 920 with movement capability plus or minus 25 percent, excellent adhesion to glass and aluminum.

A. Joint Filler:

1. Compressible Joint Filler: Manufacturer's standard open cell flexible foam strip of polyurethane or other weather-resistant foam, saturated with butylene or other non-drying liquid sealant/adhesion.

2. Compressible Joint Filler for Paving: Provide joint fillers of thickness and widths as shown on the Drawings. Joint fillers shall be preformed strips of asphalt saturated fiber board conforming to the requirements of ASTM D 1751.

2.2 MISCELLANEOUS MATERIALS

A. Joint Primer/Sealer: Provide type of joint primer/ sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer to be applied to sealant contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.

C. Sealant Backer Rod: Preformed, compressible rod stock of closed-cell polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended by sealant manufacturer for compatibility with sealant.

3. PART 3 - EXECUTION

3.1 GENERAL

A. Conform to sealant the manufacturer's printed installation instructions except where more stringent requirements are shown or specified, and except where manufacturer's authorized

technical representative directs otherwise.

3.2 JOINT PREPARATION

A. Clean out joints immediately before installing joint sealers to conform to the recommendations of joint sealer manufacturer as well as the following requirements:

1. Remove foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellant; water; surface dirt; and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers.

3. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Remove laitance and form release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile; and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on pre-construction joint sealer-substrate tests. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION

A. Set joint filler units with no voids or gaps between ends at proper depth of position in joint to coordinate with other work, including installation of bond breakers, backer rods, and sealants.

B. Install sealant backer rod for sealants, except where shown to be omitted or recommended to be omitted by the sealant manufacturer for the application indicated and as approved by Engineer.

C. Install bond breaker tape between sealants and joint fillers where indicated and where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

D. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

E. Seal joints before adjacent surfaces are waterproofed or painted.

F. Install sealant to depths as shown or, if not shown, as recommended by sealant manufacturer.

G. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Clean joint surfaces by whatever means may be necessary to eliminate evidence of spillage.

H. Recess exposed edges of exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

I. Bond ends of joint filler together with adhesive or weld by other means as recommended by the sealant manufacturer to ensure continuous watertight and airtight performance.

3.4 SEALANT SCHEDULE

A. At Contractor's option, provide one of the sealant types listed below for the corresponding joint type:

1. Exterior Joints:

a. Joints between metal frame and concrete or masonry and joints between marble cladding:

- Sealant No.1
- Sealant No.2

b. Expansion and control joints:

- Sealant No.1
- Sealant No.2

c. Exterior sills, jambs, and heads of window frames, door frames, louvers and similar openings and where metal, wood or other materials abut or join masonry concrete or each other:

- Sealant No.2
- Sealant No.3

d. Horizontal joints in pavement and sidewalks:

- Sealant No. 4

2. Interior Joints:

e. Interior sill, jamb, around window and door frames and all items adjoined to masonry or concrete surfaces.

- Sealant No.2
- Sealant No.3

f. Expansion and control joints:

- Sealant No. 1
- Sealant No. 2

g. Joints between plumbing fixtures and other elements of wet areas:

- Sealant No. 5

3. Exterior and Interior Glazing Sealant:

- Sealant No. 6

3.5 CLEANING AND PROTECTION

A. Clean off sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by sealant manufacturers.

B. Protect joint sealers during and after curing period from contact with contamination substances or damage resulting from construction operations or other causes so that they are without deterioration or damage at the time of Substantial Completion.

END OF SECTION

DIVISION - 8

DOORS AND WINDOWS

SECTION 08100

HOLLOW METAL DOORS AND FRAMES

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hollow metal doors and frames as shown on Drawings and as specified herein.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials:

ASTM A 36 Structural steel

ASTM A 164 Electro-deposited coating of Zinc on Steel

ASTM A 307 Carbon Steel externally and Internally threaded Standard Fasteners

ASTM A 366 Steel sheets, Carbon, cold-Rolled Commercial Quality

ASTM A 525 General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process

ASTM A 526 Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Commercial Quality

ASTM A 569 Steel Carbon (0.15 Maximum Percent) Hot-Rolled sheet and Strip, Commercial Quality

ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

B. FS - Federal Specification:

FS-S-325 - Shield Expansion, Nail Expansion and Nail Drive Screw (Devices, Anchoring, Masonry)

C. ANSI - American National Standard Institute:

A.115 - Specifications for Door and Frame Preparation for Hardware

D. SDI - Steel Door Institute:

SDI 100 - Standard Steel Doors and Frames

E. NFPA - National Fire Protection Association:

NFPA 80 - Fire Doors and Windows

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiation that products comply with requirements.

B. Shop Drawings: Submit for fabrication and installation of metal doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and details of joints and connections. Show anchorage and accessory items. Provide schedule of doors and frames using same reference numbers for details and openings as shown on Drawings.

C. Samples:

1. Submit 300 mm x 300 mm section sample of door showing internal construction, edge detail and reinforcement for butts for the Engineer’s review and approval.

2. Submit 300 mm x 300 mm L-section sample of frame showing corner detail and 300 mm long samples of removable stop for the Engineer’s review and approval.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver, store and handle hollow metal work in a manner to prevent damage and deterioration.

B. Provide packaging such as cardboard or other containers, separators, banding, spreaders and paper wrappings to protect hollow metal items.

C. Store doors and frames upright, in a protected dry covered area, at least 100 mm or more above ground or floor and at least 6 mm between individual pieces.

D. Doors and frames are to have a metal tag with the door number thereon.

1.5 WARRANTY

A. Submit a written 1 year guarantee, starting from substantial handover of the project, for all items specified under this Section, signed by manufacturer and the contractor, against all the defects, including bowing, and twisting.

1.6 QUALITY ASSURANCE

A. General: Unless otherwise specified, provide doors and frames complying with the Steel Door Institute Recommended Specifications - Standard Steel Doors and Frames (ANSI/SDI-100).

B. Fire-Rated Door Assemblies: Provide doors and frames complying with NFPA 80 or ASTM E 152 and which are labeled and listed by UL, FM or other testing agency acceptable to the Engineer.

D. Manufacturer: Provide doors and frames from a single manufacturer approved by the Engineer.

2. PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526 with ASTM A 252 G-60 zinc-coating, mill phosphatized.

D. Reinforcement Steel: ASTM A 36.

E. Core Material: Manufacturer's standard closed cell, waterproofed foamed in place polyurethane, completely filling the core.

F. Supports and Anchors: Fabricated of 1.25 mm thick, galvanized sheet steel.

G. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

H. Shop Applied Paint: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints. Finish painting shall comply with the requirements of Section 09900 - PAINTING.

2.2 FABRICATION - GENERAL

A. Fabricate metal door and frame units to be rigid, neat in appearance and free from defects (warp or buckle). Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. All fire rated doors shall be UL listed or equivalent and shall be labeled in factory indicating the fire rating.

B. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel.

C. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold- rolled or hot-rolled steel.

D. Fabricate exterior doors, panels, and frames from galvanized sheet steel. Close top and bottom edges of exterior doors as an integral part of the door construction or by addition of inverted steel channels.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

F. Finish Hardware Preparation:

1. Prepare doors and frames to receive mortised and concealed finish hardware in

accordance with Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.

2. Reinforce doors and frames to receive surface- applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

3. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with **Recommended Locations for Builder's Hardware**, Published by Door and Hardware Institute.

G. Shop Painting - Primer:

1. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

2.3 PRESSED METAL FRAMES

A. General: Provide continuous type pressed metal frames, including glazing stops and reinforcement, of various profiles to suit conditions detailed on the drawings and be constructed of new prime quality, hot or cold-rolled sheet steel. Exterior frames shall be fabricated from zinc-coated sheet chemically treated after fabrication for optimum paint adhesion.

B. Materials: Provide pressed metal frame of the following minimum thicknesses:

1. Exterior Frames: 1.5 mm thick.

2. Interior Frames: 1.2 mm thick for openings that are 1 m wide or less and 1.5 mm thick for openings wider than 1 m.

3. Exterior frames shall be provided with a weather striping, 2 mm thick.

4. Wall Anchors: Same thickness and material as frame.

5. Frame Splines: Same thickness and material as frames.

6. Hinge Reinforcement: 250 x 40 x 5 mm, unless recommended otherwise by the manufacturer.

7. Strike Reinforcement: 100 x 40 x 5 mm unless recommended otherwise by the manufacturer.

8. Closer and Holder Reinforcement: 5 mm by the required length and width.

C. Frames: Provide frames that have joints die-mitered with integral tabs for reinforcement and interlocking of the jambs to head. Frames shall be knockdown or equivalent, with self

aligning tabs and slots for securely locked corners.

D. Construction: The finished work shall be strong and of rigid construction neat in appearance and free from warp, wave and buckle. Molded members shall be clean cut, straight and true. Miters shall be well formed and in true alignment. Fastenings shall be concealed where practicable.

E. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 rubber silencers on strike jamb of single-swing frames and 4 silencers on heads of double-swing frames.

F. Anchors:

1. Unless otherwise indicated on drawings, anchor frame in concrete and masonry walls by means of galvanized expansion shields and flat-head machine screws. Screw heads shall be counter-sunk in soffit of jamb. Machine screws shall be Phillips or Jackson-head type, 9 mm diameter by minimum 75 long of zinc plated or dichromated steel with 9 mm diameter by minimum 44 mm long malleable iron or steel expansion shield. Reinforce jamb at each expansion screw location with 5 mm by 38 mm wide steel fitting into inside of stop and welded to backbends. Anchors shall be located not more than 150 mm from top and bottom of each jamb with intermediate anchors spaced at a maximum of 650 mm on center.

2. Anchors for plaster partitions with truss stud framing shall be Z-clip type, to be secured to studs and welded to back of frames above each hinge reinforcement and just below the top hinge reinforcement. Anchors on the strike side shall occur directly opposite to those on the hinge side.

   Provide at least 4 anchors for each jamb for frames up to 2.28 m in jamb height; 5 anchors up to 2.40 m; and one additional anchor for each 0.6 m fraction thereof over 2.4 m jamb height.

G. Bottoms of frames shall have not less than 2.8 mm thick welded-on floor clips punched for two 6.4 mm expansion bolts or shot pins. Return bends of frames shall be flanged.

H. Temporary channel or angle spreaders shall be tack-welded to bottom of frames to prevent distortion during shipment and storage and shall hold the frames in proper position until adjacent construction has been completed.

2.4 HOLLOW METAL DOORS

A. Interior doors: Fabricate interior hollow metal doors of 2 outer sheets, 1.2 mm thick cold rolled stretcher-level sheet steel, free from rust, scale, pits and surface defects.

B. Exterior doors: Fabricate exterior hollow metal doors of 2 outer sheets, 1.5 mm thick zinc-coated bonderized sheet steel. Provide exterior doors with spring tension type (aluminum or corrosion resisting steel) or integral elastomeric type (synthetic rubber, vinyl or neoprene) standard weather stripping at frames and/or doors in accordance with the manufacturer's instructions and as approved by the Engineer.

C. Service Heavy-Duty Doors: Fabricate service doors using same sheet facing thickness as that for interior or exterior doors as per door location. Provide additional reinforcing stiffeners

for the door construction.

D. Construction:

1. Doors are to have continuous internal reinforcing channels or z-shaped members, 1.5 mm thick steel, full height of door, spaced not more than 150 mm on center and spot welded to face sheets 75 mm on center. Doors with continuous truss inner core, full height and width, spot welded to face sheets at 75 mm on center both vertically and horizontally are also acceptable.

2. Provide 0.9 mm thick stile channels and 1.9 mm thick horizontal stiffener channels at top and bottom of doors welded to face sheets.

3. Fill hollow portions of doors shall be filled completely with expanded polyurethane, mineral fiberglass or rock wool or an approved equal filler.

4. Exposed joints shall be fully welded, filled and ground smooth.

5. Interlocking joints or seams are not approved on faces or edges.

6. Provide single swing doors with not more than 3 mm clearance at jambs and heads and not more than 6 mm clearance at meeting edges of pair of doors (3 mm on fire rated doors).

7. Doors shall have a 3 mm in 50 mm bevel on the strike side.

E. Heads and jambs of doors shall be flush constructed unless otherwise shown to be rebated. Fire rated door pairs shall be provided with astragal intumescent protection strip unless otherwise shown.

F. Undercutting: Undercut doors a maximum of 19 mm at bottom except toilet doors which shall be undercut a minimum of 30 mm, unless directed otherwise by the Engineer.

G. Reinforcement: Provide reinforcement for finish hardware as follows:

1. Reinforcement for butts shall be not less than 5 mm thick by 230 mm long and 6 mm narrower than the thickness of the door.

2. Reinforcing plates for closers, holders, stops and checks shall be not less than 5 mm thick and by template requirements as to length and width.

3. Reinforcement for locks and escutcheons shall be not less than 1.9 mm thick steel, with spring leaf contacts for lock cases.

4. Reinforcement for exit devices and mortised or surface applied hardware shall be not less than 2.6 mm thick and by template requirements as to length and width.

H. Where indicated on Drawings, provide 10 mm thick tempered clear glass vision panels. Size shall be as shown on Drawings. Where indicated on Drawings, provide anodized aluminum door grille.

I. Tolerances: provide door panels that are free from buckles, twists or other imperfections. Do not use panels having a buckle exceeding 1.5 mm, as determined by a straight edge applied to the face of the panel.

2.5 METAL LOUVERS

Where indicated, doors shall be provided with full louvers or louver sections. Louvers shall be sight-proof type inserted into the door. Inserted louvers shall be stationary. Louvers shall be non-removable from the outside of exterior doors or the unsecured side of interior doors. Insect screens shall be a removable type with 18 by 16 mesh aluminum or bronze cloth. Full louver doors shall be in accordance with SDOI SDI-100, Grade III, Model 3.

2.6 SECURITY DOORS

Security type doors and frames shall be factory fabricated in accordance with NAAMM HMMA 862 and the additional requirements specified herein Doors and frames shall be galvanized 1.7 mm construction. Doors shall have 1.7 mm steel plate on both sides, and be internally reinforced vertically with continuous 1.0 mm steel stiffeners spaced 150 mm on center maximum. Doors shall be fully welded seamless construction with no visible seams or joints on their faces or vertical edges. Door thickness shall be 44.5 mm. Exterior doors shall be insulated to provide a thermal conductance (U-value) not to exceed 2.33 W/ sq m times K when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863. Door frames shall be all welded type, with double rabbet jamb profile. At meeting stiles, an astragal shall be provided by extending the face panel of the active leaf not less than 16 mm across the gap between the two leaves. Astragal shall be flush with the face panel of the inactive leaf. Frame corners shall be machine-mitered, full (continuously) welded. All exposed welds shall be ground and finished smooth.

2.7 SHOP FINISH

A. Carry out shop finishing of metal doors and frames as follows:

1. Fill door edges with mineral filler to conceal seams.

2. Chemically treat non galvanized, non bonderized metal surfaces with a phosphate compound to assure maximum paint adherence.

3. Thoroughly clean all metal surfaces of all rust, scale, grease, rough spots and other foreign matter which may prevent proper paint adhesion.

4. Apply dip or spray coat of rust-inhibitive metallic oxide zinc chromate or synthetic resin primer on all surfaces of frames and on all exposed surfaces of doors and panels. Exposed surfaces of metal shall receive a mineral filler baked on and sanded between coats followed by a coat of primer. Primer shall be baked on in accordance with manufacturer's recommendations for developing maximum hardness and resistance to abrasion; paint dry film thickness not less than 1.25 mills.

5. Primed surfaces shall be smooth and suitable to receive the finish coats.

2.8 FINAL FINISH

A. Painted Doors: Provide a final painted finish conforming to Section 09900 - PAINTING. Color shall be as approved by the Engineer.

2.9 HARDWARE PREPARATION

A. General: Hollow metal doors and pressed metal frames shall be prepared at the manufacturer's plant for all hardware in accordance with templates furnished and shall be drilled and tapped to receive hardware as indicated on the hardware templates. Preparation shall conform to the requirements of ANSI A115.

B. Mortised and concealed hardware: Mortise, reinforce, drill and tap for mortised and concealed hardware.

C. Locations: Locate hardware as shown on the drawings and conform to standards established by the National Builders Hardware Association, and ANSI standards as applicable.

3. PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrates and the conditions under which hollow metal doors and frames shall be installed and correct any unsatisfactory conditions.

B. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.2 INSTALLATION

A. General: Install metal doors, frames, and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. Placing Frames: Shall comply with provisions of SDI-105 (Recommended Erection Instructions For Steel Frames), unless otherwise indicated.

C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.

D. Finish Hardware: Conform to Section 08710 - DOOR HARDWARE.

3.3 ADJUST AND CLEAN

A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

C. Final Adjustments: Check and readjust operating finish hardware items leaving steel doors and frames undamaged and in complete and proper operating condition.

D. Finish Painting: Conform to Section 09900 - PAINTING.

END OF SECTION

SECTION 08120

ALUMINUM DOORS AND FRAMES

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aluminum doors and frames as shown on Drawings and as specified herein.

1.2 REFERENCES

A. AAMA - American Architectural Manufacturer Association

AAMA 101	Aluminum Prime windows and Sliding Glass Doors
AAMA 603.8	Pigmented Organic Coating on Extruded Aluminum.
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

B. AA - Aluminum Association

Aluminum Association Designation System for Aluminum Finishes

C. ANSI - American National Standards Institute

A134.1	Specification for Aluminum Prime windows

D. ASTM - American Society of 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

ASTM F 468 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

A. DIN - Deutsches Institut fuer Normung

DIN 4108 Heat Insulation in Buildings.

DIN 18055 Windows; Air Permeability of Joints, Water Tightness and Mechanical Strain.

B. AWS - American Welding Society:

D1.1 - Structural Welding Code, Steel.

D1.2 - Structural Welding Code, Aluminum.

1.3 SUBMITTALS

A. Product Data: Submit Manufacturer's specifications, standard details, and installation recommendations for components of aluminum doors and framing required for project, including data that products have been tested and comply with performance requirements.

B. Shop Drawings: Submit shop drawings for fabrication and installation of aluminum doors and framing, including elevations, detail sections of typical composite members, anchorages, reinforcement, expansion provisions, and glazing

C. Certification: Submit statement certified by registered structural engineer that systems including glass will withstand specified wind-loads.

D. 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.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. 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.

1.5 WARRANTY

A. Submit 2 copies of written guarantee signed by the Manufacturer, Installer and Contractor, agreeing to replace aluminum door units that fail in material or workmanship within 2 years of date of substantial handing over.

1.6 QUALITY ASSURANCE

A. Standards: Comply with applicable provisions of **Metal Curtain Wall, Window, Storefront and Entrance Guide Specifications Manual - AAMA.**

B. Performance and Testing:

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.

2. 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:

a. Uniform Pressure: 97.6 kg/m² inward; 97.6 kg/m² outward.

b. Maximum Deflection: 1/175 of clear span any framing member.

3. 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).

a. Air Infiltration: Tested in accordance with ASTM E 283 and shall have a minimum of 0.6 m^3/min/m of crack.

b. 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.

2. PART 2 - PRODUCTS

2.1 MATERIALS AND ACCESSORIES

A. Aluminum Members:

1. Extrusions of Bars, Rods and Tubes: 6063-T6 Alloy conforming to ASTM B 221.

2. Sheets and Plates: 5005-H14 alloy conforming to ASTM B 209.

3. Doors and frames shall be manufacturer standard systems of extrusions not less than 3 mm thick.

4. Use manufacturer's standard thermal-break sections for all aluminum doors, unless otherwise shown on Drawings.

B. Fasteners: Aluminum, or non-magnetic stainless steel, or other materials warranted by Manufacturer to be non-corrosive and compatible with aluminum components.

1. Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.

2. Provide Phillips flat-head machine screws for exposed fasteners.

C. Glazing Gasket: Manufacturer's standard vinyl glazing gasket.

D. 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.

E. Concrete/Masonry Inserts: Cast iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386.

F. Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC - Paint 12, compounded for 20 mil thickness per coat.

G. Glass: Glass and glazing materials shall be as specified in Section 08800 - GLAZING and as indicated on Drawings with all doors factory glazed.

H. Hardware: Provide aluminum doors with Manufacturer's standard, factory-installed hardware conforming to the requirements of Section 08710 - DOOR HARDWARE.

2.2 FINISH

A. Exposed aluminum surfaces shall have the manufacturer's standard powder-coated finish, unless otherwise indicated on Drawings and in accordance with the following:

1. Powder Coated Finish: 60 - 80 micron thick. Color shall be as selected and approved by the Engineer.

2. Anodized Finish: Conform to AA C22A42; 22 micron thick; with shop-applied protective coating of clear acrylic lacquer or any coating in accordance with AAMA 602.2, 0.5 mil dry film thickness, over anodized finish. Color shall be as approved by the Engineer.

2.3 FABRICATION

A. Sizes and Profiles: Required sizes for door 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.

B. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

C. 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.

D. Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds

smooth and restore mechanical finish.

E. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.

1. Provide continuous steel reinforcing stiffening members within jambs and heads of all doorframes, except omit at jambs that are secured to adjacent fixed walls.

2. Cut vertical reinforcing 50 mm less than mullion height and cut horizontal reinforcing 75 mm less than door head framing member.

3. 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.

4. Doorframes shall be free of vibration and distortion when doors are used.

F. Maintain accurate relation of planes and angles, with hairline fit of contacting members.

G. Fasteners: Conceal fasteners wherever possible.

H. Weatherstripping: For exterior doors, provide compression weatherstripping against fixed strip; at other edges, provide sliding weatherstripping retained in adjustable strips mortised in other edge.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Manufacturer's instructions and recommendations for installation of aluminum doors and frames.

B. Set units plumb, level, and true to line, without warp or rack of framing members, doors, 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.

C. Set sill members and other members in bed of compound as shown, or with joint fillers or gaskets as shown to provided weathertight construction.

D. Expansion and Contraction: Allow for expansion and contraction due to temperature and building movement, and for practical building tolerances in 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.

E. 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.

F. Caulking: Seal joints between metal members and between metal and adjacent surfaces in accordance with the requirements of Section 07900 - SEALANTS.

G. Refer to Section 08800 - GLAZING for installation of glass and glazing requirements.

3.2 ADJUST AND CLEAN

A. Adjust operating hardware to function properly, without binding, and to provide tight fit at contact points and weatherstripping.

B. 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.

C. Remove protective coating when completion of adjoining works and construction activities no longer requires its retention.

D. Institute protective measures and other precautions required to assure that aluminum doors and frames will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 08210

WOOD DOORS AND FRAMES

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wood doors and frames as shown on the Drawings and as specified herein.

1.2 REFERENCES

A. AWI - Architectural Woodwork Institute:

AWI Architectural Woodwork Quality Standard Guide Specification and Certification Program

B. NWMA - National Woodwork Manufacturers Association:

IS.1 - Industry Standard for Flush Doors

C. WIC - Woodwork Institute of California:

WIC Manual of Millwork

D. ASTM - American Society of Testing and Materials:

ASTM E 152 - Fire Test of Door Assemblies

E. NEMA - National Electrical Manufacturer's Association:

LD 3 - High Pressure Decorative Laminates

F. NFPA - National Fire Protection Association:

NFPA 80 - Fire doors and Windows

1.3 SUBMITTALS

A. Product Data: Submit door manufacturer's product data for each type of wood door, including details of core and edge construction, unless otherwise indicated.

B. Samples: Submit samples of door faces representing typical range of color and grain, strips of solid wood of species to be used for exposed edges, trim and other solid wood components.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Protect wood doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced ANSI standards and recommendations of door manufacturer.

B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for doors, frames and hardware, using temporary, removable or concealed markings.

1.5 WARRANTY

A. Door Manufacturer's Warranty: Submit two copies of written agreement in door manufacturer's standard form signed by the Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which shows photographing of core construction below in face veneers, or do not conform to tolerance limitations of NWMA and AWI.

B. The warranty shall also include refinishing and reinstallation that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.

C. Warranty shall be valid for a period of 1 year from the time of substantial completion.

2. PART 2 - PRODUCTS

2.1 WOOD DOORS - GENERAL

A. Doors shall be fabricated meeting the applicable requirements of the quality standard of the Architectural Woodwork Institute. All fire rated doors shall be UL listed or equivalent and shall be labeled in factory indicating the fire rating.

B. Door Size: Width, height and design shall be as shown on Drawings. Door shall be 44 mm thick, unless otherwise required by manufacturer or indicated on Drawings.

C. Tolerances: Size, squareness and warp tolerances shall be in accordance with NWMA 1.S.1.

D. Hardware: Conform to Section 08710 - DOOR HARDWARE.

E. Prefit and premachine wood doors at factory complying with tolerance requirements of AWI for prefitting. Machine doors for hardware requiring cutting of doors. Comply with final hardware schedule and door frame shop drawings and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

F. Wood used for doors and frames shall be approved by Engineer as well as the door construction and design.

2.2 SOLID PANEL DOORS

A. Doors shall be constructed of best quality hardwood with a minimum thickness of 45 mm, unless otherwise required by door manufacturer or indicated on Drawings.

1. Type of wood: Solid Cherry, premium grade.

2. Decorative reveal on solid door panels shall be machine-carved to pattern shown on drawings and approved by the Engineer.

3. Stiles, top and bottom rails, decorative raised panels and moldings, transoms, shall

be of sizes and patterns as shown on Drawings and as approved by the Engineer.

B. Door components shall be assembled using tongued and grooved connections as well as adhesive Type I and in accordance with the fabrication procedures mentioned below.

1. Where indicated on Drawings, provide carved panels. Submit various decorative designs for panels for the Engineer selection and approval.

C. Solid wood panel doors shall include single and double swing types, as shown on Drawings.

D. Where indicated on Drawings, provide 10 mm thick clear tempered glass transom in accordance with Section 08800-GLAZING.

2.3 SOLID-CORE AND HOLLOW-CORE FLUSH WOOD DOORS

A. General:

1. Doors for Transparent Finish: Comply with following requirements:

a. AWI Grade: Premium, with Grade AA faces.

b. Faces: Type as indicated on Drawings.

c. Finish: Doors and frames shall have natural lacquer finish.

2. Doors for Opaque Finish: Comply with following requirements:

a. AWI Grade: Custom.

b. Faces: Closed grain hardboard suitable for the intended application.

3. Stiles and Rails: 44 mm thick solid hardwood.

B. Solid-Core doors:

1. Particleboard Cores: Comply with the following requirements:

a. Particleboard Cores: Single thickness 3-ply conforming to ANSI A208.1, Grade LD-1.

b. Blocking: Provide wood blocking at particleboard-core doors as follows:

(1) 125 mm top-rail blocking, at doors indicated to have closers.

(2) 125 mm bottom-rail blocking, at doors indicated to have kick, mop or armor plates.

(3) 125 mm midrail blocking, at doors indicated to have exit devices.

2. Interior Veneer-Faced Doors:

a. Core: Particleboard core.

b. Construction: 7-Plies construction with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

3. Interior Hardboard-Faced Doors:

a. Core: Particleboard core.

b. Construction: hardboard faces glued directly to core with stiles and rails bonded to core, then entire unit abrasive planed before faces are applied.

C. Hollow-Core Flush Doors:

1. Interior Veneer-Faced Doors:

a. Core: Corrugated expandable honeycomb core complying with ANSI Section 1300/NWWDA I.S.1.

b. Construction: 7-Plies.

c. Blocking: Provide wood blocking with minimum dimensions as follows:

(1) 250 mm bottom-rail blocking.

(2) 125-by-460 mm lock blocks.

(3) 46 mm midrail blocking.

D. Fire-rated Doors:

1. Construction: Manufacturer standard mineral-core construction as required to provide fire rating indicated.

2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors or fire ratings indicated and as necessary to eliminate need for through-bolting hardware.

3. Edge Construction: At hinge stiles, provide manufacturer standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

4. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.

2.4 DOOR FRAMES

A. Door Frame Type: As indicated on Drawings and in accordance with the following requirements:

1. Solid Wood Frames:

a. Type of Wood: Use rigid, square and uniform, best quality solid hardwood, architectural grade, clear all heart. Type of wood shall be premium grade solid Teak.

b. Wood used shall be of a species listed as suitable for door frames and shall match with type specified for the related wood door.

c. Frame Sizes, Rebates and Shapes: As shown on Drawings and as approved by Engineer. Frame rebates shall be 13 mm minimum depth for the internal doors and 19 mm for the external doors. Frames shall have wood architraves as shown on Drawings.

2. Metal Door Frames: Manufacturer standard steel door frames complying with the requirements specified in Section 08100 - HOLLOW METAL DOORS AND FRAMES.

2.5 FABRICATION

A. Openings: Where indicated, cut and trim openings through doors and panels complying with the applicable requirements of referenced standards for the kind of doors required.

B. Exterior Doors: Treat exterior doors at factory with water repellent after manufacturing has been completed.

C. Assembly: Assemble solid paneled doors and frames using be tongued and grooved connections with Type I waterproof adhesive.

D. Adhesives: Assemble doors using Type I waterproof adhesives.

E. Factory-Finishing: Provide manufacturer's standard finish to match approved sample.

2.6 FINISH

A. Doors and Frames Finish: As indicated on Drawings and in accordance with the following requirements:

1. Natural lacquer finish complying with requirements of Section 09900 - PAINTING.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. Each door unit shall be installed in accordance with the manufacturer's instructions including handling and storage recommendations.

B. Doors shall be fitted to the following tolerances:

1. 3.18 mm on each vertical side and top.

2. 13 mm on bottom, except when fitted hardware requires otherwise.

3. Bevel non-rated doors 3.18 mm in 50 mm at lock and hinge edges.

C. Install finish hardware to the templates provided. Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for fit and uniform clearance

at each edge.

D. Restore finish on edges of shop-finished doors before installation, if fitting or machining is required at the job site.

3.2 ADJUST AND CLEAN

A. Operation: Re-hang or replace doors which do not swing or operate freely, as directed by the Engineer.

B. Finished Doors: Refinish or replace doors damaged during installation as directed by the Engineer.

C. Institute protective measures as recommended and accepted by door manufacturer to assure that wood doors will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 08311

ALUMINUM SLIDING GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide labor, materials, equipment and services and perform operations required to install aluminum sliding doors.

B. Work Includes

1. Aluminum sliding glass doors.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Glazing requirements for sliding glass doors, including those specified to be factory-glazed, are specified in Division 8 Section "Glazing."

1.2 SYSTEM PERFORMANCE REQUIREMENTS FOR EXTERIOR DOORS

A. General: Provide aluminum sliding glass doors that comply with performance requirements specified, as demonstrated by testing manufacturer's corresponding stock systems according to test methods indicated.

B. Design Requirements: Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA 101 for each grade and performance class required.

C. Testing Requirements: Test each grade and size of sliding glass door by a recognized independent testing agency, according to ASTM E 330 for structural performance, ASTM E 283 for air infiltration, and ASTM E 547 for water penetration. Test samples shall comply with AAMA 101 for sample size.

1. Operating Force for Residential Doors: Adjust each moving panel before performing tests so the maximum force to open the panel is 134 N and the maximum force required to maintain motion is 89 N.

D. Performance Requirements: Each required aluminum sliding glass door unit shall comply with the following performance requirements:

1. Structural Performance: Sliding glass door units shall not show evidence of failure or permanent deflection of either the frame or panel after testing according to ASTM E 330 at a positive (inward) and negative (outward) test pressure of 1.0773 kPa.

a. Failure, as defined in AAMA 101, consists of any damage that causes the sash to be inoperable, glass breakage, permanent damage to fasteners or hardware, or permanent deformation of any main frame or sash member in excess of 0.4 percent of its span.

2. Air infiltration shall not be more than 1.9 L/s x sq. m of area at an inward test pressure of 75 Pa when tested according to ASTM E 283.

3. Water Penetration: There shall be no water leakage as defined in the test method at an inward test pressure of 137 Pa when tested according to ASTM E 547.

4. Deglazing: There shall be no disengagement of the glazing surround members of operable panels when tested according to ASTM E 987 at 312 N on the vertical rails and 223 N for other rails.

E. Condensation Resistance: Provide sliding glass door units of thermal-break construction with a condensation resistance factor (CRF) of not less than 45 when tested according to AAMA 1502 at an outside design temperature of -18 deg C with a wind velocity of 24 km/hr and an inside relative humidity of 25 percent at 20 deg C.

1. Thermal Transmittance: Provide sliding glass door units with a maximum U-value of 3.9 W/sq. m x K at 24 km/hr exterior wind velocity.

2. Forced-Entry Resistance: Provide sliding glass door units that comply with requirements for Performance Level 10 when tested according to ASTM F 842.

1.03 SUBMITTALS

A. Product data for each type of aluminum sliding glass door unit required. Include the following:

1. Manufacturer's standard construction details.

2. Profiles and dimensions of individual components.

3. Data on finishes, hardware, and accessories.

4. Recommendations for maintenance and cleaning of exterior surfaces.

B. Shop drawings for each type of sliding glass door unit required. Include information not fully detailed in manufacturer's standard product data and the following:

1. Layout and installation details, including anchors.

2. Typical unit elevations.

3. Full-size details of typical composite members, including reinforcement.

4. Glazing details.

5. Hardware and accessories.

1.04 QUALITY ASSURANCE

A. Aluminum Sliding Glass Door Standard: Comply with provisions of AAMA 101 for standards of performance and fabrication workmanship for aluminum sliding glass doors.

B. Safety Glass Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide the type of products indicated that comply with ANSI Z97.1 and testing requirements of 16 CFR for Category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with the certification label of the Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

C. Glazing Standards: Comply with recommendations of the Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual," except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this Section or referenced standards.

D. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component pane of units with the certification label of the Insulating Glass Certification Council (IGCC).

E. Single-Source Responsibility: Provide aluminum sliding glass doors produced by a single fabricator who is capable of indicating prior successful production of units similar to those required.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check actual door openings in construction work by accurate field measurement before fabrication. Show recorded measurements on final shop drawings.

1. Coordinate fabrication schedule with construction progress to avoid delay. Where necessary, proceed with fabrication without field measurements and coordinate fabrication tolerances to ensure properly fitting sliding glass door units.

1.06 WARRANTY

A. Aluminum Sliding Glass Door Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace sliding glass door units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to the following:

1. Structural failures, including excessive deflection, excessive leakage, air infiltration, or failure of weatherstripping.

2. Faulty operation of movable panels or hardware.

3. Deterioration of metals, finishes, and other materials beyond normal weathering.

4. Warranty period for sliding glass doors is 3 years after the date of Substantial Completion.

5. The warranty shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum Extrusions: Provide alloy and temper recommended by the sliding glass door manufacturer for the strength, corrosion-resistance, and application of required finish, but not less than 150 MPa ultimate tensile strength and not less than 1.58 mm thickness at any location for the main frame and panel members.

B. Fasteners: Provide aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum sliding glass door members, trim, hardware, anchors, and other components of sliding door units.

1. Reinforcement: Where fasteners are screw-anchored into aluminum less than 3.18 mm thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in splined grommet nuts.

2. Exposed Fasteners: Except where unavoidable for applying hardware, do not use exposed fasteners. To apply hardware, use Phillips flat-head screws that match the finish of the member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Fabricate anchors, clips, and sliding glass door accessories of aluminum, nonmagnetic stainless steel, or hot-dip, zinc-coated steel complying with requirements of ASTM A 123. Provide strength sufficient to withstand design pressure indicated.

D. Compression Weatherstripping: Provide the manufacturer's standard compressible weatherstripping of molded PVC gaskets complying with ASTM D 2287, or molded expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4, designed for permanent resilient sealing under bumper or wiper action, concealed when door is closed.

E. Sliding Weatherstripping: Provide woven-pile weatherstripping of wool, polypropylene, or nylon pile, with resin-impregnated backing fabric and an aluminum backing strip; comply with AAMA 701.2.

1. Provide weatherstripping with integral center-line barrier fin of semirigid plastic polypropylene sheet.

G. Glazing Materials: Provide safety glazing materials that comply with ANSI Z97.1 and requirements of Division 8 Section "Glazing."

2.03 HARDWARE

A. Hardware: Provide hardware necessary to properly operate, tightly close, and securely lock doors. Do not use aluminum in frictional contact with other metals. Where exposed, provide white bronze, cast or wrought aluminum, solid white metal with special-coating finish, or nonmagnetic stainless steel.

2.05 FABRICATION

A. General: Fabricate aluminum sliding glass door units to comply with indicated standards. Include a complete system for assembly of components and anchorage of units.

1. Provide units that are reglazable without dismantling panel framing.

B. Thermal-Break Construction: Fabricate aluminum sliding glass door units with an integrally concealed, low-conductance thermal barrier, located between exterior materials and exposed interior members in a manner that eliminates direct metal-to-metal contact.

1. Provide thermal-break construction that has been in use for not less than 3 years, has been tested to demonstrate resistance to thermal conductance and condensation, and has been tested to show adequate strength and security of glass retention.

C. Weepholes: Provide weepholes and other internal water passages to conduct infiltrating water to the exterior.

D. Assembly: Assemble components into complete weathertight units with flush, rigid, and hairline joints. Mill, cope, butt, and miter joints; secure by mechanical devices or by other means to ensure permanently watertight joints. Provide at least two corrosion-resistant, pre-lubricated, or self-lubricating rollers for each sliding panel of sufficient capacity to ensure easy, quiet, and smooth operation.

E. Weatherstripping: Provide operable panels with a double row of sliding weatherstripping in horizontal rails and single- or double-row weatherstripping in meeting or jamb stiles, as required, to meet specified performance requirements. Provide compression-type weatherstripping at the perimeter of each movable panel where sliding-type weatherstripping is not appropriate.

1. Provide weatherstripping locked in to extruded grooves in the panels.

F. Preglazed Fabrication: Glaze aluminum sliding glass door units in the factory, where practical and possible for the applications indicated. Comply with requirements of Division 8 Section "Glazing" and AAMA 101.

G. Glazing Stops: Provide snap-on glazing stops, coordinated with the Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match panel frames.

H. Screens in Residential Doors: Provide insect screen unit for each operable panel. Design door units and hardware to accommodate screens in a tight-fitting removable arrangement on either inside or outside of door unit with a minimum of exposed fasteners and latches.

2.06 FINISHES

A. Provide TGIC/polyester powder coating color and quality to match curtain wall framing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Inspect openings before beginning sliding glass door installation. Verify that the rough or masonry opening is correct and that the sill plate is level. Do not install door units until unsatisfactory conditions have been corrected.

1. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.

2. Wood frame walls shall be dry, clean, sound and well-nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in the opening and within 75 mm of the opening.

3. Metal surfaces shall be dry, clean, free of grease, oil, dirt, rust, corrosion, and welding slag, without sharp edges or offsets at joints.

3.02 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installing door units, hardware, accessories, and other components.

1. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified under the "Dissimilar Materials" paragraph in the Appendix to AAMA 101.

B. Set sill members and other frame members in bed of compound or with joint fillers or gaskets, as indicated, to provide weathertight construction. Coordinate installation with wall flashing and other components.

1. Refer to Division 7 Section "Sealants" for compounds, fillers, and gaskets to be installed.

C. Set units plumb, level, and true to line, without warp or rack of frames and panels. Provide proper support and anchor frames and fixed panels securely in place.

3.03 FIELD QUALITY CONTROL FOR HEAVY COMMERCIAL DOORS

A. Conduct on-site tests for air infiltration and water penetration according to AAMA 502 with the manufacturer's representative present. The Project Manager will select door units to be tested. Units not meeting specified test requirements and units having similar deficiencies shall be corrected at no cost to the Owner. Testing shall be performed by an accredited testing agency selected by the Project Manager.

1. Air Infiltration Tests: Conduct tests according to the requirements of ASTM E 783. Allowable infiltration shall not exceed 1.5 times the amount indicated.

2. Water Resistance Tests: Conduct tests according to the requirements of ASTM E 1105. No water leakage is permitted.

3.04 ADJUSTING

A. Adjust operating panels, screens, and hardware to provide a tight fit at contact points and weatherstripping for smooth operation and weathertight closure.

3.05 CLEANING

A. Clean aluminum surfaces promptly after installing sliding glass doors. Avoid damaging protective coatings and finishes. Remove excess glazing and sealing compounds, dirt, and other substances. Lubricate hardware and the moving parts.

B. Clean glass of preglazed units promptly after installing sliding glass door units. Wash and polish glass on both faces not more than 4 days prior to the date scheduled for final inspection. Comply with manufacturer's recommendations for final cleaning and maintenance.

C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including by natural causes, accidents, and vandalism.

3.06 PROTECTION

A. Institute and maintain protective measures and other precautions required through remainder of construction period to ensure that, except for normal weathering, sliding glass door units will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08520

ALUMINUM WINDOWS

1. PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Aluminum windows as shown on Drawings and specified herein.

1.2. REFERENCES

A. AAMA - American Architectural Manufacturer Association

AAMA 101	Aluminum Prime windows and Sliding Glass Doors
AAMA 603.8	Pigmented Organic Coating on Extruded Aluminum
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

1.3. AA - Aluminum Association

Aluminum Association Designation System for Aluminum Finishes

1.4. ANSI - American National Standards Institute:

A134.1	Specification for Aluminum Prime windows.

1.5. 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

ASTM F 468 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

1.6. DIN - Deutsches Institut fuer Normung

DIN 4108 Heat Insulation in Buildings

DIN 18055 Windows; Air Permeability of Joints, Water Tightness and Mechanical Strain

1.7. AWS - American Welding Society:

D1.1 - Structural Welding Code, Steel

D1.2 - Structural Welding Code, Aluminum

1.8. SUBMITTALS

A. Product Data: Submit manufacturer's specifications, standard details, and installation recommendations for components of aluminum windows required for project, including data that products have been tested and comply with performance requirements.

B. Certification: Submit statement certified by registered Structural engineer that systems including glass will withstand specified wind-loads.

C. Samples: Submit samples of each type and color of aluminum finish, on 300 mm long sections of extrusions or formed shapes.

1.9. TRANSPORTATION, HANDLING AND STORAGE

A. Deliver aluminum window to site in packages or containers; labeled for identification with the manufacturer's name, brand and contents. Store aluminum window material in weather tight and dry storage facility. Protect from damage from handling, weather and construction operations before, during and after installation.

1.10. WARRANTY

A. Submit 2 copies of written guarantee signed by the manufacturer, installer and contractor, agreeing to replace aluminum window units which fail in material or workmanship within 1 year of date of substantial handing over.

1.11. QUALITY ASSURANCE

A. Standards: Comply with applicable provisions of the **Metal Curtain Wall, Window, Storefront and Entrance Guide Specifications Manual - AAMA.**

B. General: Provide aluminum window units that comply with performance requirements specified, as demonstrated by testing manufacturer's corresponding stock systems according to test methods indicated. Type of windows shall be as shown on the drawings.

C. Testing: Test each type and size of required window unit through a recognized independent testing laboratory or agency approved by Owner's Representative, in accordance with ASTM E 330 for structural performance, ASTM E 283 for air infiltration, and ASTM E 331 and ASTM E 547 for water penetration. Provide certified test results. Sizes of test units for the air infiltration, water resistance, and structural performance shall conform to the AAMA Guide Specification GS-001 - Chart A requirements. Tested units shall be glazed, completely assembled, and constructed in accordance with requirements indicated. Perform tests on units with window sash and ventilators closed and locked. Materials and workmanship used in test units shall be identical to those proposed for the project. Use of non-representative measures or techniques is prohibited.

D. Design Requirements: Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA 101 for type, grade and performance class of window units required.

1. In addition to AAMA design standards, component parts and completed window assemblies shall be designed, fabricated and installed to withstand design pressure of minimum 98 kg/m², for wind loads normal to wall, acting both inward and outward.

2. Uniform Load Deflection: No window member (glazed) shall deflect more than 1/175 of its span at the specified design load when tested in accordance with ASTM E 330 at a static air pressure difference of at least 98 kg/m², with ventilators closed and locked and the pressure applied first on one side of the unit then on the other.

3. Air infiltration rate of aluminum windows shall not be more than 0.30 cfm per ft of operable sash joint for inward test pressure of 30 kg/m², when tested in accordance ASTM E 283.

4. Water Penetration: There shall be no water penetration, as defined in ASTM E 331, when tested in accordance with ASTM E 331 at an inward test pressure of 39 kg/m².

5. Condensation Resistance: Where window units are indicated to be of "thermal-break construction," provide units that have been tested for thermal performance in accordance with AAMA 1503.1 showing a condensation resistance factor (CRF) of 45.

6. Forced-Entry Resistance: Provide window units having a Performance Level 10 when

tested in accordance with ASTM F 588.

E. Manufacturer and Installer Qualifications: Engage on experienced manufacturer and installer who has minimum 5 years experience of manufacturing and installing aluminum windows similar in design and finish to those required for the project and which has resulted in construction with a record of successful in-service performance. Manufacturer and installer shall be subject to approval of Owner's Representative.

F. Single Source Responsibility: Provide aluminum window units from one source and produced by a single manufacturer.

G. Field Measurements: Check actual window openings by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

2. PART 2 - PRODUCTS

2.1 GENERAL: Window types shall be as shown on Drawings.

2.2. MATERIALS AND ACCESSORIES

A. General:

1. Provide manufacturer's standard windows complete with members, hardware, weatherstripping, glazing beads, setting blocks, and glazing wedges.

2. Exterior windows and sliders shall have dead locks. Sliders shall have stainless steel V-channel over the slider track with nylon roller.

3. Operable exterior sections of sliding windows shall have aluminum insect screens.

B. Aluminum members:

1. Extrusions of bars, rods and tubes: 6063-T6 alloy conforming to ASTM B 221.

2. Sheets and plates: 5005-H14 alloy conforming to ASTM B 209.

3. Window frames and sashes shall be manufacturer standard systems of extrusions not less than 2.5 mm thick.

4. Use manufacturer's standard thermal-break sections for all aluminum windows, unless otherwise shown on Drawings.

C. Fasteners: Aluminum, or non-magnetic stainless steel, or a non-corrosive material, compatible with the aluminum components and warranted by manufacturer.

1. Do not use exposed fasteners except where unavoidable for application of hardware. Match finish of adjoining metal.

2. Provide Phillips flat-head machine screws for exposed fasteners.

D. Brackets and Reinforcements: Manufacturer standard high-strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot-dip galvanized complying with ASTM A 386.

E. Concrete/Masonry Inserts: Cast iron, malleable iron, or hot-dip galvanized steel conforming to ASTM A 386.

F. Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC - Paint 12, compounded for 20 mil thickness per coat.

G. Sealants: Aluminum frames shall be sealed using a sealant of a type conforming to Section 07900 - SEALANTS, and a color matching with the aluminum profiles.

H. Glass: Conform to Section 08800 - GLAZING. Type of glazing shall be as shown on Drawings.

I. Weatherstripping: For horizontal sliding or double-wing window units provide sliding type woven pile weatherstripping of wood, polypropylene or nylon pile and resin-impregnated backing fabric, and aluminum backing strip complying with AAMA 701.2. For other types of windows provide compression-type weatherstripping, compressible molded expanded EPDM or neoprene weatherstripping gaskets in accordance with ASTM C 509.

J. Glazing Gasket: Manufacturer's standard vinyl glazing gasket.

K. Hardware: Provide manufacturers standard hardware fabricated from aluminum or stainless steel compatible with aluminum and of sufficient strength to perform and function as intended.

2.3 FINISHES

A. Exposed aluminum surfaces shall have the manufacturer's standard powder-coated finish, unless otherwise indicated on Drawings and in accordance with the following:

1. Powder Coated Finish: 60 - 80 micron thick. Color shall be as selected and approved by the Engineer.

2. Anodized Finish: Conform to AA C22A42; 22 micron thick; with shop-applied protective coating of clear acrylic lacquer or any coating in accordance with AAMA 602.2, 0.5 mil dry film thickness, over anodized finish. Color shall be as approved by the Engineer.

2.4 FABRICATION

A. General: Provide manufacturer's standard fabrication and accessories which comply with indicated standards and are reglazable without dismantling of sash framing, except to extent more specific or more stringent requirements are indicated. Include complete system for assembly of components and anchorage of window units, and prepare sash for glazing except where pre-glazing at factory is indicated. Fabrication and installation of aluminum windows shall be executed by an approved specialized firm having at least 5 years experience of successfully completed projects.

B. Sizes and Profiles: Required sizes for window units and profile requirements are shown on the drawings. Details, where shown, are based upon standard details by one or more manufacturers. It is intended that similar details by other manufacturers shall be acceptable, provided they comply with size requirements, minimum/maximum profile requirements and performance standards as shown or specified.

C. Pre-glazed Fabrication: Pre-glaze window units at factory where possible and practical for applications indicated. Comply with requirements of Section 08800 - GLAZING in addition to requirements of ANSI/AAMA 302.9.

D. Provide weep-holes and internal passages to drain infiltrating water and condensation to exterior.

E. Weatherstripping: Provide compression-type weather-stripping at perimeter of each operating sash where sliding-type is not appropriate. Provide sliding-type weatherstripping at all locations where sash rails slide horizontally or vertically along frame of units.

F. Provide mullions and cover plates as shown matching window units, and complete with anchors for support and installation. Allow for erection, tolerances and provide for movements of window units due to thermal expansion and building deflections.

3. PART 3 - EXECUTION

3.1 INSPECTION

A. Window openings shall conform to dimensions and tolerances shown on the drawings.

B. Examine substrates, adjoining construction, and the conditions under which work is to be installed. Installation shall not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Comply with the manufacturer's written instructions for installation of units and other components.

B. Units shall be set plumb, level and true to line, without warp or rack of frames.

C. Frames shall be anchored solidly to surrounding construction to prevent distortion or misalignment.

D. Apply protective coating to separate aluminum from galvanically incompatible materials, including concrete and steel casting as recommended by aluminum manufacturer.

3.3 CLEANING AND PROTECTION

A. Upon completion of installation of aluminum windows, clean exposed metal and glass surfaces of excess sealants, dirt and other substances. Exercise care to avoid damage to protective coatings and finishes. Lubricate hardware.

B. Protect the installed work until substantial completion and replace all damaged work as required by the Engineer.

END OF SECTION

SECTION 08710

DOOR HARDWARE

1. PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Door hardware as shown on Drawings and as specified herein.

B. Verify the accuracy of quantities, sizes, finish and proper hardware to be provided. Determine all details related to door locksets functions. Hardware not specifically listed for a particular opening shall be provided under this Section and shall be the same as hardware types and quality for similar opening elsewhere in the building or as directed by the Engineer.

1.2. REFERENCES

A. ANSI - American National Standards Institute

A156.1 - Butts and Hinges (BHMA 101)

A156.2 - Locks and Lock Trim (BHMA 601)

A156.3 - Exit Devices (BHMA 701)

A156.4 - Door Control Closers (BHMA 301)

A156.6 - Architectural Door Trim (BHMA 1001)

A156.13 - Mortise Locks and Latches (BHMA 621)

A156.16 - Auxiliary Hardware (BHMA 1201)

A156.18 - Materials and Finishes (BHMA 1301)

B. NFPA - National Fire Protection Association

NFPA 80 - Standard for Fire Doors and Windows

NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures

C. UBC - Uniform Building Code

All Applicable Sections.

1.3. SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each item of hardware. Include whatever information may be necessary to show compliance with the requirements and include installation and maintenance of operating parts and finish instructions.

B. Hardware Schedule: Submit final hardware schedule including coordination with doors, frames and related work to ensure proper size, thickness, hand, functions and finish of hardware. Submit separate detailed schedule showing the implementation of the Owner's final instruction on the keying of locks.

C. Samples: Prior to submittal of hardware schedule and ordering of hardware, submit one sample of each type of exposed hardware unit, finished as required, and tagged with full description for the approval of the Engineer.

1.4. TRANSPORTATION, HANDLING AND STORAGE

A. Deliver items of hardware to job site in Manufacturer's original new packing, complete with necessary appurtenances including screws, keys and instructions. Mark each individual container with manufacturer's name and catalog number as they appear in hardware schedule.

B. Provide secure lock-up for hardware delivered to Project. Control handling and installation of hardware items which are not immediately replaceable, so that completion of work will not be delayed by hardware losses, both before and after installation.

1.5. WARRANTY

A. Submit written guarantee signed by Manufacturer and Contractor, agreeing to replace hardware items which fail in material or workmanship within 1 year of the date of substantial handing over.

1.6. QUALITY ASSURANCE

A. Manufacturers: Obtain each type of hardware from a single manufacturer to the greatest possible extent.

B. Supplier: A recognized architectural hardware supplier with warehousing facilities, and has been providing hardware for similar Projects for a period of not less than 2 years and who has, or will employ an experienced architectural hardware consultant to be available, at reasonable times during work, for consultation about Project's hardware requirements to the Engineer as well as Contractor.

2. PART 2 - PRODUCTS

2.1. MATERIALS

A. General:

1. Hardware shall be of Grade 1, heavy-duty type, solid metal, entirely free from imperfections in manufacture and finish and shall be UL Listed.

2. Finish of Hardware: Conform to BHMA coding. Finish shall be as shown on Drawings and in accordance with the following:

a. Polished brass (for Ministers' Offices, VIP Offices and Reception Areas) - BMHA finish Code No. 605, bright polished brass, clear lacquered coated (High Category).

b. Stainless steel (for General Offices) - Conform to the BHMA Code 630; satin finish, complying with ANSI/BHMA A156.18 (High Category).

c. Stainless steel (for Service Areas) - Conform to the BHMA Code 630; satin finish, complying with ANSI/BHMA A156.18 (Ordinary Category)

3. Provide matching finish for different components of the same hardware set.

4. Provide hardware items of proper design for the use of doors and frames of thickness, profile, swing, security and similar requirements indicated and as necessary for proper installation and operation.

B. Door Handles: Lever handles shall be rounded, spring loaded on both sides and have safety feature return ends. Finish shall be stainless steel, conforming to BHMA Code 630.

C. Fasteners: Fabricated of stainless steel, head finish matching with the surface of hardware item. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed or partially exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including - prepared for paint - in surfaces to receive painted finish. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners.

Furnish wood screws for all connections to wood doors, and machine screws for all connections to metal parts and assemblies.

2.2. Hinges:

A. Butt hinges shall meet the requirements of ANSI A156.1 (BHMA 101). Hinges shall bear mark or trademark of manufacturer. Size of hinge shall be 100 x 100 mm, unless indicated otherwise on hardware schedule. Full mortise five knuckle hinges shall have flat button tips, square cornered and shall have stainless steel pins, non-removable pins for external doors. Number of hinges for each door type shall be in accordance with Hardware Schedule shown on Drawings.

1. Hinges shall have minimum leave thickness 3.4 for exterior and vestibule door as well as doors over 1000 mm wide, and 3.7 mm leave thickness for other doors of standard construction. Full mortise hinges with heavy duty ball bearing shall be used for external doors and full mortise hinges with standard ball bearing shall be for internal doors.

2. Single acting spring hinges shall be as approved by the Engineer.

3. Double acting spring hinges shall be as approved by the Engineer.

E. Locksets and Latchsets: Conforming to ANSI A156.13 (BHMA 621), UL listed, shall be heavy duty series, Operational Grade 1, Security Grade 2, mortise and cylinder type as required, functions as shown on drawings. All locks shall be construction grandmasterkeyed. Electric locks, where required, shall have a solenoid integrated to lock mechanism which shall operate the lock function through a cardreader, and shall conform to UL 38G5. Cardreaders shall conform to Section 16783 - SECURITY SYSTEM.

1. Lock Cylinders: Models selected shall conform to ANSI A156.5 (BHMA 1001), having a minimum of 6 pin tumblers. Lock cylinders be interchangeable cores with their keys. Lock cylinders shall be permanently inscribed with a number that identifies the key-change combination to the building lock manufacturer. Only manufacturer's name or trademark shall be visible after installation.

2. Locksets and Latchsets: As shown on drawings, cylindrical or mortise types providing the lock functions as shown on drawings, minimum backset 70 mm with stainless steel, polished lever handle and escutcheons, minimum thickness 1.25 mm. Knobs shall be spherical design. Latchbolt throw shall be 16 mm minimum except when lockset is used on pairs of doors where latchbolt throw minimum is 19 mm. For locksets with deadbolt function, minimum throw of deadbolt shall be 25 mm.

3. Strikes: Shall be wrought box type, lips curved and returned to door frame or frame trim with minimum projection necessary for protection of frame and trim.

F. Exit Devices (Panic Bolt): Exit devices shall meet the requirements of ANSI A156.3, Grade 1, UL listed. Concealed vertical rod devices shall be provided.

G. Flush Bolt: Type required shall be as indicated on the Hardware Schedule. Flush bolt location, aligned in edge of door with operating mechanism of top bolt centered 300 mm from top of door and bottom bolt centered 300 mm above bottom of door. For doors over 2100 mm in height bolt height shall not exceed 1800 mm from the floor.

1. Automatic flush bolts shall be as approved by the Engineer.

2. Constant latch flush bolts shall be as approved by the Engineer.

H. Overhead Door Closers: Unless otherwise indicated on drawings comply with ANSI A156.4, Grade 2, overhead surface-mounted type, and function as required or as recommended by manufacturer. Sweep period of the closer shall be adjusted so that from an open position of 70 degrees, door will take at least 3 seconds to move to a point 75 mm from the latch, measured to the leading edge of the door. Closer shall have automatic hold-open feature.

1. General overhead door closers shall be as approved by the Engineer.

2. Overhead door closers for Fire Exit Doors shall be as approved by the Engineer.

I. Floor Closers: Shall be concealed type with separate hydraulic latch, strokes and back check adjusting valves and built-in positive dead stop exceeding ANSI Grade 1 standards. Sweep period of the closer shall be adjusted so that from an open position of 70 degrees, door will take at least 3 seconds to move to a point 75 mm from the latch, measured to the leading edge of the door. Closer shall have automatic hold-open feature. Floor checking device shall be provided with temporary cover plate of iron or steel, to remain in place until floor finishing is completed. Use manufacturer's installation jig when setting floor closer. Device shall include floor case, arm, top pivot and dress plate. Closers shall be sized at the factory.

J. Electro-Magnetic Holder: Electro-magnetic door holders shall be wall mounted type. In the event of power interruption the magnetic coil shall de-energize and release the door. Magnet shall be radial di-pole type with holding force in excess of 11.30 kg. Door holders shall conform to ANSI A 156.15. Electro-magnetic door holders shall be completely flush.

K. Push Plates: Size shall be as indicated on Drawings or approved by the Engineer and shall conform to ANSI A156.6 satin finish stainless steel. Provide plates with cutouts for lock cylinders, where required.

L. Thresholds: Provide units not less than 100 mm wide complying with ANSI A156.6, extruded aluminum with minimum 3 mm wall thickness. Height of threshold shall conform to door cut.

M. Door Stops: Conform to ANSI A156.16 (BHMA 1201) Grade 1.

1. Wall-mounted door stops shall be as approved by the Engineer.

2. Wall-mounted door stops with holder shall be as approved (Cast stop and holder) by the Engineer.

3. Floor-mounted door stops shall be approved (Cast stop) by the Engineer.

4. Floor-mounted door stops with holder shall be as approved by (Cast stop and holder) the Engineer.

2.2. KEYS AND KEYING

A. Keys shall be permanently inscribed with a number that identifies the cylinder or lock manufacturer and the key symbol. Keys shall be appropriately tagged. Keys shall be provided as follows:

- Grandmaster key to work on all locks of all buildings on site.
- Master key for each building.
- Sub-Master key for each floor of building.
- Sub-Master key for service areas of each building.
- Construction grandmaster key.

B. Number of keys shall be provided as follows:

1. Each Lock: 3 keys.
2. Grandmaster key: 6 grandmaster keys.
3. Master-key: 6 master keys for each master key group.
4. Sub-Master-key: 6 sub-master keys for each key group.
5. Construction grandmaster key: 6 Nos.

C. Change-key Blanks: 50 to fit keyway of cylinders for all locks.

D. Keying shall be in sets and sub-sets. Keys of any one set or subset shall not operate of any other set unless scheduled otherwise. Keys shall be packaged with core cylinders in sealed containers.

E. Key Control System: BHMA Grade 1 system, including key-holding hooks, labels, three sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers. Contain system in metal cabinet with baked-enamel finish. Wall-Mounted Cabinet shall be with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock. Cabinet shall be able to hold keys for 150 percent of the number of locks. Furnish four sets of index cards for recording key information. Include three receipt forms for each key-holding hook.

2.3. HARDWARE SCHEDULE (Refer to Drawings)

3. PART 3 - EXECUTION

3.1 INSTALLATION OF HARDWARE

A. General: Finish hardware items shall be installed in a neat, workmanlike manner according to the manufacturer's written recommendations, unless otherwise specified herein.

B. Fasteners: Suitable fastening devices shall be provided for installation of hardware items. Installation shall provide against shock and tampering. Exposed fastenings shall match contiguous materials and finish of hardware items and shall be inconspicuous. Where practicable finish flush with surrounding surfaces and fastenings shall be of materials compatible with contacting hardware surfaces.

C. Final Adjustment: Immediately upon completion and acceptance of the project, make final adjustments in the finish hardware installation; remove construction core from cylinders and then open sealed containers in the presence of the Engineer and install proper core in cylinders, demonstrate to the Engineer that each item is in perfect working condition; perform intended function and that tagged keys operate respective locks. Correct items of hardware not acceptable to the Engineer by proper adjustment or replacement at no cost to the Owner. Deliver tagged keys upon acceptance of each core cylinder installation.

D. Protection: Protect installed hardware from paint, stains, and blemishes until acceptance of the work.

E. Location of Hardware on Hinged Doors: Locate in accordance with the recommended locations for Builder's Hardware for Custom Steel Doors and Frames as published by the Door and Hardware Institute.

END OF SECTION

SECTION 08800

GLAZING

1. PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Glazing for doors, windows, skylights and glazed openings.

B. Security Glazing.

C. Mirrors.

D. Glazing materials and accessories.

1.2. REFERENCES

A. ASTM - American Society of Testing and Materials

ASTM C 920 - Elastomeric Joint Sealant

ASTM C 964 - Locking-Strip Gasket Glazing

ASTM C 1036 - Flat Glass

ASTM C 1048 - Heat-Treated Flat Glass

ASTM E 774 - Sealed Insulating Glass Units

B. FGMA - Flat Glass Marketing Association

Glazing Sealing Systems Manual

Glazing Manual

C. 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

D. ANSI - American National Standards Institute, Inc.

Z97.1 - Performance Specification and Methods of Test for Safety Glazing Material Used in Buildings

E. NFPA - National Fire Protection Association

Glazing Manual

1.3. SUBMITTALS

A. Product Data: Submit manufacturers technical data for glazing material and fabricated glass product required, including installation and maintenance instructions.

B. Samples: Submit 300 mm x 300 mm samples of each type of glass to be used.

C. Certificates: Submit certificates from manufacturer attesting that glass and glazing materials furnished for the project comply with requirements.

1.4. TRANSPORTATION, HANDLING AND STORAGE

A. 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.

1.5. WARRANTY

A. 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.

1.6. QUALITY ASSURANCE

A. 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 definitions of glass and glazing terms not otherwise defined in this Section or other referenced standards.

B. Safety Glazing Standard: Where safety glass is indicated, provide type of products which comply with ANSI Z97.1.

C. 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.

1.7. PROJECT CONDITIONS

A. 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.

B. Install sealant at ambient and substrate temperatures permitted by sealant manufacturers.

2. PART 2 - PRODUCTS

2.1. GLASS PRODUCTS - GENERAL

A. 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.

B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1084 requirements, including those indicated by reference to kind, condition, type, quality, class, and if applicable, form, finish, and pattern.

C. 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, but not less than 6 mm thick for windows and 12 mm for doors (single glazing).

2.2. GLASS

A. Tempered Float Glass:

1. 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 partitions and for fully glazed doors, unless otherwise indicated on Drawings.

2. Provide tempered float glass for doors and windows indicated on Drawings to have single glazing.

B. Sealed Insulated Clear Glass Units:

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. Unless otherwise indicated on drawings, thickness of units shall be 24 mm consisting of two 6 mm thick tempered glass panels separated by 12 mm thick air space, with clear inside panels and tinted outside panels. Color of outside glass shall be as shown on drawings or approved by the Engineer

2. Provide sealed insulating glass units for entrance doors indicated on Drawings to have double-glazing.

C. Sealed Insulated Glass Units (for Skylights): Conform to the requirements of **sealed insulated glass units** mentioned above, except glass panes shall be fully tempered, with reflective outside glass panes and clear laminated inside glass panes. Glass color shall be as approved by the Engineer.

D. Shower Glass Enclosures: 12 mm thick obscured fully tempered glass shower enclosures and

doors with manufacturer's standard stainless steel hinges and fastener, door pulls and tower bars. Provide clear vinyl profiles for proper seal. Height of enclosure shall be as shown on drawings.

2.3. SECURITY GLAZING

A. LAMINATED-GLASS UNITS:

1. Security Windows: Fabricated of 25 mm thick bullet-resistant clear laminated glass complying with requirements of UL752 and ASTM F 1233 for forced-entry resistance, consisting of two lites of fully tempered float glass and 1.52 mm thick manufacturer's standard interlayer.

2. Detention Windows: Fabricated of 15 mm thick bullet-resistant clear laminated glass complying with requirements of UL752 and ASTM F 1233 for forced-entry resistance, consisting of two lites of fully tempered float glass and 1.52 mm thick manufacturer's standard interlayer.

2.4. MIRRORS

A. 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.

B. Mirror for Wall Cladding. Refer to I.D. drawings and specifications.

C. One-Way Mirror: 10 mm thick. Refer to I.D. drawings and specifications.

D. Size and location of mirrors shall be as indicated on Drawings.

2.5 GLAZING MATERIALS AND ACCESSORIES

A. 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.

B. 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.

C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

D. 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.

E. Joint Cleaner, Primer and Sealer: As recommended by the glazing manufacturer.

F. 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.

G. 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.

H. Sealants: Conform to Section 07900 - SEALANTS.

3. PART 3 - EXECUTION

3.2 PREPARATION

A. Clean glazing channels, stops and other framing members to receive glazing materials of obstructions and deleterious substances which might impair the work. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use. Comply with manufacturer's instructions for final wiping of surfaces immediately before application of primer and glazing media.

3.3 INSTALLATION

A. 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 remain watertight and airtight, and deterioration of glazing materials. Install butt-joint glazing according to the glass manufacturer's recommendations.

B. 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.

C. 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.

D. 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.

E. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

F. 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.

G. 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. For further requirements refer Section 07900 - SEALANTS.

H. Glazing Gaskets: Miter-cut and seal joints of glazing gaskets in accordance with manufacturer's written instructions.

I. Lock-Strip Gaskets:

1. 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.

2. 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.

3.4 PROTECTION AND CLEANING

A. 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.

B. 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.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

D. Maintenance: Maintain glass in a reasonably clean condition during construction.

E. 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.

END OF SECTION

SECTION 08920

GLAZED ALUMINUM CURTAIN WALL

I. PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Aluminum framing system.

B. Vision glass and spandrel panels.

C. Other accessories including integral fire stops at floor slabs and perimeter sealant.

1.2. REFERENCES

A. AAMA - American Architectural Manufacturer Association

AAMA	Metal Curtain Wall, Window, Store Front and Entrance -Guide Specifications Manual
AAMA	Aluminum Curtain Wall Design Guide Manual
AAMA	Curtain Wall Manual #10 - Care and Handling of Architectural Aluminum From Shop to Site
AAMA Series No.	11 - Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing
AAMA 501	Methods of Test for Metal Curtain Walls
AAMA 603.8	Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum
AAMA 605.2	Specifications for High Performance Organic Coatings on Architectural Extrusions and Panels
AAMA 606.1	Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum
AAMA 607.1	Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
AAMA 608.1	Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum
AAMA T1R - A1	Sound Control for Aluminum Curtain Walls and Windows
AAMA FC-1	Field Check of Metal Curtain Walls for Water Leakage

B. ASTM - American Society of Testing and Materials

ASTM A36	Structural Steel
ASTM A386	Zinc Coating (Hot Dip) on Assembled Steel Products
ASTM A446	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube
ASTM E283	Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
ASTM E330	Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E331	Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E413	Classification for Determination of Sound Transmission Class

C. SSPC - Steel Structures Painting Council

SP-10	Near-White Blast Cleaning
PS-12.00	Guide for Selecting Zinc-Rich Painting Systems

1.3. SYSTEM DESCRIPTION

A. Glazed aluminum curtain wall system includes design, supply and installation of tubular aluminum sections with self-supporting framing, shop fabricated, factory prefinished, vision glass, glass spandrel infill, aluminum cladding and related flashings, anchorage and attachment devices, and other required accessories.

1.4. PERFORMANCE REQUIREMENTS

A. General: Provide glazed aluminum curtain wall system that has the following capabilities based on pre-construction testing:

1. Withstand loads and thermal and structural movement requirements indicated without failure. Failure includes the following:

B. Air infiltration and water penetration exceeding the specified limits.

C. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

D. Glazing: Physically and thermally isolated from framing members.

E. System is re-glazable from interior, except spandrel glazings are re-glazable from exterior.

F. Wind Loads: Provide glazed aluminum curtain wall system, including anchorage, capable of withstanding wind-load inward and outward design pressures calculated according to requirements of the American Society of Civil Engineers ASCE-7, "Minimum Design Loads for Buildings and Other Structures"; 6.4.2 "Analytical procedure".

G. Design and size components to withstand seismic loads and sway displacement when wind loads effect maximum overturning moment.

H. Limit deflection of framing members in a direction normal to wall plane to 1/175 of clear span or 19 mm whichever is smaller; with full recovery of glazing materials. Where system affects gypsum board or plaster surfaces, limit deflection of framing members in a direction normal to wall plane to 1/360 of clear span or 19 mm maximum, whichever is smaller

I. System to accommodate, without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; deflection of structural support framing, shortening of building concrete structural columns, creep of concrete structural members and a mid-span slab edge deflection of 1/175 of clear span, 19 mm maximum.

J. Test Performance: Provide glazed aluminum curtain wall system that does not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E330.

1. Test Pressure: 150 percent of inward and outward wind-load design pressure.

2. Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.

K. Average Thermal Conductance: Provide glazed aluminum curtain wall system with average U-value 1.40w/m^2k.

L. Sound Attenuation Through Wall system (Exterior to Interior): STC 50, measured according to AAMA T1R - A1 or ASTM E413.

M. Air infiltration through Assembly: Limit air infiltration to 0.3 L/s/sq. m of fixed wall area when tested according to AAMA 501 or ANSI/ASTM E283 at a static-air-pressure difference of 299 Pa.

N. Water Leakage: None, when measured in accordance with AAMA 501 or ASTM E331.

O. System to provide for expansion and contraction within system components caused by a cycling temperature range of 95 degrees C over a 12 hour period without causing detrimental affect to system components.

P. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

Q. Maintain continuous air and vapor barrier throughout assembly, primarily in line with pane of glass and heel bead of glazing compound.

R. Reinforce curtain wall system to accommodate window washing guide rails. Provide anchors sufficiently rigid to resist loads caused by equipment platform, without damage to wall system.

S. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

1.5. SUBMITTALS

A. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

B. Product Data:

1) Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details and water flow diagrams.

2) Product Data: Provide framing member structural and physical characteristics, dimensional limitations, special installation requirements.

C. Submit 2 samples 300 x 300 mm in size illustrating prefinished aluminum surface, specified glass units, insulated infill panels, glazing materials illustrating edge and corner.

D. Test Reports: Submit substantiating engineering data, test results of previous tests which purport to meet performance criteria, and other supportive data.

E. Manufacturer's Installation Instructions: Indicate special installation procedures, instruction and other recommendations.

1.6. QUALITY ASSURANCE

A. Drawings and Specifications: Plans, elevations and details as shown on Drawings and the requirements specified herein, indicate design concept. The approved manufacturer shall be responsible for complete curtain wall system design based on the system performance requirements specified herein.

B. Applicable Standards: Perform Work in accordance with the following:

1. AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

2. AAMA - Aluminum Curtain Wall Design Guide Manual.

1.7. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing aluminum curtain wall systems with minimum 10 years successful documented experience.

B. Installer for Total System: Company authorized by system manufacturer and approved by the Engineer.

C. Design structural support framing components under direct supervision of a Professional Engineer experienced in design of this work.

1.8. MOCKUP

A. Provide a floor-to-floor mock-up including intermediate mullion, corner mullion, sill, vision glass light, and infill panel. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

B. Mockup may not remain as part of the Work.

1.9. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site in strict accordance with manufacturer's instructions.

B. Handle work of this Section in accordance with the requirements of AAMA - Curtain Wall Manual #10.

C. Protect prefinished aluminum surfaces. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10. WARRANTY

A. Provide five year for the glazed curtain wall system. Warranty shall include coverage for complete system for failure to meet specified requirements.

II. PART 2 - PRODUCTS

2.1. MATERIALS AND ACCESSORIES

A. Aluminum: Alloy and temper shall be as recommended by manufacturer for type of use and finish indicated and complying with the following requirements:

1. Sheet and Plate: ASTM B209
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221
3. Extruded Structural Pipe and Tube: ASTM B429
4. Welding Rods and Bare Electrodes: AWS A5.10

B. Steel Reinforcement: ASTM A36 for structural shapes, plates and bars; ASTM A611 for cold-rolled sheet and strip; ASTM A570 for hot-rolled sheet and strip.

C. Glazing: Double glazed units as indicated on Drawings and specified in Section 08800 - GLAZING.

D. Glazing Gasket: Manufacturer standard sealed-corner pressure-glazing system of resilient elastomeric glazing gaskets, setting blocks, and shims or spacers; in hardness as recommended by manufacturer.

E. Glazing Sealant: As recommended by manufacturer for the intended application.

F. Fasteners: Stainless steel.

G. Touch-Up Primer for Galvanized Steel Surfaces: Zinc rich type.

2.2. COMPONENTS

A. Mullion Profile: Manufacturer's standard aluminum extrusions and tubular section with exterior pressure plate; matching stops and pressure plate of sufficient size and strength to provide bite on glass and infill panels; drainage holes; deflector plates and internal flashings to accommodate internal weep drainage system; internal mullion baffles to eliminate "stack effect" air movement within internal spaces. Size of aluminum framing shall be as approved by Engineer.

B. Reinforced Mullion: Where required, provide profile of extruded or sheet aluminum cladding with internal reinforcement of shaped steel structural section.

C. Spandrel Panel: Internally reinforced, glazing units, color to match vision glass, structurally sufficient to support wall fin radiation saddles with insulation.

D. Wall Cladding (If any): Aluminum with backing, plain, thickness minimum 0.7 mm; finish as selected by the Engineer to match curtain wall mullion sections.

E. Flashings: Aluminum, thickness as recommended by manufacturer to ensure flat surface, finish as selected to match curtain wall mullion sections where exposed, secured with concealed fastening method.

2.3. GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials: Comply with the requirements specified in Section 08800 - GLAZING.

2.4. INSULATION: Refer to Section 07210 – INSULATION.

2.5. VAPOR BARRIER: Provide polyethylene vapor barrier, 250 microns (10 mil) thick as shown on drawings.

2.6. SEALANT MATERIALS

A. Sealant and Backing Materials: Comply with the requirements of Section 07900 - SEALANTS for perimeter sealants.

2.7. FABRICATION

A. Fabricate curtain wall components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to ensure concealment from view.

E. Where required, reinforce interior horizontal head rail to receive drapery track brackets and attachments.

F. Reinforce framing members for external imposed loads.

2.8. FINISHES

A. Exposed aluminum surfaces shall have the manufacturer's standard finish, anodized for the outside surfaces and powder-coated for the inside surfaces, unless otherwise indicated on Drawings and in accordance with the following:

1. Powder Coated Finish: 60 - 80 micron thick. Color shall be as shown on drawings or as approved by the Engineer.

2. Anodized Finish: Conform to AA C22A42; 22 micron thick; with shop-applied protective coating of clear acrylic lacquer or any coating in accordance with AAMA 602.2, 0.5 mil dry film thickness, over anodized finish. Color shall be as approved by the Engineer.

B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 610 gm/sq m.

C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site opening conditions.

B. Verify dimensions, tolerances, and method of attachment with other work.

C. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION

A. Install curtain wall system in strict accordance with manufacturer's instructions as well as AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual and AAMA - Aluminum Curtain Wall Design Guide Manual.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Where required, install sill flashings.

G. Coordinate installation of fire and air stop insulation at each floor slab edge.

H. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Install operating sash in accordance with Drawings.

K. Install louvers, associated flashings, blank-off plates and screening. Fit blank-off plates tight to ductwork.

L. Install glass and infill panels in accordance with Section 08800 - GLAZING.

M. Install perimeter sealant to method required to achieve performance criteria, backing materials, and installation criteria in accordance with Section 07900 - SEALANTS.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 1.5 mm/m non-cumulative or 12 mm/30 m, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 0.8 mm.

3.4 FIELD QUALITY CONTROL

A. Inspection will monitor quality of installation and glazing.

B. Air Infiltration: Test areas of installed system for compliance with system performance requirements according to ASTM E783.

C. Water Penetration: After completing the installation of 25-m by 2-story minimum area of glazed aluminum curtain wall system, test system for water penetration according to AAMA 501.2 (Water Spray Test) in a 2-bay area as directed by the Engineer.

D. Repair or remove Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.5 ADJUSTING AND CLEANING

A. Adjust operating sash for smooth operation.

B. Remove protective material from prefinished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

B. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer that ensure glazed aluminum curtain wall system is without damage or deterioration at time of Substantial Completion.

END OF SECTION

DIVISION - 9

FINISHES

SECTION 09200

LATH AND PLASTER

1. PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Plaster accessories including metal lath and plastering beads as well as control joints.

B. Cement plaster

C. Gypsum Plaster

D. Sand-cement screed

E. Spray-Applied Acoustic Gypsum Plaster

1.2. REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM A 109 - Specification for Steel, Carbon, Cold-Rolled Strip

ASTM A 570 - Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM C 28 - Specification for Gypsum Plasters

ASTM C 29 - Test Method for Unit Weight and Molds in Aggregate

ASTM C 35 - Specification for Inorganic Aggregates for Use in Gypsum Plaster

ASTM C 61 - Specification for Gypsum Keene's Cement

ASTM C 150 - Specification for Portland Cement

ASTM C 206 - Specification for Finishing Hydrated Lime

ASTM C 472 - Test Method for Physical testing of Gypsum Plasters and Gypsum concrete

ASTM C 841 - Specification for Installation of Interior Lathing and Furring

ASTM C 842 - Specification for Application of Interior Gypsum Plaster

ASTM C 847 - Specification for Metal Lath

ASTM C 926 - Specification for Application of Portland Cement-Based Plaster

B. ANSI - American National Standards Institute Inc.

ANSI A42.1 - Gypsum Plastering

ANSI A42.3 - Lathing and Furring for Portland Cement and Portland Cement-line, Exterior (Stucco) and Interior

ANSI A42.4 - Specification for Interior Lathing and Furring

C. ML/SFA - Metal Lathing/Steel Framing Association

ML/SFA - Specification for metal lathing and furring

1.3. SUBMITTALS

A. Manufacturer's Certificates: Submit manufacturer's certificates showing compliance with the specified material requirements and installation and workmanship instructions.

B. Samples: Submit 300 mm long samples of the proposed accessories.

1.4. TRANSPORTATION, HANDLING AND STORAGE

A. Except for sand and water, deliver materials to the site in sealed containers or bags fully identified with manufacturer's name, brand, type and grade. Store materials in a dry, well-ventilated space, under cover, off the ground, and away from surface subject to dampness or condensation.

B. Deliver accessories in their original containers bearing the name of the manufacturer and item identification.

1.5. QUALITY ASSURANCE

A. Allowable Tolerance for Finished Work: For flat surfaces, do not exceed 3 mm in 3 meters for bow or warp of surface and for plumbness or level.

B. Mock-up Installation: Prior to installation of plaster work, provide sample mock-up panels using materials specified for final work. Build sample panels at site, of full thickness and approximately 1.2 x 1.2 m. Demonstrate the proposed range of color, texture and workmanship to be expected in the completed work, and submit to the Engineer for review. Retain sample panels construction as a standard for judging completed plaster work. Do not alter, move or destroy sample panel until plastering work is completed. Provide a sample panel for interior and exterior Portland cement plaster and plaster on metal lath.

1.6. JOB CONDITIONS

A. Protection:

1. General: Protect contiguous work from moisture deterioration and soiling, which may result from plastering operations. Provide temporary covering and whatever other provisions may be necessary to minimize harmful spattering of plaster on other work.

2. Finished door and window frames and other surfaces which do not receive a plaster finish shall be well protected during plaster application.

B. Environmental Conditions:

1. General: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic conditions to prevent rapid dry-out. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combination of these as required.

2. Ventilation: Provide adequate ventilation to properly dry interior plaster during and subsequent to its application.

2. PART 2 - PRODUCTS

2.1. PLASTER ACCESSORIES

A. Galvanized steel furring, lathing and other plaster accessories shall conform to the material provisions of ASTM C 841 and ANSI A42.3. Plaster accessories shall include but not limited to the following:

1. Metal Corner Beads: Fabricated from galvanized sheet, 5 mm radius bead with 38 mm wide expanded type flanges.

2. Strip Reinforcement: Smooth edge strips of expanded metal lath fabricated from galvanized steel sheet, with uncoated steel painted after fabrication.

3. Casing Beads: Square-edged style, with short or expanded flanges to suit kinds of plaster bases galvanized steel.

4. Curved Casing Beads: Square-edged style, fabricated from aluminum coated with clear plastic, preformed into curve of radius indicated on the Drawings.

5. Control Joints: Prefabricated, galvanized steel one-or two-piece type as required. Provide removable protective tape on plaster face of control joints.

6. Metal Corner Reinforcement: Expanded large mesh diamond lath fabricated from welded wire mesh from 1.2 mm diameter galvanized wire, specially formed to reinforce corners of Portland cement plaster where exposed while allowing full plaster encasement.

7. Expanded Metal Lath: Galvanized steel diamond mesh complying with ASTM C 847 and shall have a minimum weight of 1.85 kg/m².

B. Coordinate the depth of accessories with the thickness and number of plaster coats required in accordance with the manufacturer's recommendations and as directed by the Engineer.

2.2. PORTLAND CEMENT PLASTER

A. Portland cement plaster shall have a minimum thickness of 20 mm in a double coat provided using but not limited to the following materials:

1. Base Coat Cement: Portland cement, conforming to ASTM C 150, Type I.

2. Finish Coat Cement: Portland cement, conforming to ASTM C 150, Type I.

3. Factory-Prepared Finish Coat: Manufacturer's standard product requiring only the addition of water; white in color unless otherwise indicated.

4. Lime: Special hydrated lime for finishing purposes, conforming to ASTM C 206, Type S.

5. Sand Aggregate for Base Coat: Conform to the requirements of ASTM C 897.

6. Aggregate for Finish coat: Conform to ASTM C 897, manufactured or natural sand to match approved sample.

7. Water for Mixing and Finishing Plaster: Potable, free of substances, capable of affecting plaster set or of damaging plaster, lath or accessories.

8. Bonding Agents: Conform to ASTM C 932.

B. Portland cement plaster mixes and compositions:

1. General: Comply with ASTM C 926 for Portland cement plaster base and finish coat mixes as applicable to plaster bases, materials and other requirements indicated. Submit samples of materials used for the approval of the Engineer as well as mix design.

2. Base Coat: Proportion materials for respective base coats in parts by volume for cementitious materials and in parts by volume for sum of cementitious materials for aggregates to comply with following requirements for each method of application and plaster base as required. Adjust mix proportions indicated herein within the limits specified to attain workability as follows:

a. Two-coat Work over Concrete or Unit Masonry: Base coats shall be one part Portland cement, 3/4 to 1-1/2 parts lime, 3 to 4 parts sand.

3. Finish Coat: Proportion materials for finish coats in parts by volume for cementitious materials for aggregates with one part Portland cement, 3/4 to 1-1/2 parts lime and 3 parts sand.

2.3. GYPSUM PLASTER (FOR INTERNAL PLASTERING)

A. Gypsum Plaster Materials:

1. Base Coat Plaster: Conform to ASTM C 28, ready-mixed gypsum, high strength gypsum neat plaster with minimum average dry compressive strength of 19.3 MPa according to ASTM C 472 for a mix of 45 kg plaster and 0.19 m^3 of sand.

2. Finish Coat Plaster: Ready-mixed gypsum finished plaster, manufacturer's standard mill-mixed gauged interior finish or high-strength gypsum gauging plaster, conforming to ASTM C 28, with a minimum average dry compressive strength of 34.5 MPa according to ASTM C 472 for neat mix.

3. Lime: Conform to ASTM C 206, hydrated lime, Type S, for finishing purposes, unless otherwise indicated.

4. Aggregates for Base Coat: Conform to ASTM C 35, sand aggregate, unless otherwise

indicated.

5. Bonding Agent: Conform to ASTM C 631.

B. Gypsum plaster mixes and compositions:

1. Plaster Base Coat Compositions: Comply with ASTM C 842 and manufacturer's directions for gypsum plaster base coat proportions which corresponds to application and plaster bases as indicated below:

a. Three-coat Work over Metal Lath: Scratch and brown coats of high strength gypsum gauging plaster with job-mixed sand.

b. Two-Coat Work Over Unit Masonry and Concrete: Base coats of gypsum neat plaster with job-mix sand.

2. Finish Coat: Proportion materials for finish coat to comply with ASTM C 842 for type of finish coat and texture required.

2.4. SAND CEMENT SCREED

A. Sand cement screed be composed of a mixture of Portland Cement type I, natural sand, crushed stone or a combination of them, as well as water and other additives as indicated on Drawings and as required by the Engineer.

B. Submit the design mix for the Engineer’s approval. Screed shall have minimum thickness of 50 mm unless otherwise indicated on Drawings.

C. Test screed for a minimum compressive strength of 22 MPa after 28 days.

2.5. SPRAY-APPLIED ACOUSTIC GYPSUM PLASTER

A. Spray-Applied Plaster Materials:

1. Manufacturer's standard ready mix acoustic gypsum plaster consisting of retarded gypsum additives and light weight fibered aggregates and in accordance with the following requirements:

a. Plaster shall be ready to use by adding water only and shall be self curing.

b. Plaster shall be machine spray-applied to metal suspended ceiling system at a minimum thickness of 15 mm.

c. Texture of final finish shall be as approved by the Engineer.

B. Spray-Applied Plaster Mixes and Compositions:

1. Design and formulate the gypsum plaster mix to suit machine spray application in strict accordance with the plaster manufacturer recommendations.

2. Spraying equipment used and the nozzle for the selected texture as well as the application procedures shall be as recommended by the plaster manufacturer.

3. PART 3 - EXECUTION

3.1 INSTALLATION OF LATHING AND FURRING - GENERAL

A. Install interior lathing and furring materials indicated for plaster to comply with ASTM C 841.

B. Install lathing and furring materials indicated for Portland cement plaster to comply with ANSI A42.3.

C. Install supplementary framing, blocking, and bracing at terminations of work for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar work in accordance with details indicated on Drawings or approved shop drawings.

D. Isolation: Where lathing and metal support system abuts building structure horizontally, and where partition/wall work abuts overhead structure, isolate the work from structural movement sufficiently to prevent transfer of loading into the work from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support.

E. Frame both sides of control and expansion joints independently, and do not bridge joints with furring and lathing or accessories.

3.2 INSTALLATION OF CEILING SUSPENSION SYSTEMS

A. Coordinate installation of ceiling suspension system with installation of overhead structural systems, ducting and catwalks to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers in a manner that will develop their full strength and at spacings required to support ceiling.

B. Furnish concrete inserts, and other devices indicated, to other trades for installations well in advance of time needed for coordination with other work.

C. Attach hangers to structure above ceiling to comply with ML/SFA - Specifications for Metal Lathing and Furring as well as with referenced standards.

D. Install ceiling suspension system components of sizes and spacings indicated but not in smaller sizes or greater spacings than that required by the referenced lathing and furring installation standards.

3.3 METAL LATHING

A. Install expanded metal lath for the applications where plaster base coats are required. Provide appropriate type, configuration and weight of metal lath selected from materials required which comply with referenced lathing installation standards.

3.4 INSTALLATION OF PLASTERING ACCESSORIES

A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.

B. Accessories:

1. Corner Beads: Install at external corners.

2. Casing Beads: Install at terminations of plaster work, except where plaster passes behind and is concealed by other work and where metal screed, bases or metal frames act as casing beads.

3. Control Joints: Install at locations indicated, or if not indicated, at spacings and locations required by referenced standard and recommended by plaster manufacturer and approved by the Engineer.

4. Corner Reinforcement: Install at external corners.

3.5 PLASTER APPLICATION

A. Prepare monolithic surfaces for bonded base coats and use bonding compound or agent to comply with requirements of referenced plaster application standards for conditioning of monolithic surfaces.

B. Tolerances: Do not deviate more than 3 mm in 3000 mm from a true plane in finished plaster surfaces, as measured by a 3000 mm straightedge placed at any location on surface.

C. Grout hollow metal frames, bases and similar work occurring in plastered areas, with base coat plaster material, and prior to lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout 150 mm lengths at each anchorage.

D. Sequence plaster application with the installation and protection of other work, so that neither will be damaged by the installation of the other.

E. Plaster finish with metal frames and other built-in metal items or accessories which act as a plaster ground, unless otherwise indicated. Where plaster is not terminated at metal by casing beads, cut base coat-free from metal before plaster sets and groove finish coat the juncture with metal.

F. Apply thickness and number of coats of plaster as indicated or as required by referenced standards, and as per manufacturer's recommendations.

1. Cement Plaster: Base coat shall be 20 mm thick for concrete and CMU. Finish coat shall be 3 mm.

2. Gypsum Plaster (for internal use): Base coat shall be 12 mm thick. Finish coat shall be 3 mm.

G. Concealed Plaster: Where plaster application will be concealed by wood paneling, above suspended ceilings and similar locations, finish-coat maybe omitted. Where plaster application will be concealed behind cabinets and similar furnishings and equipment apply finish-coat. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish-coat and coordinate thickness with overall dimension as shown and comply with tolerances specified.

3.6 SAND-CEMENT SCREED

A. Roughened the concrete slabs to receive screeding before hardening. Clean and wet the hardened base surfaces, preferably overnight prior to laying of screeds.

B. Batch accurately aggregates and cement by weight at a ratio of cement-aggregate ranging from 1-3 to 1-4.5. Mix screeding material mechanically.

C. Lay and finish the screed mix carefully to true levels and correct heights for the required thickness. Tolerance in level over a 2 m length shall not exceed plus or minus 3 mm.

D. Provide adequate means of curing to prevent rapid drying of screed as directed by the Engineer.

3.7 SPRAY-APPLIED ACOUSTIC GYPSUM PLASTER

A. Acoustic plaster shall be applied as per manufacturer's written recommendations.

3.8 CUTTING AND PATCHING

A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects and where bond to the substrate has failed.

B. Sand smooth-trowelled finishes lightly to remove trowel marks and arises.

3.9 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces which are not to be plastered. Repair floors, walls and other surfaces which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean remove unused materials, containers and equipment and clean floors of plaster debris.

B. Provide final protection and maintain conditions which ensure plaster work being without damage or deterioration at the time of substantial completion.

END OF SECTION

SECTION 09250

GYPSUM AND CEMENT BOARDS

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ceiling suspension system, wall framing and furring systems for dry walls.

B. Gypsum and cement board for walls and ceilings.

C. Cement board for decorative exterior wall moldings.

D. Miscellaneous materials and the related accessories as shown on Drawings and as specified herein.

1.2 REFERENCES

A. ANSI - American National Standards Institute, Inc.

A97.1 Standard Specifications for the Application of Finishing of Wallboard

B. ASTM - American Society of Testing and Materials

ASTM A 525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM C 36 Specification for Gypsum Wallboard

ASTM C 442 Specification for Gypsum Backing Board and Core Board

ASTM C 475 Specification for Joint Compound and Joint Tape for Finishing Gypsum Wallboard Construction

ASTM C 630 Specification for Water-Resistant Gypsum Backing Board

ASTM C 754 Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum

ASTM C 840 Specification for Application and Finishing of Gypsum Board

C. GA - Gypsum Association

GA 201 - Using Gypsum Board for Walls and Ceilings

GA 216 - Recommended Specifications for the Application and Finishing of Gypsum Board

GA 220 - Special Recommendations - Gypsum Board Winter Related Problems

GA 650 - Recommendations for Covering Interior Walls and Ceilings with Gypsum

Board

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product specification and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these Specifications.

B. Samples: Submit manufacturer's samples for the Engineer's approval.

C. Shop Drawings: Submit complete shop drawing of layout and details of ceiling and/or partitions for the Engineer's approval.

D. Mock-Up: Install a full size mock-up showing different elements completed for drywall partitions and ceilings.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Comply with the requirements of transportation, handling and storage specified in ASTM C 840.

2. PART 2 - PRODUCTS

2.1. METAL SUPPORT SYSTEM

A. Ceiling Support System:

1. Main Runners: Steel channels with rust inhibitive coating (Galvanized), hot or cold-rolled, minimum nominal thickness 0.6 mm with 40 mm flanges and channel web of suitable size.

2. Hanger Wire: Conform to ASTM A 641, soft, Class 1, galvanized.

3. Hanger Rods and Flats: Mild steel with zinc or equally rust inhibitive coating for rods and zinc or rust-inhibitive paint finish for flats.

4. Furring Members: Conform to ASTM C 645, not less than 0.6 mm thick, hat-shaped with 19 mm flanges.

5. Furring Anchorage: Conform to ASTM C 754, 1.6 mm diameter galvanized wire ties, manufacturer's standard wire-type clips, bolts, nails or screws.

6. Direct Suspension System: Manufacturer's standard zinc-coated or painted steel system of furring runners, tees, and accessories designed for concealed support of gypsum drywall ceilings.

B. Wall/Partition Support Materials:

1. Runners, Studs and Furring: Formed from steel sheets conforming to ASTM C 645 with manufacturer's standard hot-dipped galvanized coating to ASTM A653, G60, minimum 0.7 mm thick with web dimension compatible with thickness of wall as shown on Drawings. Provide holes and knockouts for utilities. Furring members

shall be hat-shaped type.

2.2. GYPSUM BOARD

A. Regular gypsum board for General Use: Conform to the requirements of ASTM C 36, Grade R or DIN 18-180, regular, 13 mm thick for ceilings and 16 mm for walls with tapered or beveled edges.

B. Moisture-resistant gypsum board for Toilets, Washroom, Showers, Ablution Areas and Similar Wet Areas: Conform to ASTM C 630 or DIN 18-180, Type X, 13 mm thick for ceilings and 16 mm thick for walls with tapered or beveled edges.

C. Fire retardant wallboard: Where indicated on Drawings, use Type X, same requirements as mentioned above.

2.3. CEMENT BOARD:

A. Cement Board for Wall, Ceiling and Molding: Calcium silicate boards, reinforced with selected fibers and fillers and asbestos free, minimum 9 mm thick for internal wall and ceiling; and not less than 12 mm thick for external moldings and ceiling unless otherwise indicated on Drawings. Design and pattern of cement board moldings shall be as approved by the Engineer. Cement boards shall be moisture-resistant, undamaged by water; fire performance shall be as follows:

1. Combustibility: Non-combustible in accordance with BS 476: Part 4.

2. Surface Spread of Flame: Class 1 in accordance with BS 476: Part 7.

B. Boards shall be unaffected by brine and chlorine, resistant to low concentrations of most acids, alkalis and bleaching agents as well as attack of insects or vermin.

2.4. MISCELLANEOUS MATERIALS

A. Fasteners:

1. Screws: Self-drilling, self-tapping bugle head for use with powder-driven tool and of the type recommended by board manufacturer for the intended application.

2. Fasteners for furring members: Type and size shall be as recommended by furring manufacturer for the substrate and intended application.

B. Joint Treatment Materials:

1. Joint reinforcing tape: Perforated type, width range between 45 mm and 60 mm, and 0.3 mm thick.

2. Joint compound: As recommended by the board manufacturer for the intended application and in accordance with ASTM C 475.

3. Concealed Sealants: Mastic type, non-shrink, non-drying, non-migrating, and non-

staining sealant.

4. Exposed Sealant: Acrylic-latex type, permanently elastic and paintable.

C. Acoustic Insulation: Comply with requirements specified in Section 07210 – BUILDING INSULATION.

D. Trim Accessories:

1. General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound.

2. Provide corner beads, L-type edge trim-beads, U-type edge trim-beads, special L-kerfs type edge trim-beads, and one-piece control joint beads as required.

3. PART 3 - EXECUTION

3.1 PREPARATION OF FRAMING SYSTEMS

A. Ceiling Anchorages: Coordinate work with the structural ceiling work to insure that the inserts as well as the other structural anchorage provisions have been installed to receive ceiling hangers.

3.2 INSTALLATION OF FRAMING SYSTEMS

A. Ceiling Support System: Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to inserts, clips or other anchorage devices and fasteners as indicated.

B. Wall Support System: Align top and bottom tracks to assure plumb wall. Secure track with suitable fasteners at a maximum of 600 mm on center. Position studs in track at 600 mm on center spacing.

3.3 BOARD INSTALLATION

A. Locate exposed end-butt joints as far from center of walls and ceilings, and stagger not less than 300 mm in alternate courses of board.

B. Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling.

C. Install wallboard vertically to avoid end-butt joints wherever possible.

D. Install boards with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.5 mm open space between boards. Do not force in place.

3.4 ADJUSTMENT AND CLEANING

A. When face of paper for gypsum board is punctured, a new screw shall be driven

approximately 30 mm from puncture and fill damaged surface with compound.

B. Fill cracks with compound and finish smooth and flush.

3.5 PROTECTION OF WORK

A. The required procedures for protecting drywall work from damage and deterioration during remainder of construction period shall be as recommended by board manufacturer or drywall installer and approved by the Engineer.

END OF SECTION

SECTION 09310

CERAMIC TILES

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ceramic tiles for walls and/or floors as indicated on Drawings.

B. Miscellaneous materials including tile adhesive, grout, and sealants.

1.2 REFERENCES

A. 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
A137.1-88	Specification for Ceramic Tiles

1.3 ASTM - American Society for Testing and Materials:

ASTM C 1027-90	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tiles.
ASTM C 1028-89	Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other like Surfaces by the Horizontal Dynamometer Pull Meter Method
ASTM C 241-90	Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
ASTM C 648-94	Standard Test Method for Breaking Strength of Ceramic Tile.
ASTM C 373-94	Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products.
ASTM C 150	Specification for Portland Cement
ASTM C 206	Specification for Finishing Hydrated Lime

1.4 TCA - Tile Council of America:

TCA 137.1 Standard Specification for Ceramic Tile

TCA Handbook for Ceramic Tile Installation

1.3 SUBMITTALS

A. Complete set of samples of manufacturer's standard products for color selection.

B. Certification from manufacturer of tile certifying the following:

- Materials provided are suitable for intended use.
- Materials meet or exceed appropriate ANSI Standard or SASO Standard.

C. Tile manufacturer's complete installation instructions.

D. Shop drawing layout showing the tile arrangements.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials in containers with labels legible and intact and grade-seals unbroken. Store material so as to prevent damage or contamination.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tiles of same type and color or finish from one source or producer.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each adhesive, and grout component from a single manufacturer.

C. 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.

D. 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.

E. 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.

2. PART 2 - PRODUCTS

2.1. GENERAL::

A. Type, Size, Texture, Color and Pattern: Refer to I.D. drawings and specifications for selections

of ceramic tiles.

2.2. CERAMIC TILES

A. General:

1. Ceramic tiles shall have a standard grade quality in accordance with the Grade Specifications of ANSI A137.1 or DIN 18166 or BS 1286 or SASO 1031.

2. 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.

3. Accessories: Provide the necessary manufacturer's standard trims and half pieces required for the complete installation.

4. Selection and Size: Type, color and pattern shall be as indicated on Drawings unless otherwise approved by the Engineer.

B. Physical Properties:

1. Breaking strength: 41 kg for wall tiles and 113 kg for floor tiles.

2. Water absorption: Less than 0.5 %

3. Coefficient of Friction (COF): 0.5

2.3. MISCELLANEOUS MATERIALS

A. Adhesive and Grout:

1. 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.

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.

B. Sealants: Elastomeric type, in conformance with the requirements specified in Section 07900 - SEALANTS.

3. PART 3 - EXECUTION

3.1 GENERAL

A. 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.

B. Protection and Curing:

1. 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.

2. Damp cure for at least 3 days; add dampness as needed to achieve a hard cure.

C. Jointing Pattern:

1. 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.

3.2 INSTALLATION OF WALL TILES

A. 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.

B. 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.

C. Joint width shall be determined by spacers on tile or by strings or pegs if tile without spacers are used.

D. Tiles shall be pressed and beaten into place to obtain full coverage by adhesive on back.

E. Tiles shall be adjusted before initial set of adhesive takes place.

F. 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.

3.4 INSTALLATION OF FLOOR TILES

A. 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.

B. Press tiles firmly into the adhesive to obtain full contact with adhesive with no voids.

C. 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.

3.5 CLEANING AND PROTECTION

A. Upon completion of placement and grouting, all ceramic and quarry tiles surfaces shall be cleaned free of foreign matter.

1. Glazed tiles surfaces shall be sponged and washed thoroughly diagonally across joints and finally polished with clean, dry clothes.

2. 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.

B. Finished installation shall be left clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.

C. 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.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

E. Seal plumbing and electrical penetrations through wall tile as specified in Section 07900 - SEALANTS.

END OF SECTION

SECTION 09320

PORCELAIN TILES

PART 1-GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, tools, equipment and services necessary for an reasonably incidental to complete the tile work as shown on the drawings or specification.
B. Related documents, drawings and general provisions of contract, including general and supplementary conditions and Division 1 specification section apply to work of this section.
C. Related Sections:
   1. Division 7, sealing expansion joints and other joints in tile work(joint sealant types, colors and manufactures to be specified by Architect).
   2. Division 3, concrete.

1.2 REFERENCE STANDARDS

A. Comply with the following current edition of:
   1. American Society for Testing and Materials (ASTM)
   2. American National Standards Institute (ANSI).
   3. Tile Council of America (TCA) Handbook for Ceramic Tile Installation.

1.3 QUALITY ASSURANCE

A. Provide tile materials of each type, color and finish from Granito, RAK, Niro Granite provide setting, grouting and related materials of each type, color and finish obtained from one source.
B. Deliver, store and handle materials in accordance with manufacturer's instructions.
C. The contractor, by commencing the work of this section, assumes overall responsibility to assure that all assemblies, components and parts shown or required within the work of this section comply with contract documents and are compatible with each other and with the conditions and expected use.
D. Installer Qualification: Engage and installer with a minimum of five(5) years commercial tile installation similar in material, design and scope to that indicated.
E. Pre-Installation Meeting: Prior to tile installation, conduct a pre-installation project meeting. Contractor, Subcontractor, Material Suppliers, Architect and Owner representative shall be notified of the meeting.
F. Field mock –up: Install a fully finished mock-up for each type tile installation. Mock-up shall be a minimum of 6'-0" x 6'-0" and will be reviewed for joint quality, color range, pattern and workmanship.

G. Extra Stock: Furnish extra stock of quantity equal to 3% of amount installed, in full-size units, for each type, color, size and finish of tile.

1.4 SUBMITTALS

A. Verification Samples: Submit the following for each type, color, size and finish included in the work.
   1. Full size tile and trim shapes.
   2. Grout color samples.
   3. Sealant color samples.

B. Product and Installation Data:

   1. Porcelain tile manufacturer's product and technical data indicating compliance with applicable standard herein.
   2. Motor and grout manufacturer's technical data sheets indicating suitability for the installation specified and compliance with applicable standard.
   3. Sealant manufacturer's product and technical data.

1.5 ENVIRONMENTAL

A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during and after installation.
B. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
C. Maintain minimum and maximum temperature limits as recommended by manufacturers.
D. Protect adjacent surface during progress of the work in this section.
E. Illuminate the work area during installation providing the same level and angle of illumination as will be available for final inspection.

2.1 GENERAL REQUIREMENTS

A. Furnish tile complying with "Standard Grade" requirements per ANSI A 137.1 for types of tile indicated.
B. Comply with ANSI Standard for Tile installation Material for products and materials indicated for setting and grouting.

2.2 TILE

A. Porcelain tile shall be procured from the following brands after approval from the Engineer/Employer:
   i. Granito ii. RAK iii. Niro Granite

1. Size: 24" x 24" inches normal
2. Trim: As indicated on drawings.
3. Type and Finish: textured and glazed.
4. Color: To be from _____ full range of colors available. For bidding purposes allow 90% to be chosen within price groups I and II 10% from price group III.
5. Product Test Data:

PORCELAIN – TECHNICAL PROPERTIES

	NAME OF POST	ASTM	REQUIREMENT
a.	Water Absorption	C373	0.5% Maximum
b.	Abrasive Wear	C501	100 minimum
c.	Breaking Strength	C648	250Lbs. Minimum
d.	Bond Strength	C482	50 Minimum
e.	Coefficient of friction- Dry	C1028	.6 Minimum
f.	Coefficient of friction- Wet	C1028	.6 minimum
g.	Facial Dimensions (Range)	C499	1.5% maximum
H.	Range of Thickness	C499	0.040
I.	Warpage (Diagonal)	C485	+/- 0.75 Maximum
j.	Wedging	C502	1.00% Maximum
k.	Scratch Hardness	C373	7/8

6. Provide matching trim shapes such as bull-nose, coroners and cove base when specified.

2.3 SETTING AND GROUTING MATERIALS:

A. Latex-Portland Cement Mortar ANSI A118.4.

B. Latex-Portland Cement Grouts. ANSI A1 18.6.

2.4 EXPANSION JOINTS, CONTROL, CONTRACTION, AND ISOLATION JOINTS:

A. Refer to TCA Handbook, Method EJ171-99 for recommendations on locating and detailing various types of construction joints. NOTE: Architect must specify expansion joints and show location and details on drawings.

B. Use sealants complying with ASTM C920 according to Type, Grade, Class and Uses required.

C. Provide marble threshold trim strips, or other metal edging material where tile terminates at dissimilar finishes as shown or specified.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates where tile will be installed for compliance with requirements for installation tolerances and other conditions effecting performance of installed tile.

Verify that substrates for setting tile are well cured, dry, clean and free from oil or waxy films and curing compounds.

B. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of work signifies acceptance of substrate and installation conditions.

3.2 PREPARATION

A. Substrate preparation: Repair and clean substrate in accordance with installation standard and manufacturer's instructions, and as follow:

1.Remove protrusions, bumps and ridges by grinding of chipping.

2.Repair, fill and level cracks, holes, depressions and rough or chipped areas in substrate using patching material recommended by setting materials manufacturer.

3.Concrete slab to have steel trowel and broom finish when tile is installed by the thin –set method.

4.insure substrate is within the following tolerance:

a. horizontal surface (floors) – Maximum variation in substrate shall not exceed 1/8" in ten feet from required plane: ¼ in ten feet when substrate is recessed or depressed to receive full mortar bed.

b. vertical surface (walls) – Maximum variation in substrate shall not exceed 1/8" in eight feet from required plane.

B. Jobsite Blending: Blend tiles before installing, in accordance with reference standard, to produce an even range and distribution of color and finish.

3.3 INSTALLATION

A. Manufacturer's Instructions: Perform work in compliance with instructions and with setting materials manufacturer's instructions.

B. General installation standards: install tile in accordance with ANSI standards and appropriate TCA methods.

1. Thin-set Floor Installations: TCA Method F 113-2K.

2. Thin-set Wall Installations: TCA Method W243-2K

C. Installing Tile:

1. Install tile in pattern indicated. Align joints when adjoining tiles on floor, base, walls and trim are same size. Center tile fields in both directions, adjust to minimize tile cutting and to avoid tile less than half size.

2. Grind cut edges of tile. Provide straight cuts which align with adjacent materials.

3. Extend tile into recessed and under equipment and fixture to form a complete covering without interruption.

4. Terminate tile neatly at obstructions, edges and corners, without disruption of pattern or joint alignment.

5. Provide tile joint uniform in width, subject to variance in tolerance allowed in tile size. Make joints smooth and even, without voids, cracks, or excess grout. Maximum joint size ¼" preferably 1/8: joint.

6. Max mortar in strict accordance with manufacturer's recommendations.

7. Apply setting material in accordance with manufacturer's directions and install tile before mortar has started initial cure. When installing unglazed paver tile up to 12" x 12" in size, the notch trowel used should be minimum of ¼" x 3/8" x ¼". For larger unit tiles use a nominal 3/8" x 9/16" x ¾" round notch trowel.

8. Do not spread more material than can be covered within 10 to 15 minutes maximum. If skinning occurs, remove mortar and spread fresh material. Spread mortar with notches running in one direction.
9. Place tile in fresh mortar, press, push and pull the tile in to achieve as near 100% overage and contract of tile with setting material and substrate as possible. The coverage shall be sufficiently distributed to give full support of the tile. Make sure that all corners and edges are well backed with mortar. Leave no hallow corners or edges. NOTE: The 100% coverage is particularly important for wet or exterior areas or areas with heavy or traffic.
10. Ensure there is a minimum 3/32" mortar between tile and substrate after tile has been beaten into place.
11. Use a beating block and mallet so that faces and edges of individual tiles are flush and level with faces and edges of adjacent tiles, and to reduce lippage.

D. Grouting:

1. Install grout in accordance with ANSI A108.10 and manufacturer's recommendations.
2. Mix grout material in strict accordance with manufacturer's directions.
3. Apply grout to produce full, smooth grout joints of uniform width, even with edge of titles ad free of voids and gaps.
4. Before grouting entire area, do a test area, to assure there will be no permanent staining or discoloration of the tile. If necessary, precoat exposed surface of tile with a grout release as recommended by the manufacturer.
5. Cure all setting and grouting materials in accordance with manufacturer recommendations.

E. Cleaning and Protection:

1. Remove grout release and clean tile surface so they are free of grout residue and foreign matter, in accordance with manufacturer's instructions. Flush surface with clean water before and after cleaning. Do not use acid or acid-based cleaners to clean glazed tiles or tile grouted with latex modified grout.

2. When applicable, acid cleaning of tile grouted with Portland cement grout shall not be done before 10 days after grouting. Tile and grout shall be soaked with water before cleaning. In the absence of a recommendation from the grout manufacturer, acid cleaning may be done with a started solution of sulfamic acid, mixed in accordance with manufacturer's recommendations and ANSI A108.

3. After cleaning, provide protective covering and maintain conditions to protect tile work from damage or deterioration. Where tiled surface will be subject to equipment or wheel traffic or heavy construction traffic, and during move-in of furniture and equipment, cover protective covering with ¼" hardboard or plywood.

4. Final clean up shall be done by finishing or polishing with a terry cloth, cheesecloth, or similar pad.

5. Leave finished installation clean and free of cracked, chipped, broken, unbonded and otherwise defective tile work.

END OF SECTION

SECTION 09400

TERRAZZO (PRECAST)

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work under this Section consist of furnishing and installing all precast terrazzo tiles and poured in place terrazzo treads and risers as shown on drawings and as specified herein.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials:

ASTM A 815 Welded Steel Wire Fabric for Concrete Reinforcement

ASTM C 33 Concrete Aggregate

ASTM C 150 Portland Cement

ASTM C 241 Abrasion Resistance of Stone Subjected to Foot Traffic

ASTM C 309 Liquid Membrane-Forming Compounds for Curing Concrete

B. NTMA - National Terrazzo and Mosaics Association

NTMA Terrazzo Design Data Book

NTMA Terrazzo Technical Data Book

1.3 SUBMITTALS:

A. Product Data: Manufacturer's technical information and installation instructions for type of terrazzo, accessory items and materials.

B. Samples: Manufacturer's samples for each kind of precast terrazzo for Engineer's approval.

C. Shop Drawings: Show layout of divider strips, control, joint strips, base and border strip.

D. Certificate of compliance.

1.4 TRANSPORTATION, HANDLING AND STORAGE:

A. Handling: Separate precast units during shipment with polyethylene film or other non staining protective separator material.

B. Protection: Protect terrazzo work against damage throughout the construction period.

1.5 QUALITY ASSURANCE:

A. Reference Standards: Comply with specified provisions and recommendations of National Terrazzo and Mosaic Association Inc. (NTMA).

2. PART 2 - PRODUCTS

2.1. TERRAZZO FLOORING:

A. Precast Terrazzo Tiles: Terrazzo shall consist of natural, sound, crushed marble chips without excessive flats or flakes, with colors as selected from manufacturer's range of colors. Chips shall be a mixture of sizes 6 mm (No. 1) - 10 mm (No. 2) of equal parts. Matrix shall be either white or colored cement. Marble chips shall have a dust content of less than 1% by weight and shall have an abrasion resistance of not less than HA10 in accordance with ASTM C241. The mix shall consist of 3 parts of marble chips to one part of cement by weight. The facing layer shall provide a minimum wearing thickness of 6 mm after grinding. Terrazzo bases (if required) shall be from the same mix, and shall be 100 x 20 mm thick, unless indicated otherwise on the drawings. Sizes shall be as indicated on drawings.

B. Poured in Place Terrazzo Floor: Same composition as precast terrazzo tiles.

2.2. DIVIDER STRIPS (WHERE REQUIRED):

A. Divider strips, where required, shall be of white alloy zinc or half-hard brass, angle or "T" type for adhesive bonding to substrate.

2.3. SEALER:

A. Interior floor penetrating sealer shall be colorless, slip and stain resistance which will not affect color and physical properties of terrazzo surface.

2.4. COLORANTS (IF REQUIRED): Alkali-resistant color stable pigments.

2.5. CLEANER:

A. pH factor between 7 and 10.

B. Shall not discolor or amber.

C. Biodegradable and phosphate free.

2.6. CURING MATERIALS: Water, Wet Sand, or Polyethylene Sheeting.

2.7. MORTAR AND GROUT:

A. Materials shall conform to ANSI A108.1 and A108.2. Mixture of Portland cement and sand for floors shall be roughly in proportions of 1:6, and for walls shall be Portland cement, sand, and hydrated lime in proportions of 1:5:1/2 to 1:7:1.

3. PART 2 - EXECUTION

3.1 UNDERBED:

A. Underbed shall be composition of one part Portland cement to 4 to 5 parts sand with sufficient water to provide workability at as low a slump as possible.

B. Bed shall be screeded to a level true plane, pitching to drain where required.

3.2 INSTALLATION OF PRECAST TERRAZZO TILES:

A. Precast units shall be set on underbed.

B. Joints shall be raked to depth of at least 19 mm and shall be pointed with a grout matching the color of the matrix.

C. Final installation shall be level and true to grade without projecting edges and corners.

3.3 INSTALLATION OF POURED IN PLACE TERRAZZO:

A. Underbed:

1. Thoroughly saturate concrete substrate with water, slush and broom with neat cement slurry.
2. Place concrete underbed.
3. Screed underbed to 13 mm below finished elevation or slope.
4. Install divider strips as shown on drawings in semi-plastic underbed.

B. Placing Terrazzo

1. Slush underbed with neat cement slurry same color as specified for the topping.
2. Broom slurry into underbed surface.
3. Place terrazzo mixture in panels formed by divider strips as detailed on drawings. Trowel mixture to level of top of strips.
4. Roll and compact surface until excess cement and water has been extracted.
5. Trowel to a dense uniform flat surface disclosing lines of divider strips.

C. Curing:

1. After completing placement of terrazzo and composition has sufficiently set, cover with water, wet sand or polyethylene sheeting.
2. Cure until topping develops sufficient strength to prevent lifting or pulling of terrazzo chips during grinding.

D. Finishing:

1. Rough Grinding:
   a. Grind with 24 or finer grit stones or with comparable diamond plates.
   b. Follow initial grind with 80 or finer grit stones.

2. Grouting:

   a. Cleanse terrazzo with clean water and rinse.

   b. Remove excess rinse water and hand apply grout using identical Portland cement, color pigments as used in topping, taking care to fill voids.

3. Cure Grout.

4. Fine Grouting:

   a. Grind with 80 or finer grit stones until all grout is removed from surface.

   b. Upon completion, terrazzo shall show minimum of 70% of marble chips.

3.4 CLEANING, SEALING AND PROTECTION:

A. Clean terrazzo after installation and finishing operation are completed, complying with sealer manufacturer's instruction.

B. Apply sealer to cleaned terrazzo surfaces in accordance with the sealer manufacturer's instruction.

C. Protect terrazzo from damage and wear during construction operation.

D. When building is ready for occupancy, clean and machine buff terrazzo as recommended by the sealer manufacturer.

END OF SECTION

SECTION 09510

ACOUSTICAL CEILING

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grid suspension system for acoustical ceiling.

B. Mineral fiber acoustical ceiling tiles as shown on the Drawings and as specified herein.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM A 446	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural Quantity
ASTM A 525	Steel Sheet Zinc-Coated (Galvanized) by Hot-Dip Process
ASTM A 614	Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C 423	Test for Sound Absorption of Acoustical Materials in Reverberation Rooms
ASTM C 523	Light Reflectance of Acoustical Material
ASTM E 90	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 84	Test for Surface Burning Characteristics of Building Materials
ASTM C 635	Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	Recommended Practice for Installation of Metal Ceiling Suspension System for Acoustical Tile and Lay-In Panels
ASTM C 637	Tests for Strength Properties of Prefabricated Architectural Acoustical Materials

B. UL - Underwriters Laboratories, Inc.

UL Fire Resistance Directory, 1989 Edition

1.3 SUBMITTALS

A. Samples of grid system components and ceiling tiles.

B. Certification that the components meet the requirements and tests specified.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in fully enclosed space where they will be protected against damage from humidity, direct sun light, surface contamination, and other causes. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.5 WARRANTY

A. Submit written guarantee signed by the contractor and manufacturer for 1 year from the date of substantial handover. Guarantee shall cover repair and replacement of defective material and workmanship.

1.6 QUALITY ASSURANCE

A. Engage an experience installer who has successfully completed acoustical ceilings similar in material, design and extent to that indicated for the Project.

1.7 PROJECT CONDITIONS

A. Do not install acoustical materials unless temperature and humidity conditions closely approximate the interior conditions which will exist when the building is occupied. Maintain temperature and humidity conditions during and after installation. Plastering, concrete and terrazzo work (including grinding) shall be completely dry. Windows and doors shall be in place and glazed.

2. PART 2 - PRODUCTS

2.1. SUSPENSION SYSTEM

A. Suspension System: Manufacturer's standard exposed grid system designed and fabricated to meet requirements of ASTM C 635 with UL classification as approved by the Engineer.

B. Materials: Double-web, cold-rolled electro-galvanized steel with the following features:

- Face Dimension: 15/16"
- Profile: Exposed Tee
- Color: As selected by the Engineer from the Manufacturer's standard range of products
- Finish: Baked polyester paint

C. Hanger Wires: Galvanized steel wires, pre-stretched, 2.8 mm diameter.

D. Hanger Wire Anchors: Drill-in type as approved by the Engineer.

E. Accessories: Edge Moldings, hold-down clips and other necessary accessories shall be provided in accordance with the Engineer's selection and approval.

2.2. ACOUSTICAL CEILING TILES

A. General: Refer to I.D. drawings and specifications for selection of acoustical tiles.

B. Tile Construction: Wet-formed mineral fiber composition conforming to ASTM E 1264 or Federal Specifications FS-SS-S-118B, Type III, form 1 units; Class A with an STC Range from 35 - 40; Flame Spread of 0 - 25 and Smoke Developed 0 - 50 in accordance with ASTM E 84.

- Profiles: Square-cut and Beveled Tegular, lay-in type.
- Sizes: 600 x 600 mm as indicated on Drawings.
- Thickness: Not less than 19 mm.
- Finish: Factory-applied washable white finish with light reflectance value of LR-1 (over 75 percent).

B. Access Hatches: Provide manufacturer standard access hatches which are designed specially for the acoustical ceiling systems. Provide the access hatches with complete features including door locks, frames, pivots, metal trims and gaskets.

3. PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation of all exposed grid acoustical work covered in this section shall be done by a qualified acoustical subcontractor recommended by the manufacturer, having at least 5 years experience in successfully completed projects.

3.2 SUSPENSION SYSTEM

A. Installation of suspension system shall be in accordance with ASTM C 636 and in accordance with manufacturer's directions.

B. Rough Suspension:

1. Space hanger wires at 1200 mm on centers, each direction. Supported from structural angle runners by looping and wire-tying.
2. Hangers shall be installed at ends of each suspension member and at light fixtures, 150 mm from vertical surfaces.
3. Wires shall not be splayed more than 125 mm in a 1200 mm vertical drop.
4. Wire shall be wrapped a minimum of three times horizontally, turning the ends upward.

C. System shall be level within tolerance specified and parallel with walls.

D. Wall moldings shall be installed at intersection of suspended ceiling an vertical surfaces.

1. Corners shall be mitered where wall moldings intersect or corner caps shall be installed in lieu thereof.
2. Continuous ribbon of acoustical adhesive or caulking compound shall be applied on vertical web.

3. Attachment to vertical surface shall be by means of mechanical fasteners.

3.3 CEILING TILES

A. Installation of acoustical ceilings shall not begin until the building has been closed to weather with Relative Humidity not more than 70 percent.

B. Ceiling tiles shall be in a leveled plane and in straight line courses.

C. Provide cutting and patching for the passage of materials of other trades.

3.4 CLEANING

A. Clean exposed surfaces of acoustical ceiling including trims, edges, moldings and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09600

STONEWORK

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Marble for floors, wall, base, countertops, thresholds and accessories including matching base.

B. Granite for floors, wall, base and countertops including matching base.

C. Granite for external paving, steps, banding and edging.

D. Anchors and attachments, setting materials, grouts, and accessories related to stone works.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for the type of stone as well as accessories and other manufactured products required.

B. Samples: Submit samples in the form of sets for each color, grade, finish, type and variety of materials required. Sample size shall be 600 x 600 mm. Include 2 or more samples in each set showing full range of variations in appearance and characteristics to be expected in the completed work also submit samples of fixing devices and joint sealants for the approval of the Engineer.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect stone, mortar materials and accessories during storage and construction against moisture, soiling, staining and physical damage.

B. Handle stone in a manner to prevent chipping, breakage, soiling or any other damage.

C. Store stone on wood skids or pallets covered with a waterproof non-staining membrane.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each color, grade, finish, type and variety of stone from a single quarry, approved by the Engineer.

B. Execute the work under this Section through a specialized firm approved by the Engineer and having at least 5 years experience in successful projects.

2. PART 2 - PRODUCTS

2.1 MARBLE

A. General: Type, Color, Texture, Size and Finish of Marble: Refer to I.D. drawings and specifications for selections of marble stones.

B. Marble - Marble for flooring shall be cut from sound stock with even texture, shade, marking, free from imperfections and as approved by the Engineer.

1. Nominal Thickness: 30 mm thick unless otherwise indicated on drawings.

2. Provide marble cut from sound stock with even texture, shade and marking, and free from imperfections.

3. Finish: Polished.

C. Marble for Wall Cladding and Bases : (Unless otherwise indicated on Drawings, marble shall be 20 mm thick, length and width dimensions of individual slabs within plus or minus 1 mm, thickness within 2 mm from those specified.

D. Marble for Stair Treads and Risers: Unless otherwise indicated on Drawings, marble shall be 30 mm for treads with non-slip nosing and 20 mm for risers.

E. Marble for Countertop: Unless otherwise indicated on Drawings, countertops shall be 30 mm thick with 20 mm thick apron and backsplash, as shown on Drawings.

F. Marble for Thresholds: Unless otherwise indicated on Drawings, thresholds shall be not less than 30 mm thick with dimensions as shown on Drawings.

2.2 GRANITE

A. Granite - General:

1. Type, Size, Color, Texture and Finish: Refer to I.D. drawings and specifications for selection of granite stones.

2. Provide granite of the highest density available for the particular type selected, free from imperfections and even texture.

3. Obtain granite from one quarry with consistent color range and texture throughout the work.

4. Nominal Thickness: 20 mm thick unless otherwise indicated on drawings.

5. Provide granite cut from sound stock with even texture, shade and marking, and free from imperfections.

B. Provide granite to the shapes and sizes indicated on the Drawings with length and width dimensions of each individual slab within plus or minus 1 mm and thickness within 2 mm from those specified.

C. Unless otherwise indicated, granite tiles thickness for wall cladding bases and floor tiles shall be 20 mm.

D. Granite for stair treads and risers shall be of sizes as indicated on Drawings, thickness not less than 30 mm for treads with non-slip nosing and 20 mm for risers.

E. Granite for external paving and edging for precast concrete pavers shall be not less than 20 mm thick except for driveways which shall be 30 mm thick laid over 150 mm thick cast-in-place reinforced concrete base. For banding and edging where shown on drawings, granite shall be 20 mm thick.

F. Granite for Counter Tops and Cladding: Unless otherwise indicated on Drawings, countertops shall be 30 mm thick with exposed edges rounded and polished; and minimum 20 mm thick for cladding, as shown on Drawings.

G. Granite shall be laid with matching grain and color and pattern shown on drawings.

2.3 LASBELLA STONE

A. Description Beige hard stone, 97 percent or more calcium carbonate. Type, texture, color, size and pattern shall be as shown on drawings and approved by the Engineer. Physical properties shall include:

1. Density: Not less than 2000 kg/cm^3.

2. Modulus of Rupture: Tested in compliance with ASTM C99-90, minimum 300 kg/cm^2.

3. Water Absorption: Tested in accordance with ASTM C97-90, maximum 1.5 percent.

4. Abrasion: Tested in compliance with DIN 100/52, maximum 12 cm^3/5cm^2.

5. Dimension: As indicated on drawings.

2.4 MISCELLANEOUS MATERIALS

A. Setting Materials:

1. Portland Cement: ASTM C 150, Type I, except complying with staining requirements of ASTM C 91 for not more than 0.03 percent water soluble alkali.

2. Hydrated Lime: ASTM C 207, Type S.

3. Aggregate: ASTM C 144, non-staining, except graded with 100 percent passing the No. 16 sieve for 6 mm and narrower joints.

a. For white pointing mortar and grout, use natural white sand or ground white stone.

b. For colored aggregate pointing mortar and grout, use fine aggregate produced from natural sands or ground stone including marble, granite or other sound stone as selected to produce mortar color indicated.

4. Water: Potable, clear and free from deleterious materials which would impair the work.

B. Grouts:

1. Ready mixed, cement based, consisting of cement, carefully selected fillers and additives to provide workability. Grouts shall have good adhesion to dry stone pieces and shall be so formulated to avoid drying, shrinkage and cracking.

   Mixing shall be in accordance with the manufacturer's instructions. Color and shade of grouts shall be as directed by the Engineer.

A. Control Joints:

1. Form control joints to allow for movement in the floor at locations recommended by the manufacturer or as directed by the Engineer. Fill control joints with elastomeric material recommended by the manufacturer. No control joints material shall be allowed to project above the finished surface level.

B. Anchors and Attachments:

1. Provide required anchors and attachments of type and size to support the tiles from the following metals for conditions and anchors indicated below:

   a. Stainless Steel for Wall Cladding: Type 304, for anchors, dowels and clamps in direct contact with stone.

   b. Cast or Malleable Iron: For adjustable inserts embedded in concrete and not in direct contact with stone.

   c. Hot-Dip Galvanized Steel: For anchor bolts, nuts and washers not in direct contact with stone; comply with ASTM A 307, Grade A, for material and ASTM C 153, Class C for galvanizing. For steel plates shapes and bars not in direct contact with stone; comply with ASTM A 36 for material and ASTM A 123 for galvanizing. Fixing devices shall be provided by a specialized firm as approved by the Engineer.

2. Dove-tail Slots: Where indicated, furnish dove-tail slots with filler strips, of slot size required to receive anchors provided, fabricated from gage 22 galvanized sheet steel complying with ASTM A 446, Designation G-90.

C. Accessories:

1. Setting Buttons: Resilient plastic buttons, with no staining effect on the tiles, sized to suit joint thickness and bed depth of stone work involved without intruding into required depths of joint sealants or causing third-side adhesion between sealant an setting button.

2. Sealer for Floors: Colorless, slip and stain resistant sealer which will not affect color or physical properties of stone surface, as recommended by sealer and by stone manufacturer for application indicated.

3. Cleaner: Provide cleaners of proper formulation for kinds of stone, finishes and applications indicated, as recommended by the stone manufacturer and if sealer specified by sealer manufacturer. Do not use acid-type cleaning agents or other

cleaning compounds containing caustic or harsh fillers except where expressly approved by the stone manufacturer for type of condition involved.

2.5 FABRICATION

A. Fabricate as shown and as detailed on approved shop drawings. Provide holes and sinkages, cut or drilled for anchors, fasteners, supports and lifting devices, as shown and as necessary to secure stone work in place.

B. Contiguous Work: Provide reveals, openings and similar spaces and features as required for contiguous work also coordinate with Drawings and approved shop drawings showing contiguous work.

C. Cut accurately to shape and dimension shown on the shop drawings. Dress joints straight and at right angles to face, unless otherwise indicated. Cut to provide joint width as shown on the Drawings or as directed by the Engineer. Field cutting is not allowed.

D. Pattern Arrangement: Fabricate stone to the patterns indicated on Drawings and in accordance with approved shop drawings.

3. PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Clean stone before setting by scrubbing with fiber brushes and thoroughly drenched with water.

B. Stone work shall be done by experienced workmen of the trade employing skilled stone fitters at the site for necessary field cutting as stone is set.

C. Where stone will come in contact with ferrous metal surfaces, apply an approved anti-corrosion paint on the metal surfaces prior to setting as well as using approved rust inhibitors as pre-primers after primary preparation.

D. Set stone work in accordance with Drawings and approved shop drawings for the stone work and provide expansion joints where required.

E. Do not use stone units with chips, cracks, voids, stains or any other defects that might be visible in the finished work.

F. Expansion and Control Joints: Provide for expansion and control joints of width and at locations indicated, sealant material complying with the requirements of Section 07900 - SEALANTS.

3.2 INSTALLATION - WALL CLADDING

A. Support each stone with both gravity and lateral anchors of type and number indicated complying with the requirements indicated for material and performance.

B. Attach anchors securely to stones and to back-up surfaces. Attach framing for stone support system to structural frame of building at connection points indicated by welded or bolted

field connections.

C. Where required, fill anchor holes with mortar and where dowel holes occur at pressure-relieving joints, provide compressive material above and below dowels.

D. Install concealed flashing at continuous shelf angles, lintels, ledges and similar obstructions to the downward flow of water so as to divert such water to the exterior.

E. Keep cavities open where unfilled space is indicated between back of stone and back-up wall. Do not fill cavities with mortar or grout unless otherwise indicated or directed by the Engineer.

F. Upon completion of work, apply joint sealants as per instructions and at locations shown on Drawings and as specified in Section 07900 - SEALANTS.

3.3 INSTALLATION - FLOORS

A. Setting of Floors in Portland Cement Mortar Bed:

1. Saturate concrete subfloor with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

2. Apply slush coat of cement grout over surface of concrete subfloor about 15 minutes prior to placing of setting bed. Limit area to avoid its drying out prior to placing of setting bed. Slush coat shall be properly mixed and shall not exceed the thickness of 1.5 mm.

3. Mix setting bed in proportions by volume of one part of cement to 3 parts of sand (measured in damp loose condition) to the quantity of water to produce a stiff mixture with a moist surface when setting bed is ready to receive flooring.

4. Spread and screed setting bed to uniform thickness indicated to produce sub-grade elevations required for accurate setting of tiles to finished floor elevations shown. Mix and place only the amount that can be covered with prior to initial set. Cut back, bevel edge, remove and discard setting bed which has reached initial set prior to the placing of tiles.

5. Butter backs of flooring units with skim coat of neat cement and water just prior to placing it on bed.

6. Tamp flooring units until firmly bedded to proper finished floor elevations indicated also set and level each unit in single operation. Do not return to areas already set and disturb for leveling purposes prior to initial set of cement bed.

B. Grouting - Floors

1. Mix grout in proportion, by volume of one part Portland cement to 2 parts fine aggregate (measured in damp loose conditions). Except for thin joints with fine sand, reduce fine aggregate proportion to one part. Add liquid admixtures in proportion and concentration as per manufacturer's recommendations. Select grout materials to match the approved samples.

2. Grout joints in flooring units, except at expansion and control joints indicated to be filled with sealant. Fill all gaps to produce a finished joint which is uniform in color, smooth and without voids, pinholes or low spots.

3. Remove grout spillage from face of stone as the work progresses.

4. Cure grout by maintaining in a moist condition for not less than 7 days.

3.4 REPAIR AND CLEANING

A. Units which are broken, chipped, stained or otherwise damaged shall be removed and replaced.

B. Clean stone work after completion using clean water and stiff bristle brushes. Do not use wire brushes, acid type cleaning agents or compounds with caustic or harsh fillers.

C. Apply sealer to cleaned interior flooring in compliance with sealer manufacturer's instructions.

3.5 PROTECTION

A. Provide proper procedures to protect the stone work from collapse, deterioration, discoloration or damage during construction and until the acceptance of work.

END OF SECTION

SECTION 09680

CARPET

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall-to-wall carpet and the accessories as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. AATCC - American Association of Textile Colorists and Chemists

AATCC 30 - Anti-Fungal Activity Assessment on Textile Materials; Mildew and Rot Resistance of Textile Materials.

AATCC 100 - Assessment of Anti-Bacterial Finishes on Textile Materials.

AATCC 134 - Electrostatic Propensity of Carpets.

B. CCC - Carpet Cushion Council

Traffic Classifications - 1990

C. ASTM - American Society for Testing and Materials

ASTM C 423 - Test Method for Sound Absorption of Acoustical Materials by Reverberation Room Method.

ASTM D 1335 - Test Method for Tuft Bind of Pile Floor Coverings.

ASTM D 2859 - Test Method for Flammability of Finished Textile Floor Covering Materials.

ASTM D 3574 - Method of Testing Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.

ASTM E 648 - Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

ASTM E 662 - Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

D. DOC - Federal Standard, Department of Commerce

FF 1-70 - Methenamine Pill Test.

E. UL - Underwriters Laboratories

UL 992 - Smoke Chamber Test.

F. NFPA - National Fire Protection Association

NFPA 253 - Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

NFPA 255 - Test Method for Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

A. Product data for each type of carpet material and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading, and flame resistance and smoke development characteristics.

B. Shop drawings showing layout and seaming diagrams. Indicate pile or pattern direction and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Show installation details at special condition.

C. Submit 400 x 400 mm samples of each type, color, texture, and pattern of carpet to be used for the work.

D. Manufacturer's standard color chart.

E. Certificate of compliance.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials to project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.

B. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 20 degree C at least three days prior to and during installation in area where materials are stored.

1.5 WARRANTY

A. Submit a written 1 year guarantee, starting from substantial handover of project, for all items specified under this section, signed by manufacturer and the Contractor, against defective material and workmanship.

1.6 QUALITY ASSURANCE

A. Installer: Carpet installer shall have at least five years successful experience in carpet installation similar in size and type to the installation for this Project. Installer shall be subject to approval of the Engineer.

B. Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction.

Identify carpet with appropriate markings of applicable testing and inspecting organization.

- Test Method: DOC FF 1-70
  Rating: Pass
- Test Method: ASTM E 84
  Flame Spread: 75 or less
  Smoke Developed: 450 or less

C. Dimensional Stability: Maximum variance not exceeding plus or minus 0.02 percent.

1.7 PROJECT CONDITIONS

A. Substrate: Examine the substrate and conditions under which the carpet is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Protection: Protect carpet from soiling and damage during transit, storage, and installation.

C. Temperature: Temperature in the area to be carpeted shall be within the manufacturer's recommended range.

2. PART 2 - PRODUCTS

2.1 MATERIALS

A. Woolen Carpet - General:

1. Type, Pattern, Color and Construction: To be approved by the Engineer.

B. Accessories:

1. Carpet Edge Guard: Aluminum with fold down edge and concealed griper teeth; minimum 35 mm wide punched anchorage flange, anodized aluminum finish.

2. Seaming Tape: Hot-melt adhesive tape as recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and prevent pile loss at seams.

3. Adhesives: Water resistant, non-staining and as recommended by the carpet manufacturer to comply with the flammability requirements of the installed carpet.

C. Concrete Screed: Refer to Section 09200 – LATH AND PLASTER.

3. PART 3 - EXECUTION

3.1 PREPARATION

A. Measurement: Measure each space to receive carpet as a basis of supplying and cutting the carpet. Do not scale Drawings or calculate sizes from dimensions shown.

B. Patch holes and cracks, and level to a smooth surface. Seal powdery or porous surfaces with sealer recommended by carpet manufacturer.

C. Vacuuming: Immediately prior to carpet installation, vacuum substrate and remove all

deleterious substances which would interfere with the installation or be harmful to the work.

D. Substrate: Prior to installation of the carpet, ascertain that floors are completely dry to prevent accumulation of moisture under carpet, and that the temperature of the premises is proper to prevent sag, buckle, and shrinkage of carpet after installation.

3.2 INSTALLATION

A. Comply with manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame, in direction of traffic through doorway. Do not bridge building expansion joints with continuous carpet.

B. Carpet shall be installed on concrete screed as shown on drawings.

C. Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.

D. Provide cutouts where required, and bind cut edges where not concealed by protective edge guards or overlapping flanges.

E. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

F. Install carpet by trimming edges, butting cuts with seaming tape to provide sufficient strength for stretching where carpet length is greater than 20 feet.

G. Stretch carpet to provide smooth, ripple-free, taut, trim edges; secure to stripping and conceal behind edge of stripping. Use power stretcher where carpet length is greater than 20 feet.

H. For bonded application, glue carpet to substrate using approved adhesive materials, in accordance with the manufacturer recommendations.

I. Fit sections of carpet prior to application of adhesive. Trim edges and butt cuts with seaming tape. Apply adhesive uniformly to substrate in accordance with carpet manufacturer's written instructions. Butt edges tight to form seams without gaps. Roll entire area lightly to eliminate air pockets and ensure uniform bond.

3.3 CLEANING

A. Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.

B. Remove and dispose of debris and unusable scraps. Vacuum with commercial machine with face-beater element. Remove soil. Replace carpet where soil cannot be removed. Remove protruding face yarn.

C. Vacuum clean carpet.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and the Engineer, to ensure carpet is not damaged or deteriorated at time of Substantial Completion.

END OF SECTION

SECTION 09900

PAINTING

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Painting materials complete with primers, sealers, stains applied for exterior and interior areas as indicated on Drawings and as specified herein.

1.2 REFERENCES

A. FS - Federal Specifications

P-W-158E - Wax, General Purpose, Solvent Type

TT-E-489G - Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)

TT-E-506K - Enamel, Alkyd, Gloss, Tints and White (for Interior Use)

TT-E-509B(2) - Enamel, Odorless, Alkyd, Interior, Semi-gloss, White and Tints

TT-E-527C - Enamel, Alkyd, Lusterless

TT-E-543A(1) - Enamel, Interior, Undercoat, White and Tints

TT-F-336E - Filler, Wood, Paste

TT-P-19C(2) - Paint, Acrylic Emulsion; Exterior

TT-P-25E(2) - Primer Coating Exterior (undercoat for Wood, Ready-Mixed, White and Tints)

TT-P-29J(1) - Paint, Latex Base, Interior, Flat, White and Tints

TT-P-30E - Paint, Alkyd, Odorless, Interior, Flat, White and Tints

TT-P-37D - Paint, Alkyd Resin; Exterior Trim, Deep Colors

TT-P-52D(2) - Paint, Oil, (Alkyd-Oil) Wood Shakes and Rough Siding

TT-P-55B(2) - Paint, Polyvinyl Emulsion, Exterior

TT-P-81E - Paint, Oil, Alkyd, Ready-Mixed, Medium Shades

TT-P-641G(1) - Primer Coating; Zinc Dust-Zinc Oxide (for Galvanized Surfaces)

TT-P-645A - Primer Paint, Zinc Chromate, Alkyd Type

TT-P-650C(1) - Primer Coating; Zinc Dust-Zinc Oxide (for Galvanized Surfaces)

TT-P-664C(2) - Primer Coating, Synthetic, Rust-Inhibiting, Lacquer Resisting

TT-S-176E(1) - Sealer, Surface, Varnish Type, Floor, Wood and Cork

TT-S-300A - Shellac, Cut

TT-S-708A(2) - Stain, Oil, Semi-Transparent, Wood, Exterior

TT-S-711C - Stain, Oil-Type, Wood, Interior

TT-V-86C(1) - Varnish, Oil, Rubbing (for Metal and Wood Furniture)

B. SSPC - Steel Structures Painting Council

SP-6-63 - Commercial Blast Cleaning

SP-10-63T - Near-White Blast Cleaning

C. ASTM - American Society for Testing and Materials

ASTM D 16 - Standard Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products

ASTM D 562 - Consistency of Paints Using the Stromer Viscometer

ASTM D 2833 - Standard Index of Methods for Testing Architectural Paints and Coatings

ASTM D 3276 - Standard Guide for Painting Inspectors (Metal Substrates)

ASTM D 3927 - Standard Guide for State and Institutional Purchasing of Plant

ASTM E 84 - Surface Burning Characteristics of Building Material

1.3 SUBMITTALS

A. Product Data: Submit manufacturers technical information including instructions for thinning, mixing, curing and touch-up.

B. Manufacturer's standard color charts.

C. Test Reports and certificates of compliance.

D. Samples: Prior to beginning work, furnish color chips for surfaces to be painted. Submit samples for the Engineer review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

1. On 300 mm x 300 mm hardboard, provide 2 samples of each color and material, with texture to simulate actual conditions. Re-submit samples as requested by Engineer until acceptable sheen, color and texture is achieved.

2. On wood surfaces, provide 2 samples 100 x 200 mm of natural and stained wood finish on actual wood types. Label and identify each as to location and application.

3. On concrete masonry, provide two 100 mm square samples of masonry for each type of finish and color, defining filler, prime and finish coat.

4. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. Provide full-coat finish samples on at least 9 m² of surface, as direct, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.

5. Final acceptance of colors will be from samples applied on the job.

1.4 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials to job site in manufacturer's original new and unopened packages and containers bearing manufacturer's name and label, and following information:

- Name or title of material.
- Manufacturer's stock number and date of manufacture.
- Manufacturer's name.
- Contents by volume, for major pigment and vehicle constituents.
- Thinning instructions.
- Application instructions.
- Color name and number.

B. Store materials not in actual use in tightly covered containers in a well-ventilated area and protect from moisture, direct sunlight and temperatures below 10ºC and above limits recommended by the manufacturer. Maintain containers used in storage of paint in clean conditions, free of foreign materials and residue.

C. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

C. Material Quality: Provide manufacturer's best quality trade sale paint material of various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1.6 JOB CONDITIONS

A. Do not paint when air is dust-laden or when weather and temperature conditions are unsuitable. Do not paint exterior surfaces in damp or rainy weather. Comply with manufacturer's recommendations with respect to application and drying period

temperatures.

B. Apply water-based paints only when temperature of surfaces to be painted and surrounding air temperatures are between 10ºC and 32ºC, unless otherwise permitted by paint manufacturer's printed instructions.

C. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 7ºC and 35ºC, unless otherwise permitted by paint manufacturer's printed instructions.

D. Do not apply paint when relative humidity exceeds 85% or to damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.

2. PART 2 - PRODUCTS

2.1 MATERIALS

A. General: For type of paint, texture and color, refer to Interior Design (I.D.) drawings and specifications.

B. Material Quality: Paints, coatings, and primers shall be ready-mixed at the manufacturer's plant and shall be delivered in sealed containers, labeled and identified. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Paints and finishes shall have Class A rating in accordance with ASTM E 84. Materials without manufacturer's identification as a standard, best-grade product will not be acceptable. Use products of same manufacturer for succeeding coats.

C. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

D. Color and Texture:

1. Exterior Painting: Color and texture of the exterior paint shall be as indicated on Drawings.

2. Interior Painting: Colors, textures, and degree of luster will be as indicated on I.D. drawings and specifications. Color selection will include safety colors for hazards in accordance with ANSI Z53.1 Safety Color Code for Marking Physical Hazards. Tint prime and undercoats approximately to the shade of the final coat but with sufficient variation to distinguish them from the preceding coat.

D. Mildewcide: Paints shall contain a mildewcide as recommended by the manufacturer.

E. Solvents and Thinners: As recommended by the paint manufacturer.

2.2 PAINTING SCHEDULE

A. Exterior Paint Schedule:

1. Concrete, Plaster, and Masonry - Smooth:

a. Prime Coat : Acrylic Solvent Based Primer.
b. Second Coat: Acrylic Copolymer Emulsion, Total Dry Film Thickness (DFT)

25 micron.

c. Finish Coat: Same as for Second Coat.

2. Concrete, Plaster, and Masonry - Textured:

a. Prime Coat : Acrylic Solvent Based Primer.
b. Second Coat: Acrylic Copolymer Emulsion (Sprayed Applied), Dry Film Thickness (DFT) 50 micron.
c. Finish Coat: Acrylic Copolymer Emulsion Dry Film Thickness (DFT) 50 micron.

3. Waterproof Painting System:

a. Proprietary coating system consisting of synthetic rubber copolymer and suitable for external exposed application.

b. Prime coats and finish coat shall be applied as per the manufacturer's written recommendations for the intended application.

4. Ferrous Metals:

a. Prime Coat : Polyamide Cured Epoxy Primer, 50 micron (DFT).
b. Second Coat: High Build Epoxy, 125 micron thick (DFT).
c. Finish Coat: Two-Component Polyurethane, semi-gloss, 50 micron (DFT).

5. Zinc-Coated Metals:

a. Prime Coat : Acrylic Water Based Primer for GI.
b. Second Coat: Alkyd Enamel, semi-gloss, 30 micron (DFT).
c. Finish Coat: Same as for second coat.

6. Painted Wood:

a. Prime Coat: Alkyd Wood Primer + Wood Filler.
b. Second Coat: Alkyd Enamel, semi-gloss, 30 micron (DFT).
c. Finish Coat: Same as for second coat.

7. Natural Finish Wood:

a. Prime Coat: Alkyd Wood Stain.
b. Second Coat: Lacquer, semi-gloss, 25 micron (DFT).
c. Third Coat: Same as for second coat.
d. Finish Coat: Same as for second coat.

B. Interior Paint Schedule:

1. Concrete, Plaster, Gypsum Board, Reinforced Decorative Gypsum and Masonry:

a. Prime Coat: Acrylic Solvent Based Primer, flat.
b. Second Coat: Acrylic Emulsion, eggshell, Dry Film Thickness 25 micron (DFT).

c. Finish Coat: Same as for second coat.

2. Ferrous Metals:

a. Prime Coat: Alkyd Primer.
b. Second Coat: Alkyd Enamel, semi-gloss, 30 micron (DFT).
c. Finish Coat: Same as for second coat.

3. Zinc-Coated Metals:

a. Same as specified for Exterior Paint Schedule.

4. Painted and Natural Finish Wood:

a. Prime Coat: Alkyd Wood Stain.
b. Second Coat: Lacquer, semi-gloss, 25 micron (DFT).
c. Third Coat: Same as for second coat.
d. Finish Coat: Same as for second coat.

5. Exposed Pipes, Ducts, and Metal work:

a. Prime Coat: Alkyd Primer.
b. Second Coat: Alkyd Enamel, semi-gloss, 30 micron (DFT).
c. Finish Coat: Same as for second coat.

6. Intumescent Coating for Steel Structures: Refer to Section 07270 - FIRESTOPPING.

3. PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrate and conditions under which painting will be performed. Proceed with the work only when conditions are satisfactory.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

A. General:

1. Remove hardware and accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

2. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

3. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

4. Fill dents, cracks, hollow places, open joints, and other irregularities with a filler suitable for the purpose and, after setting sand to a smooth finish.

5. Prime surfaces not more than 8 hours after cleaning. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Engineer in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

B. Concrete, Masonry and Plaster Works: Prepare surfaces of concrete, concrete masonry cement plaster and gypsum plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze. Use abrasive blast-cleaning methods if recommended by paint manufacturer and approved by Engineer.

1. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

2. Clean concrete floor surfaces scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

C. Gypsum Board: Repair minor cracks and holes with finishing compound, and sand smooth after drying.

D. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended know sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

E. Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop coated; remove mortar, plaster, grease, dirt, rust, loose mill scale and other foreign substances by solvent or mechanical cleaning methods that comply with the recommendations of the Steel Structures Painting Council, before priming coat is applied.

F. Shop-Primed Ferrous Surfaces: Remove grease, oil and other foreign substances with approved type of cleaner manufactured for the purpose. Exercise care to prevent damage to shop coat. Touch-up abraded or marred shop coats with paint used for priming.

G. Zinc-Coated (Galvanized) Surfaces: Remove grease and oil with a cleaner manufactured for the purpose. Treat surfaces with a chemical compound such as a phosphoric acid wash. Remove the chemical compound completely with clean, fresh water.

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Maintain containers used in mixing and application of paint in clean condition, free of foreign materials and residue.

C. Stir materials before application to produce mixture of uniform density, stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.4 APPLICATION

A. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied. Do not exceed manufacturers recommended coverage per gallon. Apply materials with care to a uniform and proper film thickness, showing no runs, holidays, sags, crawls, or other defects. Apply with a minimum of brush marks. Finish surfaces shall be uniform in sheen, color and texture and match approved samples.

B. Allow coats to dry thoroughly before succeeding coats are applied; allow a minimum of 24 hours between applications on any one surface unless otherwise specified by the paint materials manufacturer.

C. Sandpaper undercoats on interior metal thoroughly and uniformly to provide a smooth, even surface for finish coats.

D. Apply paint by brush, roller, spray, or other acceptable practice in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high-pile sheep wool as recommended by the paint manufacturer for material and texture required.

E. Brush-out and work all brush coats into the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Neatly draw all primer or first coats, unless otherwise permitted to use mechanical applicators.

F. Except as otherwise specified, apply a prime coat to material that is required to be painted or finished.

G. Apply the first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

H. Number of coats and paint film thickness required is the same regardless of the application method. Sand between each enamel and varnish coat application with fine sandpaper or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the paint manufacturer's directions.

I. Allow sufficient time between successive coatings to permit thorough drying. Do not re-coat until paint does not deform or feel sticky under moderate thumb pressure and the application of loss of adhesion of the undercoat.

J. Paint type, color, surface treatment shall be as scheduled. Provide finish coats that are compatible with prime paints used.

K. When undercoats, stains, or other conditions show through the final coat of paint, apply additional coats until the paint film is of uniform finish, color and appearance. Insure that all surfaces including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

L. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only. Exposed surfaces are defined as those areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles and similar items are in place in areas scheduled to be painted.

M. Where visible through registers or grilles, paint interior surfaces of ducts and void spaces with a flat, non-specular black paint.

N. Paint the back sides of access panels and removable or hinged covers to match the exposed surfaces.

O. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.

P. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

Q. Dry Film Thickness: Provide dry film thickness for each finish type, including prime and finish coats, not less than total dry film thickness as specified in painting schedule.

R. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surfaces imperfections.

S. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable.

T. Transparent (Clear) Finishes: Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats, unless otherwise indicated.

U. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or re-paint work not in compliance with specified requirements.

3.5 CLEAN-UP AND PROTECTION

A. Clean-Up:

1. During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

2. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch otherwise damage finished surfaces.

B. Protection:

1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and re-painting, as acceptable by the Engineer.

2. Provide Wet Paint signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

3. At completion of work of other trades, touch-up and restore damaged and/or defaced surfaces.

END OF SECTION

SECTION 09955

WALL COVERINGS

1. PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation and prime painting.

B. Vinyl and fabric wall coverings.

1.2 REFERENCES

A. ANSI/ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

B. FS CCC-W-408 - Wall Covering, Vinyl Coated.

C. FS L-P-1040 - Plastic Sheets and Strips, Poly Vinyl Chloride.

D. NFPA 255 - Test of Surface Burning Characteristics of Building Materials.

E. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing commercial wall fabrics with 5 years documented experience.

B. Applicator: Company specializing in installing wall fabrics with 5 years documented] experience and shall be as approved by wall covering manufacturer and the Engineer.

1.4 SUBMITTALS

A. Indicate on shop drawings, wall elevations with seaming layout.

B. Provide product data on wall covering, adhesive and manufacturer standard systems related to acoustic treatment or fabric installation.

C. Submit two samples of wall covering 600 x 600 mm in size illustrating color, finish, and texture.

D. Submit manufacturer's installation instructions and recommendations.

E. Submit manufacturer's certificate showing that products meet or exceed the specified requirements.

F. Submit test reports verifying flame/smoke ratings, when tested by UL or an agency approved by the Engineer.

1.5 FIELD MOCKUP

A. Provide a three panel field sample panel, full height, illustrating installed wall covering, joint seaming technique and panel system where applicable for each different type of installation.

B. Locate where directed by the Engineer.

C. Accepted sample may not remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials on site to verify acceptance.

B. Protect packaged adhesive from temperature cycling.

C. Storage and handling of wall coverings as well as the related materials shall be in accordance with the manufacturer recommendation. Do not store roll goods on end.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures at 18 degrees C, unless required otherwise by the manufacturer instructions.

B. Do not apply adhesive when substrate surface temperature, ambient temperature or humidity are not within the acceptable conditions recommended by the manufacturer.

C. Maintain those conditions 24 hours before, during, and after installation of adhesive wall covering.

D. Provide a minimum lighting level of 860 lx measured mid-height at substrate surfaces.

2. PART 2 - PRODUCTS

2.1 MATERIALS

A. Vinyl Wall Covering:

1. General: For selection of vinyl wall covering refer to I.D. drawings and specifications.

2. Type: FS CCC-W-408A, Type III heavy duty wall covering.

3. Stain Resistance: Factory applied polyvinyl fluoride or polymer coating.

4. Backing Materials: As recommended by wall covering manufacturer.

B. Fabric Wall Covering

1. General: For selection of fabric wall covering refer to I.D. drawings and specifications.

2. Complies with ASTM F 793 for Category III.

3. Colors, Textures and Patterns: Refer to I.D. drawings and specifications.

4. Backing Materials: Acrylic.

C. Accessories

1. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

2. Primer/Sealer: Mildew-resistant and recommended by wall covering manufacturer.

3. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall covering manufacturer.

4. Seam Tape: As recommended by wall covering manufacturer.

D. Substrate Filler: As recommended by adhesive and wall covering manufacturers, compatible with substrate.

3. PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that substrate surfaces are prime painted and ready to receive work, and conform to requirements of the wall covering and/or fabric manufacturer.

B. Verify flatness tolerance of surfaces does not vary more 3 mm in 3 m nor vary at a rate greater than 1.5 mm per 300 mm.

C. Beginning of installation means acceptance of existing surfaces and/or substrate.

3.2 PREPARATION

A. Fill cracks and smooth irregularities with filler; sand smooth.

B. Wash surfaces with a cleaning material recommended by manufacturer, rinse and neutralize; wipe dry.

C. Sand glossy surfaces. Shellac marks which may bleed.

D. Remove electrical, telephone, and wall plates and covers.

E. Vacuum clean surfaces free of loose particles.

F. Apply 2 coats of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth. Vacuum clean.

3.3 INSTALLATION OF WALL COVERINGS AND/0R WALL FABRIC PANELS

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Use wall covering in roll number sequence or in pattern sequence as required.
D. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface. Butt edges tight.

F. Horizontal seams are not acceptable.

G. Do not seam within 50 mm of internal corners or within 150 mm of external corners.

H. Install wall covering before installation of bases, cabinets, hardware, or items attached to or spaced slightly from wall surface. Do not install wall covering more than 6 mm below top of resilient base.

I. Cover spaces above and below windows, above doors, in pattern or sequence from roll.

J. Apply fabric covering to electrical, telephone and wall plates prior to replacing.

K. Where wall covering tucks into door frame reveals, or metal wallboard or plaster stops, apply covering with contact adhesive within 150 mm of wall covering termination. Ensure full contact bond.

L. Install termination trim as required.

M. Remove excess wet adhesive from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.4 CLEANING AND PROTECTION

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Replace wall plates and accessories removed prior to work of this Section.

C. Protect finished installation as directed by the Engineer.

END OF SECTION

DIVISION - 10

SPECIALTIES

SECTION 10615

DEMOUNTABLE PARTITION

I.PART 1 - GENERAL

1. SECTION INCLUDES

A. Demountable partitions and related accessories as shown on Drawings and as specified herein.

2. REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM A 27 - Steel Castings, Carbon, for General Application

ASTM A 36 - Structural Steel

ASTM C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials

ASTM E 90 Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

ASTM E 336 Test Method for Measurement of Airborne Sound Insulation in Buildings

ASTM E 413 Classification for Rating Sound Insulation

B. UL - Underwriters Laboratory

UL 723 Surface Burning Characteristics of Building Materials

C. NFPA - National Fire Protection Association

NFPA 255 - Surface Burning Characteristics of Building Materials

3. SUBMITTALS

A. Product data on physical characteristics, durability, resistance to fading, and flame spread characteristics for each type of partition and accessory specified.

B. Shop drawings showing location and extent of partition. Include plans, elevations, large-scale details of anchorages and accessory items. Indicate unit conditions at openings, typical and special details, location and installation requirements for hardware.

C. Product certificates signed by partition manufacturer certifying that products used comply with the specified requirements.

D. Acoustical certification from an independent testing agency stating showing compliance with specified requirements. Include certified laboratory testing data indicating that panel materials meet specified test requirements, STC and NRC ratings and weight of panel.

4. TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials to site in manufacturer's original factory wrappings and containers, clearly labeled for identification of manufacturer, brand name and contents.

B. Store panels on edges, blocked off ground to prevent sagging and warping in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling and extreme temperatures.

5. WARRANTY

A. Submit a written warranty signed by Manufacturer, Installer and Contractor agreeing to replace partitions which fail in material or workmanship within 2 years from date of substantial handing over.

6. QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain partitions, accessories and mounting hardware from one source from a single manufacturer.

B. Fire Performance: Partitions shall have flame spread of 25 or less and smoke development of 450 or less when tested in accordance with ASTM E 84.

C. Acoustical Performance: Partitions shall have a Sound Transmission Class (STC) rating of 42 when tested in accordance with ASTM E 90 and ASTM E 413.

II.PART 2 - PRODUCTS

1. MATERIALS

A. General: Entire installation shall be fully modular with flat panel surfaces and tight straight line joints. Partition construction shall permit 2-way, 3-way, 4-way or corner intersections made at any joint location, and shall permit the removal of any panel or door unit without disturbing the adjacent units. All units of like size shall be completely interchangeable. Panels shall be 100% reusable. Installation shall be free of exposed fasteners.

B. Demountable partitions shall be nominally 80 mm thick in manufacturer's standard width in accordance with the following requirements:

1. Panel Size: Panels shall be full height, size as shown on drawings.

2. Panel Construction: Panels shall be fabricated of 20 gauge roll-formed steel faces, internally reinforced with steel ribs to assure uniform thickness and flatness and insulated with 2-1/2 lb/m^3 density mineral wool sound insulation.

3. Glass and Glazing: Glass panels, where indicated on drawings, shall be set in vinyl glazing extrusions without exposed screws. Glass shall be minimum 6 mm thick

clear tempered glass complying with the requirements of Section 08800 - GLAZING.

4. Post Members: Posts shall be fabricated of 14 gauge roll-formed steel faces completely concealed. Posts shall extend to floor channel. Post covers shall snap onto the posts and form tight joins with adjacent panel faces.

5. Ceiling Trim: Recessed ceiling channel consisting of one-piece 18 gauge steel ceiling channel with built-in light and sound seal.

6. Panel Base: Panel base shall consist of continuous 18 gauge steel floor channel with built-in light and sound seal and continuous panel retainer flush with panel face. Snap-on baseboard trim matching with panel shall be readily removable from either side for insertion or access to lay-in wiring.

7. End Fillers: Partition end fillers connecting to fixed walls shall be 20 gauge double steel insulated sheets flush with panel face. End channels shall fit readily into wall channels with built-in light and sound seal securely fastened to building wall.

8. Electrical Provisions: Spaces for wiring shall be provided at base and ceiling members. Posts design shall permit wiring from either side of the partition. Panel bases shall pre-punched for installation of receptacles. Provide receptacles and raceways in partition base for power, telephone and data system as shown on drawings or as required.

9. Finish: Shall have manufacturer's standard baked polyester powder coated finish, color as shown on drawings or as approved by the Engineer.

III. PART 3 - EXECUTION

1. EXAMINATION

A. Examine flooring for compliance with requirements for installation tolerances and other conditions affecting performance of partitions. Do not proceed with the installation until unsatisfactory conditions have been corrected.

2. INSTALLATION

A. Install partitions after other finishing operations including painting, have been completed.

B. Partitions shall be installed by manufacturer or his authorized agent. Install partitions in conformance with Drawings and approved shop drawings and in strict compliance with manufacturer's written installation instructions.

C. Match partitions for color and pattern by installing partitions from cartons in same sequence as manufactured and packaged, if so numbered. Broken, cracked, chipped, or deformed partitions are not acceptable.

3. CLEANING AND ADJUSTING

A. Lubricate bearings and sliding parts; adjust to ensure smooth, easy operation.

B. Clean partition surfaces and adjacent surfaces soiled by work of this Section. Avoid use of abrasive cleaners or solutions containing corrosive solvents. Use cleaning materials and method as recommended by manufacturer.

END OF SECTION

SECTION 10800

TOILET AND BATH ACCESSORIES

1. PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Toilet and washroom accessories for all toilets, bathrooms and washrooms as shown on drawings and specified herein.

1.02 REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

ASTM A 167 Specification for Stainless Steel and Heat-Resistant Chromium-Nickel Steel Plate, Sheet and Strip.

ASTM A 269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

ASTM A 366 Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

ASTM A 527 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.

ASTM B 16 Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Machines.

ASTM B 19 Specification for Cartridge Brass Sheet, Strip, Plate, Bar and Disks (Blanks).

ASTM B 30 Specification for Copper-Base Alloys in Ingot Form.

ASTM B 455 Specification for Copper-Zinc-Lead Alloy (Leaded Brass) Extruded Shapes.

ASTM B 456 Specification for Electro-Deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

ASTM C 1036 Specification for Flat Glass.

1.03 SUBMITTALS

A. Product data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.

B. Samples: Full-size samples of each toilet accessory item for verification of design, operation, and finish requirements. Acceptable samples will be returned and may be used in the work.

C. Setting Drawings: Where cut-outs are required in other works, provide templates, substrate preparation instructions, and directions for preparing cut-outs and for installation of anchorage devices.

1.04 TRANSPORTATION, HANDLING AND STORAGE

A. Deliver materials to the site in manufacturer's original factory wrappings and containers, clearly labeled for identification of manufacturer, brand name and contents. Store materials as per manufacturer's written recommendations.

1.05 WARRANTY

A. Submit a written guarantee signed by the manufacturer, agreeing to change the items that fail in material or workmanship within a period of 1 year from the date of substantial handing over.

1.06 QUALITY ASSURANCE

A. Inserts and Anchorages: Provide inserts and anchoring devices to be set in concrete or built into masonry; coordinate delivery with other works to avoid delay.

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise indicated on Drawings.

C. Coordination: Coordinate the accessories locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of the accessories items.

2. PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Dignitary lounge and sitting: Shall be best quality products by top European, U.S. or Japanese manufacturers.

B. Offices: Shall be medium quality products by top European, U.S. or Japanese manufacturers.

C. Public Toilets: Shall be best quality products by local manufacturers.

2.02 MATERIALS

A. Stainless Steel:

1. Bar stock: Conform to ASTM A 276, Type 304.

2. Plates and Sheets: Conform to ASTM 167, Type 304.

3. Pipes: Conform to ASTM A 312, Grade Type 304.

4. Type of Finish: Polished, No. 4 unless otherwise indicated.

B. Brass: Leaded and unleaded, flat products conform to ASTM B 19; rods, shapes, forgings, and flat products with finished edges conform to ASTM B 16; Castings conform to ASTM B 30.

C. Bronze: Conform to ASTM B 36, Alloy 280 metal with satin chrome finish.

D. Plating: Nickel and chromium electro-deposited on base metal, conforming to ASTM B 456, Type SC-2.

E. Sheet Steel: Cold-rolled, commercial quantity conforming to ASTM A 366.

F. Galvanized Steel Sheet: Conform to ASTM A 527, Designation G-60.

G. Galvanized Steel Mounting Devices: conform to ASTM A 153, hot-dip galvanized after fabrication.

H. Fasteners: Screws, bolts, and devices of same material as accessory units. Where concealed, provide galvanized steel screws, bolts, and devices.

I. Mirror Glass: Conform to ASTM C 1036, Type I, Class 1, Quality q^2, and 6 mm thick with silvering, electro-plated copper coating and protective organic coating.

2.03 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet and bath accessories are not permitted, except where otherwise indicated. Wherever locks are required for a particular type of accessory, provide same keying throughout the project. Furnish two keys for each lock.

B. Surface-Mounted Accessories: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous piano hinge or minimum of two 38 mm pin hinges of same metal as unit cabinet. Provide concealed anchorage wherever possible.

C. Recessed Accessories: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage which is fully concealed when unit is closed.

2.04 FABRICATED FITTINGS AND ACCESSORY ITEMS

A. Single Robe Hook: Flange 50 x 50 mm, 50 mm projection from wall, satin stainless steel (High Category).

B. Single Robe Hook: Flange 50 x 50 mm, 50 mm projection from wall, satin stainless steel.

C. Single Robe Hook: Flange 50 x 50 mm, 50 mm projection from wall, satin stainless steel (Security Grade).

D. Soap Dish and Holder (SDH): With trim kit in polished chrome finish (High Category).

E. Soap Dish and Holder (SDH): With trim kit in polished chrome finish.

F. Soap Dish and Holder (SDH): With trim kit in polished chrome finish (Security Grade).

G. Towel Ring: With trim kit, stainless steel, with bright polished finish (High Category).

H. Towel Ring: With trim kit, stainless steel, with bright polished finish.

I. Towel Bar, 610 mm: 19 mm square bright polished stainless steel.

J. Paper Towel Dispenser and Waste Receptacle: In hairline stainless steel finish, Type 304 body and doorframe, surface-mounted type 298 x 1400 mm, dispensing minimum 600 C-fold or 1000 single-fold paper towels.

K. Paper Towel Dispenser and Waste Receptacle (for handicapped): In hairline stainless steel finish, Type 304 body and doorframe, surface-mounted type 298 x 1400 mm, dispensing minimum 600 C-fold or 1000 single-fold paper towels.

L. Hand Dryer: Surface-mounted electric hand dryer, color as approved by the Engineer.

M. Grab Bar (for Handicapped): 40 mm dia x 600 mm length grab bar, stainless steel construction, type 304, satin finish.

N. Grab Bar (for Handicapped): 40 mm dia x 1050 mm length grab bar, stainless steel construction, type 304, satin finish.

O. Grab Bar (at Ablutions): 40 mm dia x 300 mm length grab bar, stainless steel construction, type 304, satin finish.

P. Toilet Paper Holder: Stainless steel single-roll toilet paper holder, bright polished finish (High Category)

Q. Toilet Paper Holder: Stainless steel single-roll toilet paper holder, bright polished finish.

R. Toilet Paper Holder: Stainless steel single-roll toilet paper holder, bright polished finish (Security Grade).

S. Soap Dish: Recessed-mounted soap dish of stainless steel construction, type 304 with satin polish finish (Security Grade).

T. Perineal Spray: Gun pressure heavy duty complete with gun, hose and wall hook, polished chrome finish (High Category).

U. Perineal Spray: Gun pressure heavy duty complete with gun, hose and wall hook, polished chrome finish.

V. Clear Glass Facial Mirror:

1. Mirror Size: Counter width x 900 mm height.

2. Plate glass one piece mirror shall be of quality grade No.1, not less than 6 mm thick, electrolytically copper backed complying with requirements of Section 08800-GLAZING.

3. Back shall be protected by shock-absorbing waterproof, non-abrasive 6 mm thick polystyrene padding.

4. Galvanized steel back shall have integral horizontal hanging brackets for mounting on concealed wall hangers and secured with concealed vandal-proof screws in lower frame.

5. Frameless mirrors shall have manufacturer's standard accessories as required for proper fixation.

6. Clear Glass Facial Mirrors: Clear glass facial mirror with one piece channel frame of stainless steel type 304, bright polish finish (High Category). Sizes shall be as shown on drawings.

7. One-way Mirror: Refer to Section 08800 – GLASS AND GLAZING.

3. PART 3 - EXECUTION

3.01 INSPECTION

A. Examine substrates, previously installed inserts and anchorages necessary for mounting of toilet and bath accessories, as well as other conditions under which installation is to occur, and must notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. Install toilet and bath accessory units in accordance with the manufacturer's instructions, using fasteners that are appropriate to substrate and recommended by manufacturer of units. Install units plumb and level, firmly anchored in locations indicated.

3.03 ADJUST AND CLEAN

A. Adjust toilet and bath accessories for proper operation and verify that mechanisms function smoothly.

B. Clean and polish exposed surfaces after removing the protective coatings.

END OF SECTION

DIVISION - 11

EQUIPMENT

SECTION 11010

MAINTENANCE EQUIPMENT

I.PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Design, supply and installation of the following maintenance equipment:

1. Exterior maintenance and window washing equipment.

2. Mobile Working Platform (Vertical Access).

3. Tools, Squeegees and Accessories.

1.2. REFERENCES

A. ASTM - American Society for Testing and Materials

ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A 325	High-Strength Bolts for Structural Steel Joints
ASTM A 441	High-Strength Low Alloy structural Manganese Vanadium Steel
ASTM A 501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM B 209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

B. AWS - American Welding Society

AWS B3.0	Welding Procedure and Performance Qualification
AWS D1.1	Structural Welding Code-Steel

C. ICBO Uniform Building Code (UBC)

1.3. SUBMITTALS

A. Submit the following for Engineer's review and approval:

1. Proposed design for maintenance equipment including the related construction details showing relation between the proposed equipment and adjacent areas as well as the required modifications.

2. Connection and wiring diagrams as well as outline drawings.

3. Manufacturer's technical data.

4. Operations and maintenance manuals.

5. Certificates of Compliance: For material and strength for wire ropes and hooks.

6. Test reports.

7. List of spare parts and special tools.

1.4. TRANSPORTATION, HANDLING AND STORAGE

A. Shipping container(s) shall be provided as specified in the purchase order with suitable supports and lifting eyes, location of which shall be clearly identified.

B. Manufacturer shall provide recommendations for on-site storage and handling.

1.5. WARRANTY

A. Submit 2 copies of a written Warranty signed by the Manufacturer, Installer and Contractor agreeing to replace defective materials as well as workmanship within 2 years from date of substantial completion.

1.6. QUALITY ASSURANCE

A. Quality Control:

1. Manufacturer shall provide and maintain a quality program that provides necessary degree of assurance that delivered items will conform to the purchase document requirements.

2. Manufacturer shall be responsible for ensuring that:

a. Each item provided conforms to the specified dimensional, material and functional requirements.

b. Required conformance verifications are performed in the prescribed manner.

c. Certification and labeling is as specified.

d. Quality control certification performed during fabrication is verifiable and traceable to the item after fabrication.

II. PART 2 - PRODUCTS

2.1. EXTERIOR MAINTENANCE AND WINDOW WASHING EQUIPMENT

A. General:

1. Provide suitable equipment for cleaning and maintenance of windows, skylights and external facade.

2. Proposed system shall be suitable for different areas and applications as required.

3. Contractor may propose several systems for Engineer's selection and approval.

4. Proposed systems shall be manufactured by a company having minimum experience of 10 years in manufacturing systems similar to the proposed system for the Project and who has good maintenance facilities.

5. Contractor shall be fully responsible for design, supply and installation of the system through approved Sub-Contractors.

6. The system shall be fully load tested and shall meet or exceed the requirements of ASME A 39.1, ANSI 120.1 and OSHA 1910.66, including safety factor of 3:1.

2.2. MOBILE WORKING PLATFORM (VERTICAL ACCESS)

A. General: Provide mobile working platform suitable for intended application, with the following features:

1. Operates from the ground level and suitable for working heights not less than 18
2. m.

3. Maximum Load: 225 kg

4. Power Supply: By rechargeable battery.

5. Towable with Swivel Wheels.

B. Refer to catalog cuts attached herewith at end of this section.

2.3 TOOLS, SQUEEGEES AND ACCESSORIES for WINDOW CLEANING

A. Provide equipment, squeegees, tools and accessories suitable for intended application, not less than two floors. Refer to catalog cuts attached herewith at end of this section.

III. PART 3 - EXECUTION

3.1. INSTALLATION

A. General: Install equipment in strict accordance with manufacturer instructions and recommendations.

B. Wiring: Comply with the requirements of the applicable Sections of Division 16 - ELECTRICAL.

C. Field Tests:

1. Performance Test: After installation of systems conduct performance test, in presence of the Engineer and manufacturer's authorized representative, to demonstrate compliance with Specifications.

a. Locking and safety devices shall be tested for their intended functions.

b. Visual inspection shall be made for proper installation, alignment and lubrication.

END OF SECTION

DIVISION - 12

FURNISHING

SECTION 12800

INTERIOR PLANTS AND PLANTERS

I.PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior plants, planting medium, granular material, mulch and plant containers as indicated on Interior Design Drawings and as specified herein.

1.2 REFERENCES

A. AAN - American Association of Nursery-men:

Botanical Listing, Tagging and Sizes

B. AJCHN - American Joint Committee on Horticultural Nomenclature:

Latest Edition of Standardized Plant Names

C. ANSI - American National Standards Institute:

ANSI Z60.1 American Standard for Nursery Stock

D. ASTM - American Society for Testing and Materials:

ASTM C 136Sieve or Screen Analysis of Fine and Coarse Aggregates

E. AOAC - Association of Official Analytical Chemists:

Official Methods of Analysis

F. Royal Horticultural Society:

Dictionary of Gardening

G. ALCA - Associated Landscape Contractors of America:

Guide to Specifications for Interior Landscaping

1.3 SUBMITTALS

A. Prior to commencing delivery and installation at Project premises, submit samples of the below-listed items to Engineer for inspection and approval:

- Mulch
- Planting medium
- Polystyrene (peanuts)

1.4 FOLIAGE PLANT STANDARDS

A. Provide plants, as specified on Drawings, of a quality and size equal to or surpassing Foliage No.1; grade as described below.

B. General Specifications for canes, trunks, stems and branches:

1. Visibly free of pests and pathogens which could, by their presence, induce (or contribute to) the decline of the plant.

2. Reasonably free of conspicuous scarring evidence; scars, conspicuous or not, must be substantially healed, providing no point of entry for deleterious pathogens of boring insects. There must be no splitting of canes or trunks at branching points.

3. Canes or trunks: Well formed, sturdy and well rooted; therefore, stable and self-supporting in the growing container.

4. Plant Height: Overall plant height shall be measured from base of growing container to mean foliage top.

5. Cane Height: With some cane plant varieties, quality is determined by the height of rooted canes. Cane heights shall be measured from the base of the growing container. Overall height of plant shall be from base of growing container to mean foliage top.

C. General Specifications for Foliage:

1. Visibly free of pests and pathogens which could, by their presence, induce (or contribute to) the decline of the plant.

2. Reasonably free of any chlorosis, yellowing or poor chlorophyll formation, turgid and substantially erect, as well as substantially free of blemishes resulting from mechanical, chemical, pathological or pest-induced damage.

3. Cleaned of dust and water-borne pesticide and fertilizer residues at time of project acceptance.

4. Present in such quantity as may be required to produce an appearance representative of species.

5. Foliage Width and origin: Measured across mean foliage width dimension, not including random outstanding branches. Foliage origin along a main trunk, cane or stem shall be measured from soil line. Note that width of foliage to be specified as percentage of total plant height for best proportion.

D. General Specifications for Root System and Soil Mass:

1. Root system: Well-developed and upon inspection, shall be found to be visibly free of pests and/or pathogens. Development shall be adequate to:

a. Be well distributed throughout the container, such that roots visibly extend on all sides to inside face of growing container. Conversely,

root formation within container, shall not have developed to the point where it becomes excessive (pot-bound) and prohibits water from permeating to fine water-absorbing root hairs.

b. Afford firm support and insure physical stability of plant parts above soil.

c. Maintain life systems required to produce vigorous, healthy growth.

2. Growing medium shall be comprised of such constituents as may be necessary to provide:

a. Thorough drainage and satisfactory aeration of root zone. Soil mass should be as uniform as possible.

b. Adequate moisture and nutrient retention as may be necessary to promote vigorous but controlled plant growth.

c. Sufficient density in the growing container to insure stability of entire unit, plant and container.

3. Growing medium shall be visibly free of pests, pathogens and weeds.

4. Growing medium shall be free of chemical residues which could be harmful to consumers.

5. The pH of medium should be in the acceptable range for plants.

1.5 DELIVERY AND INSTALLATION

A. Coordinate delivery and installation activities with the Engineer. Inform the Engineer at least forty-eight hours prior to commencement of work at Project premises.

B. Transport plants via enclosed and environmentally controlled vehicles through personnel experienced in handling live plants.

C. Unless otherwise stipulated herein, protect plants from adverse environmental conditions during delivery phases and installation.

D. Protect plants stored at Project premises during installation from damage, theft or deterioration of health or appearance.

E. Coordinate interior planting activities during delivery and installation so as not to interfere unduly with work of other trades. Leaving planting work area(s) clean of litter and debris at the close of each workday.

F. Maintain a qualified planting Supervisor at Project premises. Supervisor shall notify Engineer at start and completion of each work day. Supervisor shall act as Contractor's authorized agent in all communications with Engineer.

G. Planting procedures and methods shall be in conformance with the accepted industry practices and as specified herein.

H. Upon completion of installation, notify and schedule with the Engineer inspection of Work.

I. Correct any deficiencies found in installation as a result of the Engineer's inspection.

1.6 HORTICULTURAL SERVICES

A. During delivery and installation, maintain and care for plants installed or temporarily stored at Project premises and guarantee their health and appearance until acceptance by the Engineer.

1.7 GUARANTEE AND REPLACEMENT

A. Plant Replacement Guarantee:

1. During phases of Work under this Agreement, replace plant(s) which deteriorates in health and appearance so as to become of lesser specification and/or grade from that originally installed at no extra cost.

2. Perform plant replacements with the same species, size and grade plant(s) as was in place at the beginning of service period; or with another plant of comparable value which is acceptable to the Engineer.

B. Guarantee the work and materials specified herein for a period of 12 months after date of substantial acceptance by the Engineer.

II.PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. Plants for Interior Planters: As indicated on Drawings and Planting Schedules.

B. Interior plants and planters shall be supplied by Others.

2.2 MISCELLANEOUS MATERIALS

A. Planting Medium: A soil mixture of a neutral pH-value consisting of commercially prepared blend of peat, organic compost, bark fines, washed sand and commercially approved fertilizers. Soil mixture shall be free from noxious weeds, manure, litter, insects, plant disease organisms or other deleterious matter and shall be supplied in the manufacturer's original packing.

B. Mulch: Spanish Moss or approved equal, air-dried and treated with a fire-retardant material. Furnish mulch in a minimum layer of 25 mm to cover the interior planters.

C. Filter membrane: Spun-bonded polypropylene fabric manufactured by an integrated process of fiber spinning and bonding and having the following characteristics:

- Weight: 136 g/m²
- Thickness: 0.50 mm
- Multi-Directional Test Strength: 100 N/m^2
- Elongation: 32 percent; minimum elongation
- Pore Size: 120 micrometers

D. Drainage layer: Angular gravel containing no fines, nominal size from 10 - 20 mm, provided in layers 75 mm thick as a minimum.

E. Protection Board: Where required, provide manufacturer standard protection boards as approved by the Engineer.

F. Rigid Plastic Outer Pots: Where required, provide manufacturer's standard rigid durable high density plastic outer pots of suitable sizes as approved by the Engineer.

G. Peanuts: Manufacturer's standard polystyrene beads, type and size of which shall be as approved by the Engineer.

2.3 INTERIOR PLANTERS

A. Interior Planters: Type, size and selection shall be as indicated on Interior design Drawings and Interior Design Specification.

III.PART 3 - EXECUTION

3.1 INSTALLATION OF INTERIOR PLANTS AND OTHER MATERIALS

A. In Fixed Masonry or Concrete Planters:

1. Install protection board in the bottom of fixed planters with cut outs above drains.

2. Place a drainage layer of 10 - 20 mm gravel over protection board to a uniform depth as required.

3. Install filter membrane over the drainage layer and up the sides of planter to coincide with finished level of planting medium (not including mulch layer). Provide a minimum of 150 mm overlap at joints and adhere to planter wall, along top edge, prior to backfilling with planting medium.

4. Place planting medium over filter membrane to a level 75 mm of the top of planter after tamping.

5. Remove nursery pots and directly plant the plants into planting medium. Space plants evenly in the planter.

6. Spread a 25 mm layer of mulch around the plants to totally cover the planting medium in each planter.

B. In Wooden Movable Planters:

1. Place polystyrene peanuts or approved non-absorbent light weight inert material in the metal lining of wooden planters as a filler and to achieve proper levels for potted plants.

2. Provide an outer pot of rigid durable plastic having no drainage holes as a container for each nursery pot. Size outer pots slightly larger than nursery

pots so that the nursery pots containing plants can be easily set in or lifted out. Set top of outer pots at a level 75 mm below top of wooden planter. Use polystyrene peanuts to accomplish the leveling. Pack polystyrene peanuts firmly around outer pots to a level of 20 mm of the top of pot after outer pot have been properly placed and leveled.

3. Insert nursery pots containing individual plant into pots and according to locations shown on the Drawings. Top of nursery pot shall be at same level as top of outer pots. Place pebbles ranging in diameter from 5 - 10 mm, as necessary, in bottom of outer pot to bring the nursery pot to the proper level.

4. Spread mulch to a uniform thickness of 25 mm over planting medium in the pots as well as polystyrene peanuts. Surfaces within wooden planters shall be covered so that neither pots nor peanuts shall be visible.

C. In Architectural Pottery:

1. Provide a drainage layer in the bottom of each pot, 50 - 75 mm thick.

2. Remove plant(s) from the nursery container(s) and plant directly into the architectural pottery.

3. Install planting medium under and around root balls as necessary to bring plant to vertical position and proper height within pot. Firm planting medium around root ball to minimize future settlement.

4. Spread evenly a uniform layer of mulch, 25 mm thick over planting medium so that no soil shall show.

3.2 CLEANING AND PROTECTION

H. Remove debris, dirt as well as packing materials from areas of Work, leaving it in a clean and a neat condition.

I. Provide the necessary protection for the work of other trades during work as well as protection for interior planting performed in areas where construction is not over yet and as directed by the Engineer.

J. During construction period and through guarantee period plants or planters broken, damaged, dead, or un-acceptable to the Engineer for non conformance to the requirements specified herein shall be replaced with similar items conforming to the requirements or an equivalent item previously approved by the Engineer at no extra cost to Owner.

END OF SECTION

DIVISION - 13

HEALTH, SAFETY AND ENVIRONMENT

SECTION 013543

ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS that are hereby made a part of this Section of the Specifications.

B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the CONTRACT AND GENERAL CONDITIONS.

C. The Contractor is directed to the Construction Environmental Health and Safety Requirements Manual.

1.02 DESCRIPTION OF WORK

A. Furnishing all labor, materials, and equipment and perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operation under this Contract. For the purpose of this Section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires consideration of air, water, and land, and involves management of runoff, dust, noise and solid waste, as well as other pollutants. Work shall include installing, maintaining, and removing sedimentation and erosion control components within the Limits of Work.

1.03 RELATED SECTIONS

A. Section 013529 – HAZARDOUS MATERIALS HEALTH AND SAFETY

B. Section 017419 – CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

C. Section 026000 – MISCELLANEOUS HAZARDOUS MATERIAL REMOVAL

D. Section 026100 – EXCAVATED SOILS AND MATERIAL MANAGEMENT PLAN

E. Section 028200 – ASBESTOS ABATEMENT AND RELATED WORK

F. Section 028300 – LEAD-BASED PAINT ABATEMENT AND RELATED WORK

G. Section 312500 – EROSION AND SEDIMENTATION CONTROLS

H. (Appendix ____)- CONSTRUCTION MITIGATION SPECIFICATION

1.04 DUST CONTROL

A. The Contractor shall provide adequate means for the purpose of preventing dust caused by construction operations from creating a hazard, nuisance, and from entering adjacent occupied areas throughout the period of the construction contract.

B. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site generate fugitive dust from exposed waste or contaminated soil. Such activities shall also include demolition, the excavation, grading, or placement of clean fill, and control measures therefore should be considered.

1. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM_{10}) with the following minimum performance standards:

Object to be measured: Dust, Mists, Aerosols
Size range: <0.1 to 10 microns
Sensitivity: 0.001 mg/m^3
Range: 0.001 to 10 mg/m^3
Overall Accuracy: ±10% as compared to gravimetric analysis of stearic acid or reference dust

Operating Conditions:
Temperature: 0 to 40°C
Humidity: 10 to 99% Relative Humidity

Power: Battery operated with a minimum capacity of eight hours continuous operation

Automatic alarms are required.

Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes. Consequently, instrumentation shall require necessary averaging hardware to accomplish this task; the P-5 Digital Dust Indicator as manufactured by MDA Scientific, Inc. or similar is appropriate.

2. The Contractor's Certified Industrial Hygienist (CIH) shall establish a site specific dust Action Level. The Action Level should provide a real-time assessment of on-site air quality to assure both health and safety.

3. The CIH shall establish when additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal

protection for on-site personnel and implementing additional dust suppression techniques.

4. If the dust suppression techniques being utilized at the site do not lower particulates to an acceptable level (that is, below the Action Level and no visible dust), work must be suspended until appropriate corrective measures are approved to remedy the situation. Also, the evaluation of weather conditions will be necessary for proper fugitive dust control--when extreme wind conditions make dust control ineffective, as a last resort remedial action may need to be suspended.

C. This provision does not supersede any specific requirements for methods of construction or applicable general conditions set forth in the Contract Articles with added regard to performance obligations of the Contractor.

1.05 NOISE CONTROL

A. The Owner shall conduct baseline noise level monitoring prior to construction and periodic monitoring of noise levels during the construction.

B. The Contractor shall develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum. Most recent local noise ordinances shall govern. The Owner will make final interpretation concerning whether or not nuisance noise conditions exist.

C. The Construction Manager shall conduct base line testing of all equipment delivered to the site for compliance of the 86 DBA at 50 feet guideline prior to commencing work.

D. The Contractor shall execute construction work by methods and by use of equipment which will reduce excess noise.

E. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

F. The Contractor shall manage vehicular traffic and scheduling to reduce noise.

1.06 INDOOR AIR QUALITY MANAGEMENT

A. Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke. At a minimum, take the following measures:

1. Prohibit smoking in the building.

2. Locate exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes, and operable windows.

B. The Contractor shall develop a Construction Indoor Air Quality (IAQ) Management Plan for this Project and meet requirements of LEED EQ Cr 3.1 and 3.2.

C. During Construction: Comply with the following requirements, per LEED EQ Cr. 3.1:

1. During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

2. Protect stored on-site and installed absorptive materials from moisture damage.

D. Before Occupancy: Comply with one of the following requirements, per LEED EQ Cr. 3.2:

1. Option 1 - Air Quality Testing (Contractor-engaged indoor-air-quality testing):
Conduct a baseline indoor air quality testing procedure consistent with Environmental Protection Agency's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air."

E. Construction Indoor Air Quality Management Plan Submittal:

1. Within 21 calendar days after receipt of Notice to Proceed, the Contractor shall submit to finalized Construction IAQ Management Plan.

2. The proposed Plan shall comply with requirements of LEED EQ Cr 3.1 and 3.2.

3. The proposed Plan shall include, but not be limited to, the following:

a. Protection of ventilation system components during construction.
b. Cleaning and replacing contaminated ventilation system components after construction, including filtration media.
c. Temporary ventilation.
d. Protection of absorptive materials from moisture damage when stored on-site and after installation, including exterior wall rain protection.
e. Sequence of finish installation plan.
f. Selection of cleaning products and procedures to be used during construction and final cleaning.
g. Schedule of emission test data recorded by Contractor's testing laboratory.

F. Take special care to prevent accumulation of moisture on materials and within packaging during delivery, storage, and handling to prevent development of mold and mildew inside packaging and on products.

G. Immediately remove from site and properly dispose of materials showing signs of mold and mildew, including materials with moisture stains.

H. IAQ Plan Implementation:

1. IAQ Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Construction IAQ Management Plan for the Project.

2. Distribution: The Contractor shall distribute copies of the Construction IAQ Management Plan to the jobsite foreman, each Subcontractor, Manager Project, and the Engineer.

3. Instruction: The Contractor shall provide on-site instruction of appropriate procedures and methods to be used by all parties at the appropriate stages of the Project.

4. Preconditioning: Allow products, which have odors and significant VOC emissions, to off-gas in a dry, well-ventilated space for sufficient period to dissipate odors and emissions prior to delivery to Project.

5. Remove containers and packaging from materials prior to conditioning to maximize off-gassing of VOCs.

6. Condition products in ventilated warehouse or other building.

7. Coordinate Construction IAQ Management Plan with final cleaning.

1.07 NOTIFICATIONS

A. the Engineer may notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements may notify the Contractor in writing of any non-compliance with State or local requirements. After receipt of such notice from the regulatory agency, the Contractor shall immediately take corrective action. Such notice, when delivered to the Contractor or his / her authorized representative at the site of the Work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.08 APPLICABLE REGULATIONS

A. The Contractor shall comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

B. Fines and related costs resulting from failure to provide adequate protection against any environmentally objectionable acts and corrective action to be taken are the obligations of the Contractor.

PART 2 - PRODUCTS

2.01 WATER

A. Water used for dust control and equipment washes shall be clean and free of salt, oil, and other injurious materials. The Contractor shall provide all necessary water to complete the Work.

B. The Contractor shall not operate any hydrants, valves, curb stops or corporations, or shall they draw any water from the system, without specific approval of the local authorities responsible for such use. Only local authorities will operate valves, hydrants, corporations, and curb stops unless otherwise directed by the local authorities.

C. Water meters shall be installed on hydrants prior to use. The Contractor shall consult with the local authorities responsible for such use prior to hydrant operation (see above).

2.02 ONSITE SPILL KIT

B. The Contractor shall provide the following minimum equipment to be kept onsite at all times during site work activities for any unexpected spills or discharges:
1. Sand, absorbent pillows, and speedy dry.
2. Four drums (55 gallon),
3. Shovels, and
4. Steam cleaner for decontamination of tools and equipment.

PART 3 - EXECUTION

3.01 PROTECTION OF GROUNDWATER

A. Care shall be taken to prevent, or reduce to a minimum, any discharges to the ground of liquids that may infiltrate to the underlying groundwater. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the groundwater shall not be discharged from the Site. Such waters shall be collected and disposed of by the Contractor in accordance with all applicable Federal, State and local regulations.

3.02 PROTECTION OF LAND RESOURCES

A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of remediation activities that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to Limits of Work areas shown on the Drawing.

B. Outside of the Limits of Work as shown on the Drawings, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. Snow fence or other approved equal shall be wrapped around tree trunks if heavy equipment has the potential to damage the tree bark, to prevent damage to trees.

C. The locations of storage and other facilities, required in the performance of the Work, shall not be within wetlands or resource areas.

3.03 [TREE PROTECTION

A. Tree protection fencing shall be one of the following, at the Contractor's option.

1. Wire bound wood roll snow fence with 3/8 in. x 1-1/2 in. wide pickets; spaced approximately 2 in. apart bound together with at least 13 gauge galvanized steel wire and with brightly painted top edge. Stakes for fencing shall be steel or wood posts. Posts shall be spaced 5 ft. maximum.

2. Galvanized chain link fencing. Posts for fencing shall be nominal 2-1/2 in. diameter, galvanized steel posts, driven a minimum of 3 ft. into the ground. Posts shall be spaced 10 ft. on center, maximum. Fence fabric shall be 2 in. mesh, 11 gauge minimum.

3. Polypropylene barricade fencing. Stakes for fencing shall be 2 in. x 4 in. wood posts, driven a minimum of 3 ft. into the ground. Posts shall be spaced 5 ft. maximum.

4. Plastic polymer safety fence, or approved equal. Color shall be high visibility orange. Stakes for fencing shall be x 4 -in. wood posts, driven a minimum of 3 ft. into the ground. Posts shall be spaced 5 ft. o.c. maximum.

5. Unless otherwise indicated, height of fencing shall be 6 ft.]

3.04 PROTECTION OF AIR QUALITY

A. Burning – Burning for the disposal of refuse and debris and/or heat for workers will not be permitted at the project site.

B. Dust Control – Maintain all demolition, excavations, stockpiles, waste areas, and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution and which would cause a hazard or nuisance to others. The Contractor shall prepare and submit a Dust Control Plan to address potential sources and abatement measures.

C. The Contractor shall provide adequate means for the purpose of preventing dust caused by construction operations throughout the period of the construction contract. If the Manager Project or the Engineer indicates that the level of dust or odors is unacceptable, the Contractor shall employ measures necessary to reduce dust or odors to an acceptable level.

D. The Contractor shall implement engineering controls (e.g. watering, misting) to control dust whenever required by the Engineer.

3.05 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. During the life of this Contract, maintain all facilities constructed for pollution, erosion, and sedimentation control as long as the operations creating the particular pollutant are being carried out.

3.06 STORM WATER POLLUTION PREVENTION

A. The Contractor shall be responsible for conducting regular site storm water inspections as outlined in the applicable specifications and drawings included in the contract documents.

3.07 DIESEL EQUIPMENT EMISSION CONTROLS

A. All motor vehicles and construction equipment shall comply with all pertinent local, state, and federal regulations covering exhaust emission controls and safety.

B. The reduction of emissions of VOCs, CO and PM from diesel-powered equipment shall be accomplished by installing Retrofit Emission Control Devices, and by using ultra low sulfur diesel fuel.

C. The acceptable Retrofit Emission Control Devices for the project shall consist at a minimum of diesel oxidation catalysts that are verified by EPA or certified by the manufacturer to provide a minimum emissions reduction of 20 percent for PM, 40 percent for CO, and 50 percent for VOCs. The Emission Control Devices must be either included on the Environmental Protection Agency (EPA) Verified Retrofit Technology List (www.epa.gov/otaq/retrofit/retroverifiedlist.htm) or be judged by the Owner to be equivalent to the EPA standards. As of January 2007, the following retrofits are acceptable:

Manufacturer	Device Name
DCL	Mine-X DOC
Donaldson	6000
Engelhard	CMX Catalyst Muffler
Engine Control Systems	AZ Purifier; AZ Purimuffler
Johnson Mathey	CEM Catalyst Muffler

D. All diesel fuel used on the project site must be ultra low sulfur diesel which contains no more than 15 parts per million (ppm) sulfur.

E. Construction shall not proceed until the Contractor has submitted a certified list of the non-road diesel-powered construction equipment subject to this specification, which either are or will be retrofitted with emission control devices. The list shall include (1) the equipment number, type, make, and Contractor/Sub-Contractor name; (2) the emission control device make, model, and EPA verification number. Equipment that has been retrofitted with an emission control device shall be stenciled or otherwise clearly marked as “Low Emission Equipment”. The Contractor shall also submit a certified letter stating the type and source of diesel fuel that will be used.

F. The Contractor shall submit monthly reports, updating the same information stated in Paragraph F above, including the quantity of diesel fuel utilized. The addition or deletion of non-road diesel equipment shall be indicated in the report.

G. The Contractor shall use methods to control nuisance odors associated with diesel emissions from construction equipment including but not limited to the following: (1) turning off diesel combustion engines on construction equipment not in active use, and on trucks that are idling while waiting to load or unload material for five minutes or more, as stipulated in the MA state anti-idling law which contains the following exceptions: vehicles being serviced, vehicles making deliveries that need to keep their engines running (to power refrigerators, for example), and vehicles that need to run their engines to operate accessories; (2) locating diesel equipment away from the general public and sensitive receptors (e.g., fresh air intakes, air conditioners and windows); and (3) utilizing electronically-powered scissor/man lifts.

H. In selecting a contractor, Harvard will give preference to those who commit to emissions reductions strategies that go beyond the basic requirements specified above, especially to those strategies that further reduce PM emissions. Such additional strategies could include, but are not limited to:

(1) Diesel Particulate Filters

Manufacturer	Device Name
Caterpillar	Diesel Particulate Filter
Engelhard	DPX Catalyzed Diesel Particulate Filter
Johnson Mathey	CRT or CCRT Particulate Filter
Engine Control Systems	Combifilter
DCL	Mine-X Sootfilter

(2) Cleaner and/or Renewable Fuels
Biodiesel
Ethanol in any gasoline powered vehicle or generator

I. Any costs associated with implementing the diesel emissions controls as specified in this section shall be included in the general cost of the contract.

3.08 SPILL AND DISCHARGE CONTROL

A. The Contractor shall provide equipment and personnel to perform emergency measures required to contain any spillage and to remove spilled materials and soils or liquids that become contaminated due to spillage. The collected spill material shall be properly disposed of at the Contractor's expense.

B. Costs to provide the above spill and discharge control materials shall be included in the contract base bid price.

C. The Contractor shall provide the name, address and contact information for a spill response contractor in the event response activities are beyond the expertise of the Contractor.

3.09 COLLECTION AND WASTE MANAGEMENT

A. The Contractor shall provide all necessary equipment, containers and labor necessary for the collection and temporary storage of waste oil and grease, paints, solvents and all wastes generated by the Contractor and its' equipment. The Contractor is responsible for the off-site management of all waste generated by the Contractor.

B. Surplus Soil Reuse/Recycling/Disposal: Remove all surplus soil materials from the project site as provided in Section 026100 EXCAVATED SOIL AND MATERIAL MANAGEMENT PLAN.

C. Demolition/Solid Waste Materials: All demolished waste materials including trash and debris shall be removed from the project site and reused, recycled or disposed as provided in Section 017419 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

D. Burning on site is prohibited.

END OF SECTION

SECTION 013529

HAZARDOUS MATERIALS HEALTH AND SAFETY

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all SECTIONS within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of Specifications.

B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the CONTRACT AND GENERAL CONDITIONS.

C. Conditions set forth in this Section supplement Construction Environmental Health & Safety Manual.

1.02 DESCRIPTION OF WORK

A. The Contractor shall prepare and implement a site-specific Health and Safety Plan (HASP) to protect the health and safety of all workers (including subcontractors) engaged in activities where there is a potential exposure to contaminated soil or groundwater. A Certified Industrial Hygienist (CIH) shall be retained by the Contractor to make this determination and to prepare the HASP. The HASP shall also be designed to protect the general public and the environment during the course of the Work. The HASP shall include, as a minimum, the following:

1. Procedures to protect worker and public health and safety from exposure to materials that may originate from or be present at the project site, including procedures to contain oil and/or hazardous materials, if present.

2. Procedures for monitoring, controlling, and mitigating fugitive dust, odors, and gases to protect worker and public health and safety.

3. Procedures to decontaminate vehicles and equipment to prevent the spread of contaminated materials from the Work area.

4. Procedures to secure on-site work areas.

B. Conduct a health and safety coordination meeting prior to commencement of excavation work at the site to inform workers of the site conditions and proposed health and safety contingency actions. Inform new workers of the site conditions and proposed health and safety contingency actions on a continuous basis. An outline for this training must be included as part of the HASP.

C. The scope and detail of the HASP shall be commensurate with the degree and nature of the risks posed to human (worker and public) populations by the Work as determined by the Contractor's Certified Industrial Hygienist (CIH) Standardized health and safety plans may be appropriate for non-intrusive or routine activities conducted at the site.

D. The Contractor shall appoint a qualified Site Health and Safety Manager (aligned with Safety Manual (SHSM)) who will be charged with overseeing site health and safety, instrument monitoring, personnel, equipment decontamination, control of equipment check-out, dust monitoring, odor monitoring, gas monitoring, and emergency response.

1.03 RELATED SECTIONS

A. Section 026100 - EXCAVATED SOIL AND MATERIAL MANAGEMENT PLAN

B. Section 028300 - LEAD-BASED PAINT REMOVAL AND RELATED WORK

C. Section 312000 - EARTHWORK

D. Section 312319 - DEWATERING

1.04 REFERENCE

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed.

A. NIOSH/OSHA/USCG/EPA: "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," DHHS/NIOSH.

B. Occupational Safety and Health Administration, Part 29 CFR 1910.134; 19108.1001-1046; and 1926.65.

C. United States Environmental Protection Agency, Executive Order: 1440.2,

Health and Safety Requirement for Employees Engaged in Field Activities.

D. Occupational Safety and Health Administration, 29 CFR 1910, Safety and Health Regulations for General Industry, as amended 10/86.

E. Occupational Safety and Health Administration, 29 CFR 1926, Safety and Health Regulations for Construction, as amended 1974.

F. United States Environmental Protection Agency, P9/85 EPA/625/9-85/006 Protection Health and Safety at Hazardous Waste Sites: An Overview.

G. Massachusetts Division of Occupational Safety, 454 CMR 21, Workplace Regulation.

H. Massachusetts Department of Public Health, 105 CMR 670.000, Mass Substance List and Lab exemptions.

I. Department of Environmental Protection, 310 CMR 33.00, Community Right to Know.

1.05 DEFINITIONS

A. Contractor: Refers to the General Contractor and/or Subcontractor responsible for the Work under contract.

B. Engineer: Authorized Engineer shall be the Architect or Designer of Record for the project.

C. USEPA: U.S. Environmental Protection Agency

D. HASP: Health and Safety Plan

E. OSHA: Occupational Safety and Health Administration

F. PID: Photo ionization Detector

G. CIH: Certified Industrial Hygienist

H. SHSM: Site Health and Safety Manager

1.06 PROJECT CONDITIONS

A. *INSERT BACKGROUND INFO FOR EXAMPLE*: [Soils containing concentrations of contaminants exceeding RCS-1 criteria were identified during the Pre-characterization Program for the Project.] Soil and groundwater management shall be conducted in accordance with the requirements of this Section and the Contractor's HASP.

B. The nature of the materials present at the site may require use of special protective clothing and the possible use of respiratory protective equipment, which is intended to minimize worker exposure to known or suspected site hazards.

C. The Contractor shall be responsible for determining the appropriate level of personnel protection that is required based on the criteria outlined in the Contractor's HASP. If upgrading to Level C protection or higher is required, the Contractor shall suspend Work in the area identified as the "work zone" by the Contractor's SHSM and/or CIH until the Contractor is equipped to continue the Work, and has received approval to continue the Work.

D. The Contractor shall notify in writing prior to implementing any upgrades in personal protection from Level D protection. EH&S will review the Contractor's notification and determine the need to notify applicable agencies. The Contractor shall notify all agencies having jurisdiction over the Work, only after consulting with the Employer.

1.07 QUALITY CONTROL

A. The Contractor shall be solely responsible for exercising reasonable precaution to protect the health and safety of all on-site personnel, the general public, and the environment during the course of the Work. The Contractor shall comply with all applicable provisions of federal, state, and local health and safety and occupational health and safety statutes and codes.

B. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soils and groundwater. The Contractor shall notify the presence of potentially hazardous conditions, if encountered.

C. The Contractor shall retain a CIH to prepare the Contractor's HASP and for quality control as specified herein. The CIH shall have a minimum of ten years experience in this work, certification as a safety professional qualified by training and experience to act in this capacity, and certification as having completed the 40-hr. OSHA health and safety training course, with current 8-hr. refresher training and 8-hr. OSHA manager's training. The CIH shall either assume the role of Site Health and Safety Manager (SHSM) as described below, or oversee the activities of the SHSM.

D. The Contractor shall retain a SHSM to implement the Contractor's HASP and to perform field testing for evaluation of environmental contaminants and compounds of concern in air, soil, and groundwater in accordance with the Contractor's HASP and as directed by the CIH. The SHSM may be the same as the CIH. If the SHSM is not the same person as the CIH, then the SHSM shall have a minimum of five years experience in this work, and certification as having completed the 40-hr. OSHA health and safety training course, with current 8-hr. refresher training and 8-hr. OSHA manager's training.

E. Ambient Air Monitoring:

1. The Contractor, through its CIH, shall monitor air quality within and around the site and work areas for the compounds of concern (fugitive dust, odors, and gases) during those activities where exposure to contaminated soil and/or groundwater is possible, using instruments as described in the Contractor's HASP. The instruments shall be used in accordance with the procedures outlined in the Contractor's HASP.

2. The Contractor shall not undertake any Work until the Engineer has received the Contractor's HASP.

1.08 SUBMITTALS

A. Submit to the Engineer, a HASP prepared by the Contractor's CIH meeting the requirements of 29 CFR 1926.65. The Contractor is responsible for Contractor's workers and subcontractors' workers' health and safety. Therefore, the Engineer will not approve the Contractor's HASP but only review for content. The HASP shall apply to all Work to be conducted at the site, taking into consideration all workers on-site, the general public, and the environment. The plan shall include the following information:

1. A list of the Contractor's work tasks that may involve contact, excavation, and/or handling of contaminated soil and/or groundwater.

2. Compounds of concern that may be encountered during the course of the Work and signs/symptoms of exposure.

3. Potential for worker exposure to the compounds of concern for each work task.

4. Requirements for OSHA training and medical surveillance for each work task and a record or schedule for training of Contractor and subcontractor workers in the use of personal protective equipment and for medical monitoring.

5. Work task specific levels of protection and a description of health and safety equipment including protective clothing, respiratory equipment and monitoring instruments.

6. Procedures for containing oil and/or hazardous materials such as decontamination of heavy construction equipment and tools.

7. Procedures for monitoring, controlling, and mitigating fugitive dust, odors, and gases for each work task to protect worker and public health and safety, including descriptions of monitoring instruments and action levels triggering responses by the Contractor (e.g., donning personal protective equipment).

8. Emergency Response Plan.

B. The HASP must be completed for discussion at the coordination meeting scheduled by the Contractor and held at least three days prior to commencement of work relating to possible exposure to contamination at the site. The Contractor shall provide written notice of this meeting to all interested parties at least five days before the meeting.

C. The resumes of the Contractor's CIH and SHSM including the name, date, location, and description of five similar successfully completed projects. The resumes shall also demonstrate that the CIH and SHSM have a minimum of ten years' experience in writing and/or implementing HASPs.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 HAZARDOUS MATERIALS HEALTH AND SAFETY PLANNING AND IMPLEMENTATION

A. Prepare a HASP that ensures the health and safety of all workers engaged in work at the site and the general public at all times whenever exposure to contaminated soil, contaminated groundwater, dust, odors, or gases is possible. Implement the plan throughout the execution of the work.

B. The Contractor shall monitor the excavation using the equipment described in the Contractor's HASP.

C. Contractor's workers who will be engaged in work at the site that might result in exposure to contaminated soil or groundwater shall attend the coordination meeting and any follow-up supplemental briefings.

D. Provide 40-hour HAZWOPER health and safety training and medical surveillance for all personnel who may come in contact with or be exposed to contaminated materials during the course of the work. These personnel and their training shall be

provided at no additional cost to the Owner. The Contractor shall provide, at the Manager Project's request, certificates for each worker to demonstrate compliance with this requirement.

E. Provide personnel, including personnel for subcontractors, who are 40-hr. OSHA trained with an 8-hr. OSHA refresher course completed within the previous twelve months. These personnel and their training shall be provided at no additional cost to the Owner. The Contractor shall provide, at the Manager Project's request, certificates for each worker to demonstrate compliance with this requirement.

F. [As necessary, provide personnel, including personnel for subcontractors, that are confined space entry trained to complete the Work specified herein and in other Sections. These personnel shall be current in all applicable and necessary refresher courses as well. These personnel and their training shall be provided at no additional cost to Harvard. The Contractor shall provide, at the Manager Project's request, certificates for each worker to demonstrate compliance with this requirement.]

G. Personnel who have not received training, and who are not equipped with the required protective clothing and equipment, shall not be permitted access to the site by the Contractor during the course of the work that may result in exposure to contaminated soil and/or groundwater.

3.02 ACCIDENT REPORTING REQUIREMENTS

A. The Contractor must comply with all accident and or incident reporting requirements, including the following:

1. Should any unforeseen safety-related factor, hazard, or condition become evident during the course of the Work, the Contractor must immediately take prudent action to establish, maintain, and secure the site and working conditions. This shall be followed by immediate notice to the Manager Project.

2. If serious injury to a person or damage to property, environment, or natural resources results from an incident, the Contractor shall comply with Section of the Construction EH&S Requirements Manual, making notifications outlined in this section in addition to the required reports and post-incident review meeting.

3.03 DECONTAMINATION

A. Decontaminate all equipment and tools that have come in contact with soil and groundwater in accordance with the approved Contractor's HASP to prevent the spread of contaminated materials inside and outside the site limits.

END OF SECTION

DIVISION - 15

PEST CONTROL

SECTION 015716

SHORT-TERM PEST CONTROL

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the CONTRACT AND GENERAL CONDITIONS.

1.02 DESCRIPTION OF WORK

A. This Section specifies rodent control and general pest control requirements within construction areas, laydown areas, dump areas, and bordering areas. This work is to be performed prior to demolition, excavation, and site preparation and also throughout construction, so that rodents (rats and mice) and other pests (such as raccoons) do not disperse from or infest construction areas.

B. The Contractor shall develop and implement an integrated pest management (IPM) approach. As part of that approach, the Contractor shall maintain a cooperative dialogue with appropriate agencies and management representatives of neighboring properties. This IPM effort shall consist of an Initial Program that achieves control of existing rodents and other pests prior to any site disruptions, followed by a Maintenance Program that ensures continued control throughout the duration of construction until occupancy.

C. In addition to the rodent control tasks described in this Section, the Contractor shall also respond to other pest control needs when directed by the Harvard Project Manager.

D. Contractor is responsible for the phasing requirements indicated on all Contract Drawings and Specification Sections.

1.03 RELATED SECTIONS

A. Section 013543 – ENVIRONMENTAL PROTECTION

B. Section 017419 – CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

C. Section 311000 – SITE PREPARATION

D. Section 312000 – EARTHWORK

1.04 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed.

A. Massachusetts Pesticide Bureau in General Pest Control

1.05 DEFINITIONS

A. USEPA – United States Environmental Protection Agency

B. Contractor: Refers to the General Contractor and/or Subcontractor responsible for the Work under contract with Project Manager.

C. Harvard Project Manager: A representative of the Property Owner, President and Fellows of Harvard College

D. IPM – Integrated Pest Management

1.06 QUALIFICATIONS

A. A qualified pest control contractor shall perform this Work at all times in accordance with the following minimum standards and as acceptable to the Harvard Project Manager:

1. The pest control contractor and key personnel shall have experience with commercial and residential accounts and construction and demolition projects; have experience and technical training in vertebrate pest management and integrated pest management; have experience with various rodent control techniques, equipment, and strategies; have training and experience with insect control; and have knowledge of and experience with techniques to reduce non target hazards.

2. The supervisor shall be certified by the Massachusetts Pesticide Bureau in General Pest Control (category 41). The supervisor shall have specific training and experience in vertebrate pest management, commercial rodent control, general pest control, and integrated pest management.

3. Applicators shall be licensed by the Massachusetts Pesticide Bureau in General Pest Control (category 41). Applicators shall have specific training and experience in commercial rodent control and integrated pest management.

4. The supervisor and applicators shall have up-to-date knowledge of pest control techniques as obtainable through national or regional pest control associations and attendance at training seminars.

5. The supervisor and applicators shall have experience and ability in record keeping and data management.

6. The supervisor and applicators shall possess communication skills (both oral and written) adequate to ensure effective communication with residents and businesses.

1.07 COORDINATION

A. Work shall not proceed until written release is issued by Harvard's Project Manager.

B. Establish an Initial Program to control rodents before field mobilization begins for the demolition and construction work designated on the Plans and with adequate timing to achieve control before environmental disruptions and site work begins. Provide a Maintenance Program until construction is completed and all equipment and materials are removed, as determined by the Harvard Project Manager.

C. Perform the Work according to the preliminary schedule described in this Contract and as revised by the Harvard Project Manager. Estimated durations and start dates may be changed by the Harvard Project Manager to suit changes in construction schedules and field conditions. The Work could potentially require performance any day of the week and any hour of the day or night, regardless of weather, as authorized by the Harvard Project Manager.

D. Perform this Work in such a manner that toxicants or other control tools do not pose a hazard to persons, domestic animals, or non-target wildlife.

1.08 PERMITS

A. Obtain and maintain in coordination with the Harvard Project Manager appropriate permit(s) from city, state or federal agencies for pest control activities associated with this Work.

B. Obtain and maintain in coordination with the Harvard Project Manager all right-of-entry permits required for the performance of this Work. This includes all

utilities and private properties to which entrance is required, as approved by the Harvard Project Manager.

1.09 PRODUCTS

A. Furnish and use only pesticide formulations registered by the U.S. EPA and the Massachusetts Department of Food and Agriculture, where appropriate according to label directions and as acceptable to the Harvard Project Manager.

B. Furnish and use devices and supplies (e.g., traps and bait stations) to facilitate the management and effectiveness of the pest control program, where appropriate according to label directions and as acceptable to the Harvard Project Manager.

1.10 MEETINGS

A. Meet with the Harvard Project Manager weekly to discuss pest control activities.

1.11 SURVEY

A. Before baiting begins, conduct a thorough baseline survey of the proposed construction area and accessible or observable bordering areas and record signs of rodent activity and sanitation deficiencies. Closely inspect all embankments, edge areas, and properties within and adjoining the construction area. Maintain survey records in the manner described in 1.16.

B. Thoroughly inspect construction areas and accessible or observable bordering areas designated on the Plans, and any nearby areas designated by the Harvard Project Manager, for rodent activity and sanitation deficiencies weekly throughout the duration of this Contract and in accordance with the work schedule. This weekly survey shall include every premises within the areas designated. Perform one of these surveys every other month during dark (between one hour after sunset and one hour before sunrise), as acceptable to the Harvard Project Manager. Maintain inspection records in the manner described in 1.16.

C. Plan the control program and allocate resources based on survey and inspection data. Pest control areas designated on the Plans are approximate and the Contractor shall extend services beyond those areas as required based on survey and inspection results.

1.12 APPLICATION FOR RODENT CONTROL

A. Apply rodenticides in strict accordance with EPA-approved label directions and the Rules and Regulations of the Massachusetts Department of Food and

Agriculture. Maintain records of all bait placements in the manner described in 1.16.

B. Where appropriate, use properly secured and tamper-resistant bait stations consistent with EPA regulations. Individually number and properly identify all bait stations as acceptable to the Harvard Project Manager.

C. For suspected rodent burrows, determine the presence of activity prior to application of bait or tracking powder. Plug all burrows immediately after bait application. Check baited burrows frequently to ensure that the bait has not been pushed out and to determine when rodent activity has ceased.

D. Bait Surface Applications

1. Initial Baiting: Rid the construction area of all detectable rodents before construction begins. Bait all active rodent burrows. Install and secure bait stations at regular and appropriate intervals and locations, and document rodent activity (burrows, droppings, bait consumed, dead rodents). Replenish bait and shift bait stations as necessary to ensure complete control of rodent populations. Bait edge and accessible bordering areas designated on the Plans as necessary to ensure that rodents will not be dispersed by construction activities and that rodents will not infest work areas.

2. Maintenance Baiting: Establish a maintenance baiting program, in construction areas and accessible bordering areas designated on the Plans, prior to site disruption. This includes baiting of any active rodent burrows and continued use of bait stations as necessary to ensure that rodents will not re-colonize. Check bait placements weekly, or more frequently if necessary to maintain control. Use survey and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute bait and bait stations as appropriate to ensure continued control.

E. Cleanup

1. Remove visible rodent carcasses and dispose of them daily consistent with pesticide label directions and applicable codes, laws, and regulations.

2. Notify the Harvard Project Manager within 24 hours whenever rodents (rats or mice) or signs of rodent activity (burrows or droppings) are observed in construction or laydown areas.
3. Upon completion of any pest control operations, remove remaining bait and dispose of it according to the pesticide label and applicable codes, laws, and regulations. Also remove all wires used for subsurface baiting and any bait stations or traps.

1.13 SANITATION

A. As part of the baseline survey described in 1.11 and throughout the duration of this Contract, conduct surveys and inspections to identify and document potential harborage and food sources available to rodents on the construction site and in observable bordering areas designated on the Plans. This includes any littering, improper, or insufficient use of refuse containers, piles of debris, weed growth, and unnecessary or deteriorated hay/straw bales in construction areas. It also includes any bordering areas with sanitation conditions or structural deficiencies that violate City or State sanitary codes.

B. Maintain records of sanitation conditions in the manner described in 1.16.

1.14 COMPLAINT CALLS

A. During construction, respond to pest-related complaints from the adjacent neighborhood within 12 hours when directed by the Harvard Project Manager. Inspect the particular premises and adjacent areas for sanitation and structural deficiencies and also signs of historic and recent pest activity. Provide sanitation and structural maintenance information to the property owner or manager. Use pesticides or traps as necessary and appropriate to resolve the complaint when there is a relationship between the pest infestation and construction activities, or when directed by the Harvard Project Manager.

B. Maintain records of all complaints investigated, in the manner described in 1.16. This includes location, contact person, inspection results, and actions taken. Document the relatedness of the pest infestation to construction activities.

1.15 GENERAL PEST CONTROL

A. When directed by the Harvard Project Manager, determine appropriate methods for any pest control task not specifically identified above and submit them in writing to the Harvard Project Manager for approval in advance. This could include control of insects or vertebrates other than rats and mice. Also submit in advance copies of any certifications or licenses necessary for any work involving control practices not covered by category 41 as defined by the Massachusetts Pesticide Bureau.

B. Maintain records of general pest control activities and results in the manner described in 1.16.

1.16 RECORD KEEPING

A. Use standardized data sheets provided or approved by the Harvard Project Manager to maintain accurate records of date, time period of work, locations, and

type and amount of pesticides or other control tools (e.g., traps) applied. This includes records of surveys, inspections, baiting, changes in pest activity, sanitation conditions, and complaint calls. Submit data in a format acceptable to the Harvard Project Manager and as required under 1.17

1.17 SUBMITTALS

A. Submit to the Harvard Project Manager documentation of pest control qualifications, as described in 1.06, prior to initiating this Work. Thereafter, submit copies of pesticide applicator certifications within 10 days of their issuance or renewal for the duration of this Contract.

B. Submit to the Harvard Project Manager copies of all written correspondence related to permits and right-of-entry for this Work within 10 days of their issuance or receipt for the duration of this Contract.

C. After performing the baseline survey described herein, submit to the Harvard Project Manager a written plan that includes survey results and pest control procedures, indicating materials, quantities, methods, and time schedule. This plan shall include proposed locations for initial baiting and/or trapping and a list of properties where right-of-entry is assumed necessary. Pest control procedures shall be specifically linked to survey results and construction schedules. For each pesticide to be used, submit a copy of the pesticide manufacturer's EPA-approved pesticide label with application directions. This plan shall be submitted within 14 days of the Notice to Proceed and must be approved by the Harvard Project Manager before pest control is initiated.

D. Submit to the Harvard Project Manager documentation of pest control activities and results as follows:

1. Weekly - Submit data sheets for the preceding week at the weekly progress meeting described in 1.10. These shall include locations of sites treated, amounts, and types of pesticide used, number, and types of traps set, survey and inspection results, sanitation conditions, complaint calls investigated, and any problem that occurred.

2. Every two months - Submit a map within 7 days following completion of the Initial Program that shows where rodenticide has been placed and is being maintained. Revise and resubmit this map every 60 days thereafter for the duration of this Contract.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

DIVISION - 17

DEMOLITION WASTE MANAGEMENT

SECTION 017419

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within SECTION 01 - GENERAL REQUIREMENTS, which are hereby, made a part of this Section of the Specifications.

B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the CONTRACT AND GENERAL CONDITIONS.

1.02 DESCRIPTION OF WORK

A. This Section includes administrative and procedural requirements for salvaging, recycling and disposing of construction and demolition waste.

1.03 RELATED WORK

A. Section 013543 – ENVIRONMENTAL PROTECTION

B. Section 015000 – TEMPORARY FACILITIES AND CONTROLS

C. Section 024100 – BUILDING AND ANCILLARY STRUCTURES DEMOLITION

D. Section 024119 – SELECTIVE DEMOLITION AND SALVAGED MATERIAL

E. Section 026000 – MISCELLANEOUS HAZARDOUS MATERIAL REMOVAL

F. Section 028200 – ASBESTOS ABATEMENT AND RELATED WORK

G. Section 028300 – LEAD-BASED PAINT ABATEMENT AND RELATED WORK

H. Section 311000 – SITE PREPARATION

1.04 DEFINITIONS

A. Asphalt Pavement, Brick, and Concrete (ABC) Rubble: Rubble that contains only weathered (cured) asphalt pavement, clay bricks and attached mortar normally used in construction, or concrete that may contain rebar. The rubble shall not be mixed with, or contaminated by, another waste or debris, including coated ABC materials.

B. Coated ABC: Coated brick, concrete and concrete masonry units. Coatings shall include, but not be limited to: paint, stucco applications, plaster, etc.

C. Construction Debris: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction debris includes packaging.

D. Contractor: Refers to the General Contractor and/or Subcontractor responsible for the Work under contract.

E. Demolition Debris: Building and site improvement materials resulting from demolition or selective demolition operations.

F. Disposal: Removal off-site of demolition and construction debris and subsequent sale, recycling, reuse, or deposit in a permitted solid waste landfill or incinerator acceptable to authorities having jurisdiction.

G. EH&S: Environmental Health & Safety

H. Engineer: Authorized representative of the Manager Project. Engineer shall be the Architect or Designer of Record for the project.

I. LEED: Leadership in Energy and Environmental Design

J. Non-Hazardous Construction Waste: Construction waste which does not contain asbestos, lead-based paint or oil and hazardous materials.

K. Recycle: Diversion of demolition and construction debris from the landfill for reuse.

L. Salvage: Recovery of demolition or construction debris and subsequent sale or reuse in another facility.

M. Salvage for Reuse: Recovery of demolition or construction debris and subsequent incorporation into the Work.

N. WMP: Waste Management Plan

1.05 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: The Refrigerant Recovery Technician shall use recycling/recovery equipment that has a current EPA Registration.

B. Regulatory Requirements: Comply with waste collection, segregation, hauling, reuse, recycling, and disposal regulations of authorities having jurisdiction, including but not limited to solid waste regulations.

C. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.

2. Review requirements for documenting quantities of each type of waste and its disposition.

3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

5. Review waste management requirements for each trade.

6. Provide recycling education and recycling information to Contractor and subcontractor employees working on the project.

1.06 PERFORMANCE REQUIREMENTS

A. General: Develop Waste Management Plan that results in end-of-Project rates for salvage/recycling of 75 percent by weight of total waste generated by the Work.

B. Recycle Requirements: Clean Gypsum Wallboard (clean gypsum wallboard material without any existing attached material, i.e., paint, mastic, wallpaper, etc.) must be diverted from disposal to recycling and/or reuse outlets.

C. Salvage/Recycling Goals: The Contractor is responsible to salvage and recycle as much *non-hazardous* construction waste as possible including the following materials:

1. Asphaltic concrete paving.
2. Concrete and concrete reinforcing steel.
3. Brick and concrete masonry units.
4. Wood studs, wood joists, plywood, oriented strand board, paneling and trim.
5. Casework and cabinetry.
6. Structural steel, miscellaneous steel and rough hardware.
7. Roofing.
8. Insulation.
9. Doors, door frames and door hardware.
10. Windows and glazing.
11. Metal studs.
12. Gypsum board

13. Ceiling Panels
14. E-Waste (i.e. computer CPUs, monitors, etc.)
15. Acoustical tile and panels.
16. Carpet and carpet pad.
17. Demountable partitions.
18. Equipment.
19. Plumbing fixtures, piping, supports, hangers, valves and sprinklers.
20. Mechanical equipment and refrigerants.
21. Electrical conduit, copper wiring, lighting fixtures, lamps, and ballasts.
22. Electrical devices, switchgear, panel boards and transformers.
23. Packaging: 100 percent of the following uncontaminated packaging materials: Paper, cardboard, boxes, plastic sheet and film, polystyrene packaging, wood crates, plastic pails.
24. Glass
25. Slurry Wall Materials

D. In the event the Contractor encounters previously unidentified material that is reasonably believed to be hazardous, asbestos containing, coated with lead-based paint or other hazardous material, or oily debris, the Contractor shall immediately stop work in the affected area and report the condition to the Engineer. At no time shall such material be handled or disposed of by the Contractor.

E. The Contractor is responsible for obtaining any and all state and local permits and/or licenses issued by the CDA relating to the management, storage and disposal of solid waste materials, including construction and demolition debris, generated, removed, stored or disposed on the project site.

1.07 SUBMITTALS

A. Waste Management Plan - The Contractor shall develop a Waste Management Plan (WMP) identifying the types and quantities by weight of construction and demolition material and solid waste expected to be reused, sold, donated, recycled, disposed or incinerated. The Plan shall include separate sections for demolition and construction waste management. The Waste Management Plan shall include the following information:

1. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction materials generated by the Work. Include estimated quantities and assumptions for estimates.

2. Waste Reduction: For each C&D material-type, the Contractor shall identify whether the material will be salvaged, reused, recycled, disposed in a landfill and/or incinerated. Include points of waste

generation, estimated total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

a. For C&D materials which will be reused on-site, sold, and/or donated off-site, the following information shall be provided:

i. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

ii. Salvaged Materials for Sale: For each type of material that will be sold to individuals and organizations, provide a list of names, addresses, and telephone numbers.

iii. Salvaged Materials for Donation: For each type of material that will be donated to individuals and organizations, provide a list of names, addresses, and telephone numbers.

3. Waste Disposal/Incineration: The Contractor shall provide the name, address, contact information of the off-site waste disposal/incineration facility. A copy of the facilities current solid waste management facility permit, in accordance with 310 CMR 19.000, shall be included in the Waste Management Plan.

4. Asphalt, Brick & Concrete: The Contractor shall provide the name, address, and contact information for all off-site ABC rubble crushing and/or recycling facilities. For each selected facility, the facility shall also provide a copy of the facility's current solid waste management facility permit in accordance with 310 CMR 19.000, and air quality permit, if applicable. If the facility operations are except from the solid waste regulations (per 310 CMR 16.05 (3) (e)), documentation from the facility, identifying the specific exemption that applies to the facility operations shall be made together with notifications made to municipal authorities.

5. Cost/Revenue Analysis: The Waste Management Plan shall include a cost/revenue analysis for the management of C&D demolition and construction materials.

6. Source Separation: For all C&D materials, the Contractor shall identify in the Waste Management Plan the handling and transportation procedures which will be used for conducting source separation of recyclable materials including sizes of containers, container labeling, and designated location on Project site where materials separation will occur.

7. Waste Management Coordinator: The Contractor shall identify an employee who will be the Waste Management Coordinator for the project. The Waste Management Coordinator will be responsible for implementing, monitoring, and reporting status of waste management work plan.

8. Qualification Data: The Contractor shall identify a Refrigerant Recovery Technician(s) certified by an EPA-approved certification program; the Contractor shall provide a copy of current certification to the Engineer prior to starting work.

9. Waste Management Plan Approval: The Waste Management Plan must be prepared during the pre-planning stage of the Project and submitted for approval within fourteen days of the date established for the Notice to Proceed. Once the Plan is approved, the Contractor is responsible to distribute copies of the Plan to the Job Site foreman and to each subcontractor on the project.

B. Waste Management Final Report – Prior to Substantial Completion, the Contractor shall submit a written Waste Management Final Report summarizing the types and quantities of materials reused, recycled, salvaged, treated and disposed under the Waste Management Plan. This report shall be a cumulative Waste Management Report to be submitted with the following attachments:

1. A record of the type and quantity, by weight, of each material salvaged, reused, recycled, treated, or disposed.

2. Point of generation of each material.

3. Total quantity of waste recycled as a percentage of total waste.

4. Record Keeping for Donations, Reuse, Recovery, Recycling and Landfill Disposal: Documentation shall be submitted by the Contractor and include the following: :

   a. Records of Donations: Indicate receipt and acceptance of salvageable materials donated to individuals and organizations. Indicate whether organization is tax exempt.

   b. Records of Sales: Indicate receipt and acceptance of salvageable materials sold to individuals and organizations. Indicate whether organization is tax exempt.

   c. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable materials including ABC materials by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts,

and invoices. Include documentation for back-charge fees, if any, for improperly segregated materials.

d. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept waste materials. Include manifests, weight tickets, receipts, and invoices.

e. Statement of Refrigerant Recovery: The Refrigerant Recovery Technician responsible for recovering refrigerant shall prepare and sign a document stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations and using equipment that has a current EPA Registration. The document shall include the name and address of technician, date refrigerant was recovered, amount of refrigerant recovered and shipped, and date of receipt of shipment by the reclaimer.

5. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. General: Implement Waste Management Plan. Provide containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Tool-box training shall be provided to all workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute Waste Management Plan to everyone concerned within three days of HPM and EH&S Plan approval.

2. Distribute Waste Management Plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

3. Clearly identify the Waste Management Coordinator and explain the Coordinator's responsibilities to all Project workers.

4. Review and finalize procedures for material separation and verify availability of containers and bins needed to maintain production.

5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

6. Provide recycling education for all workers, subcontractors and suppliers engaged in on-site activities.

7. Distribute recycling educational literature.

8. Provide appropriate recycling signage for containers and workspaces.

C. Site Access and Temporary Controls: Waste management operations must not interfere with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2. Comply with project requirements for controlling dust and dirt, environmental protection, and noise control.

3.02 RECYCLING CONSTRUCTION AND DEMOLITION WASTE

A. General

1. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Conduct source separation of recyclable material by type at Project site, if feasible. For waste, which cannot be source separated at Project site, co-mingle only with waste which is to be separated later at a recycling facility. Contamination of recycling containers with trash or other contaminants will be addressed by the Contractor and who will be solely responsible for payment of all fines and penalties.

a. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin. Inspect containers and bins for contamination and remove contaminated materials if found.

b. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

2. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

3. Store components off the ground and protect from the weather.

4. Remove recyclable waste from property and transport to recycling receiver or process

B. RECYCLING CONSTRUCTION WASTE

1. Packaging:

   a. Cardboard and Boxes: Break down packaging into flat sheets.
      Bundle and store in a dry location.
   b. Polystyrene Packaging: Separate and bag materials.

2. Pallets: Require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

3. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

4. Concrete: Deposit all debris in designated container to be transported to an approved aggregate recycling facility to be crushed and screened for use as satisfactory soil for fill or sub-base.

5. Gypsum Board: Deposit clean gypsum scrap into source separated containers. Protect from weather. Remove edge trim and sort with other metals. Remove and dispose of fasteners and other contaminants. Clean gypsum shall be diverted to recycling and reuse outlets.

6. Metals: Separate metals by material type if practical. Stack salvageable structural steel members according to size, type of member, and length.

7. Wood Materials:

   a. Clean Cut-Offs of Lumber: Deposit into designated clean wood
      container to be transported to designated recycling facility for use mulch or bio-fuel.
   b. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
   c. Sawdust that is generated from painted or treated wood shall be handled in accordance with Section 02600 –

Miscellaneous Hazardous Material Removal and Section 028300 – Lead-based Paint Removal and Related Work.

C. RECYCLING DEMOLITION WASTE

1. Asphaltic Concrete Paving: Break up and transport pavement to asphalt-recycling facility.

2. Brick and Concrete (Coated and Non-Coated): Salvage/Recycle/Dispose
in accordance with SECTION 024100 – BUILDING AND ANCILLARY STRUCTURES DEMOLITION.

3. Masonry: Clean and stack undamaged whole masonry units on wood pallets for reuse. All damaged masonry shall be salvaged/recycled/disposed in accordance with SECTION 024100 – BUILDING AND ANCILLARY STRUCTURES DEMOLITION.

4. Wood Materials: Sort and stack salvageable members according to size, type, and length. Separate lumber waste and deposit into appropriate container. Separate engineered wood products, panel products, and treated wood materials into designated containers.

5. Metals: Separate metals by type if practical. Stack salvageable structural steel members according to size, type of member, and length.

6. Asphalt Shingle Roofing: Organic and glass-fiber asphalt shingles and felts shall be disposed of at a facility permitted by Mass DEP to process post-consumer (used) asphalt shingles. Recycle nails, staples acceptable, flashing trim and accessories as metals.

7. Asbestos containing shingles shall be pre-abated and properly disposed of by a Massachusetts licensed asbestos abatement Contractor, in accordance with all applicable regulations and Section 028200 – ASBESTOS ABATEMENT AND RELATED WORK. [Asbestos abatement work, including disposal of asbestos contain materials, is not included in the Scope of the Work and will be performed by others.]

8. Gypsum Board: Sort and deposit used gypsum wallboard material with attached material, (i.e., paint, mastic, wallpaper, etc.) into separate container. Off-site management of used wallboard includes recycling or disposal.

9. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets, stretch wrap and store in a dry location. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

10. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

11. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

12. Plumbing Fixtures: Separate by type and size fixtures suitable for reuse. Deposit all other fixtures into designated containers by material type to be transported to an approved recycling facility.

13. Piping: Separate piping materials by material composition. Deposit in designated containers. Separate supports, hangers, valves, sprinklers, and other components by material type and deposit in designated containers for transport to approved recycling facility.

14. Lighting Fixtures: Separate lamps by type and protect from breakage.

15. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panel boards, circuit breakers, and other devices by type.

16. Conduit: Deposit conduit and fittings into designated container.

17. Site-Clearing Wastes: Chip brush, branches, and trees on-site.

3.03 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and dispose/incinerate the materials in accordance with federal, state, and local regulations.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. The Contractor shall dispose and/or incinerate of solid waste materials.

B. Burning: Do not burn waste materials on-site.

END OF SECTION

ELECTRICAL SPECIFICATIONS

SPECIFICATIONS
FOR
ELECTRICAL WORK

Scope of Work

The work consists of tool, plants, labour, material, equipment, shop drawings, testing & commissioning of all the work given below:

1. PVC & G.I Conduits & Accessories.
2. Wires, Cables & Cords.
3. Wiring Accessories
4. Light, Fan Points & Circuit wiring.
5. Fans.
6. Light Fixtures.
7. Power Cables.
8. Distribution Boards & LV Panels.
9. Lighting Protection.
10. Earthing System
11. Generators, ATS, Sync. Panel & P.f.i Units.
12. MV (11 KV) Panels & Power Transformer
13. Telephone & Data networking System.
14. Fire Alarm Services
15. CCTV System
16. MATV System
17. Testing

The work shall be carried out in strict accordance with the conditions of contract, Drawings, Technical specifications and as per items of Bill of Quantities and including the responsibility of all related works necessary for their proper functioning, testing, commissioning and satisfactory operation and performance including maintenance for the period specified elsewhere. The contractor shall provide all required technical non-technical personnel, skilled and non-skilled labour, construction equipment, transportation etc., as required for the completion of works in strict accordance with the technical specifications laid here in after.

a) QUALIFICATION OF CONTRACTOR

A licensed Electrical Contractor should have the following qualifications.

a. Must posses a valid Electrical Contractor's license issued by the Electric Inspector of the region Islamabad.
b. Must have in its employment an Electrical Supervisor & B.Sc Electrical Engineer having certificate of competency who will exclusively look after this work.
c. Must have necessary tools, plant and instruments.
d. Must have adequate experience of similar works.

e. Must be approved by Consultant.
f. Must be registered with Pakistan Engineering Council (PEC) in appropriate category.
g. Must be approved by the consultant.

b) RULES AND REGULATIONS

The installation in general shall be carried out in conformity with the Electricity Rules, 1937, and the latest edition of the Regulations for the electrical equipment of buildings issued by the Institution of Electrical Engineers London (I.E.E.) However, in case of conflict between these specifications and the I.E.E. Regulations, these specifications shall be followed and the Consultant to decide.

c) STANDARDS

The latest relevant British specifications and codes, Pakistan Standard Specifications, VDE, I.E.C, I.E.E UK. recommendations shall be applicable. The
consultant is to decide the suitability and application of these standards which
one to be followed for the equipment specified herein.

d) CLIMATIC CODITIONS

All equipment supplied shall withstand, without developing any defect, the following climatic conditions.

Maximum Ambient Temperature	=	55ºC
Minimum Ambient Temperature	=	-10ºC
Maximum Humidity	=	90%

e) SPECIFIC REQUREMENTS

The contractor shall furnish all material and equipment at site, conforming fully to the specifications given herein and to the accepted standards as laid down by British Standards, the Institution of Electrical Engineer, London, and the Pakistan Standard Institution. It is not the intent of these specifications to include all details of design and construction of various material and equipment to be supplied under this contract. The Contractor shall supply and install all material and equipment specified herein and also all installation and small material such as nuts, bolts, washers, shims, angles, leveling material, installation as intended by the specifications.

All material and equipment supplied by the Contractor shall be new and in all respects conform to the high standard of engineering design and workmanship, perform and function as herein specified and fully meet the quality level and ruggedness requirement of the specifications. All material and equipment which have to be supplied and installed by the Contractor shall be passed / approved by the Consultant, even if the same is exactly in accordance with the Bill of Quantities and Drawings.
The contractor is required to obtain approval of the designer consultant's approval for all the electrical material to be used on site. If the consultant considers testing of the material is required at the manufacturer's works,then the consultant must arrange visit of the consultant and client representative to the works and back.All expanses of the consultant and client's representative to be

borne by the contractor including traveling, messing, lodging and daily allowance to the personnel who witness the testing as permissible under the local laws and rules.

The contractor, after the award of work, shall submit for approval of the Engineer all drawings and cuts of equipment, appliances, fixture and accessories that are to be furnished under the contract. After final approval of a sufficient number of copies as desired shall be furnished for distribution. Cuts, catalogues and drawings shall be early marked to indicate the items furnished. Cuts of all fixtures, and not few, shall be submitted.
In case of import of material preference is to be given to Saudi Arabia manufacturers with approval of the consultant.
The custom duties of the imported goods are to responsibility of the client who are exempted from these.

f) APPROVAL OF DRAWINGS AND DATA

The Contractor shall provide detailed electrical drawings, wiring diagrams, foundation details, etc., for all electrical switchgear and all other systems etc., for the Engineer's review for obtaining approval.

The manufacture of electrical equipment shall be started only after the above mentioned drawings and data are approved.

The time required for review and approval shall be considered included in the total time of completion of job.

g) DRAWINGS AND DATA

Three sets of drawings and data for each equipment shall be furnished by the Contractor for the Engineer's approval before commencement of fabrication and manufacture. The drawings to be supplied by the Contractor shall be as follows:-

- Arrangements.
- Dimensional Plans, elevations and front view.
- Foundational Plan, anchors and configuration.
- Incoming and outgoing cable termination positions.
- Earthing arrangement.

Electrical Drawings showing.

- One-Line diagram.
- Details wiring diagram.
- All interconnections.
- Instrument transformers.
- Relays, their locations and internal wiring diagrams.
- Other electrical devices including meters instruments and their wiring diagram.
- Signal and alarm circuit.

h) SHOP DRAWINGS

The design drawings show approximate conduit routes and depict only the position of various fixtures and outlets. All the actual planning for the conduit routes shall be carried out, well in advance of the actual execution of work, by the Contractor to the satisfaction of the Engineer. For this purpose the Contractor shall prepare shop drawings and obtain prior approval of the Consultant. The prints of each shop drawing shall be submitted for obtaining approval. Soft copies should also be submitted on CDs.

No piece of work shall be allowed to be executed at site without the availability of these approved shop drawings. These shop drawings shall clearly depict the load balancing chart of each distribution board. Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

i. SETTING OUT OF WORK

The Contractor shall set out the work himself and if any discrepancy is found, he shall report the matter to the Engineer and shall act as directed. If any defective or modified setting out is carried out by the Contractor on his own, he shall rectify or make it good at his own cost.

ii. PROGRAMMING

The contractor shall keep pace with the work of the Civil Contractor and any other specialist contractor. The engineer shall be kept informed about the program and the progress of the work so that there is no hindrance in the execution of work at site.

iii. PROTECTION

The contractor shall take care not to damage the structure, material, equipment and property belonging to and/or installed by other contractors during execution of work and shall repair and make-good all losses at his own cost, if found damaged in the opinion of the Engineer.

iv. CHANGE OF SPECIFICATIONS

No change in specification of the equipment / material will be allowed at any stage, except with the prior approval of the designer Consultant.

v. PURCHASE OF EQUIPMENT / MATERIAL

All the equipment and material e.g. transformers, switchgear, cables, conduits, Light fixtures and fans will be purchased direct from the manufacturer. Certificate and copies of delivery challans for all such material will be produced as and when desired, prior approval of the consultant must be obtained.

vi. MANUFACTURERS AND BRANDS

Where brands and names of Sub-Station equipment or any other system are specified by name, alternative can be offered provided these are equal in quality to those specified. Satisfaction of the Consultant in this respect shall be essential and prior approval for such deviation shall have to be obtained before submission of Tenderers. However all equipment for any one substation or system shall be from one manufacturer with his guarantee.

vii. FACTORY TESTS

All routine type tests on switchgear, fusegear, Light fixtures, Cables and other equipment shall be performed at the manufacturer's factory in the presence of the Engineer & Consultant see para 1.8 (the specific requirement). The contractor shall inform the Engineers about the date and time of tests on each equipment at least two weeks in advance. All test result shall be supplied in triplicate for the Engineer's record. The witnessing of test by the Engineer Consultant shall not absolve the contractor of this responsibility for the proper functioning of the equipment, and for furnishing the guarantee.

viii. OWNER'S SUPPLIED MATERIAL

Material and equipment if supplied by the Owner shall be made available at site
Store to the contractor for installation. Any transportation up to and within the site of work shall be at the cost and responsibility of the contractor. The contractor shall ensure safe handling and proper protection after the material and equipment are issued to him at site store and shall install at his own cost.

ix. SPARE PARTS LIST

A list of spare parts recommended by the manufacturer required for one year's operation of each equipment where deemed necessary together with unit price of each part, shall be supplied by the contractor. The spare parts as approved by the consultant must be supplied before provisional approval certificate of the building issued.

x. GUARANTEE

The contractor shall furnish written guarantee in triplicate of the manufacturer for successful performance of each equipment. Such guarantee be of material or workmanship. The guarantee shall cover a minimum period of 12 months effective from the date of completion certificate.

xi. AS BUILT DRAWINGS

The contractor shall, during the progress of work keep a careful record of all changes and revision where the actual installation differs from that shown on shop drawings. These changes and revisions shall be accurately carried out on the shop drawings and submitted to the Engineer for approval. After approval these drawings shall become the property of the Owner.
These updated and approved shop drawings depicting clearly As-Built drawings shall be submitted to the Engineer. Reproducible tracings of all these As-Built drawings shall be handed over to the

Engineer. Final payment will be withheld until the receipt of the approved As-Built Drawings. Soft copies on CDs should be handed to the Engineer.

xii. TEST REPORTS

The contractor shall be responsible for reports / certificates and get the installation inspected / passed by the Regional Electric Inspector at his own cost. As the testing of wirings installation etc. is not covered by the electrical inspector therefore independent testing company which is as recommended by the consultant should be employed, the installation will not be accepted without it.

xiii. WAPDA (IESCO) REQUIREMENT

The contractor shall assist the owner in sponsoring application for electrical connection liase with WAPDA/IESCO and carry out necessary formalities. Any special requirement of WAPDA/IESCO shall be complied with by the contractor. The owner shall arrange to deposit all amounts, on demand, to WAPDA/IESCO for providing service connection and security deposits thereof as required by IESCO.

xiv. TELEPHONE CO's REQUIREMENT

For the supply, installation and regularization of telephone system, the contractor shall obtain N.O.C from Director General, PTA, and Ministry of Communications. Government of Pakistan. Any special requirement of the PTA shall be complied with by the Contractor.
The Owner shall arrange to deposit all amounts on demand from PTCL(Telephone company) for obtaining telephone connections to public Exchange and security deposits etc.

SECTION-1

PVC, STEEL CONDUITS AND ACCESSORIES

1.1 CONDUITS:

The conduit for wiring of circuits, lights, sockets outlets and other systems shall be made of PVC manufactured under the trade names of Beta, Popular conforming to BSS 3505/1968 Class-D

Steel(GI) conduits shall conform to BSS 31 or /latest standard and shall be of any famous Philippines manufacturer as approved by the consultant The MS conduits shall be enameled with good quality non-cracking and non flaking black paint, with 2 coats of ICI or Berger red oxide.
The manufacturers & conduits (PVC/Steel) must be approved by the consultant.

1.2 FLEXIBLE PIPE:

Steel Flexible (galvanized) conduit shall be furnished and installed where necessary for convenient dismantling and/or avoiding vibrations to be transmitted. Flexible conduit shall be spiral interlocked type made of steel strip construction and then galvanized. In case of plastic coating zinc coats can be avoided. Alway use such conduits above false ceiling when dropping wires to light fixtures from roof boxes.

1.3 CONDUIT ACCESSORIES:

Factory made round PVC junction boxes shall be installed with non pressure type PVC conduits. Junction boxes shall be of 60mm dia and 75mm long to receive PVC conduit and shall be concealed in RCC of slab. The wall type junction box shall also factory made round PVC boxes having minimum dimensions of 60mm dia and less 30mm long. Each junction box shall be provided with one piece cover which shall be fitted on the box with chromium plated serous.

1.3.1 Conduit accessories such as switch boxes, socket outlet boxes. Pull boxes inspection boxes shall be made of G.I of 16/18 SWG steel having dust light covers. All boxes shall have required number of conduit entry holes and earth terminals for connecting E.C.P. All the rectangular or square shaped boxes shall have nipples to receive PVC conduit with force fit. Shapes sizes of these boxes shall be as per British Standards. No local inventions are accepted.

1.3.2 Manufactured smooth bends shall used where conduit change direction. Bending of conduit by heating or otherwise shall be allowed only at special situations with the permission of the Engineer. Use of shape 90 degree bends and tees is probhited. Bends shall have enlarged ends to receive the conduit without any deduction in the internal diameter of the PVC pipe.

1.3.3 All accessories e.g. boxes, couplings, bends, solid plugs, bushes, reducers, check nuts etc. shall be equal in quality to the specified conduit.

1.3.4 Not more than 10 meter conduit run without a inspection box is allowed, also provide a inspection box after every 2 ninety degree bends.

1.4 INSTALLATION INSTRUCTIONS:

The contractor shall furnish all labour and material for the installation of conduit as required.

1.4.1 Where conduits are to be fixed to steel trusses it should be done with G.I hospital saddle Red oxide painted or galvanized using self threading screws of brass or stain less steel.

1.4.2 Where conduit cross from one truss to anther and these are more than 1 meter (1000mm) away than a steel angle (50x50x6mm) should be provided.

1.4.3 Conduit shall be installed concealed in RCC ceiling slabs, columns, walls and floor etc. Recessed conduit shall be laid over first tier of reinforcement and under the second tier of reinforcement before pouring of concrete. All conduit outlet boxes to be concealed shall be laid firmly flush with the soffit of the slab or beam. The conduit should be tied to the reinforcement firmly so that the alignment is not disturbed by vibrators. All the outlet boxes installed shall be stuffed their cover plates fixed so as to prevent concrete entering the outlet boxes.

1.4.4 Under no circumstances shall chassis be made for recessing conduit in the RCC structure after it has been cast without the permission of the Structural Engineer. Where conduits have to be concealed in cement concrete or brick masonry, chases shall be made with appropriate tools not deeper than required. The conduit shall than be fixed in the chases with iron hooks before covering it up with at least 20mm thick plaster. Conduit ends pointing upward shall be properly sealed to avoid entry of foreign material.

1.4.5 The drawing show conduit routes but planning for proper arranging conduit routes shall be carried out by the contractor to the satisfaction of the Engineer.

1.4.6 The entire conduit system shall be essentially completed before wire pulling is taken in hand. Each conduit run shall be tested for continuity and obstruction. All obstruction shall be cleared in an approved manner. Water and moisture that has entered any section of the conduit installation must be dried with suitable swabs to the satisfaction of the Engineer.

1.4.7 Adequate expansion joint shall be provided in all conduit runs passing across the expansion joints in the concrete slabs of the building. Contractor to suggest a proper method for approval from consultant.

1.4.8 Pull boxes shall be installed in conduit runs at intervals mentioned below to facilitate the pulling length of wires:

i)	Straight runs.	10 meter.
ii)	Runs with one 90 Degrees bends.	07 meter.
iii)	Runs with two 90 Degrees bends.	07 meter.

The minimum length of conduit for inspection / pull boxes, distribution boards and switch boards shall be in an approved manner to the satisfaction of the Engineer without any additional cost in the owner.

1.4.9 Conduit runs between two outlets shall not contain more than two quarter bends or one 90 degree bend.

1.4.10 All the free ends of conduit shall be solidly plugged till such time as final and proper terminations are made.

1.4.11 All conduits of a system shall be run at least 150mm away from the other systems and services where conduit of one system crosses the other it shall be done so at aught angle i.e.90 degree.

1.4.12 All multiple runs of conduit shall be arranged symmetrically.

1.4.13 Exposed runs of conduit where required shall be firmly held by means of hospital type saddles, clamps etc. to the surfaces of walls, columns and ceiling, Rawal plugs or Phil plugs may be used for fixing saddles, clamps brackets etc. The spacing between two saddles may not be more than 760mm. The straight runs on walls may be 450mm to 600mm below the ceiling and in the event of any obstruction due to bands the runs may be routed them. The conduit shall have a minimum clearance of 6mm from the surface supporting it, purpose made special clips and brackets may be required at some situations to support the conduit. Plugs, anchors etc.shall be of Hilti or spit companies.

1.4.14 No conduit less them 20mm dia shall be used for point wiring and 25mm dia for circuit wiring upto switch box. The size of conduit shall be determined from the number of wires required in the conduit run according to number of wires allowed as per IEE Regulations.

1.5 MEASUREMENT:

1.5.1 All conduit work including all accessories shall be measured on the basis of actual numbers of circuit, light points, call bell points and / or 13A,10A or15A socket outlet points installed as shown on drawing, or as specified in the B.O.Q.

1.5.2 For other systems the conduit work shall be on actual measurement basis on the running length installed in feet or meters as the case may be or as specified in B.O.Q.

SECTION-2

WIRES, CABLES AND CORDS

2.1 WIRES & CORDS.

The wires & cords for conduit wiring shall be single core. Made of stranded or Solid copper conductor purity 99.9 %. PVC insulated, tested to BS 6004, 1975. The voltage grade shall be 300/500 volts or 450/750V unless otherwise specified on drawings and Bill of Quantities. The cables shall be of M/S Pakistan cables Limited. M/S Newage Cables Limited, M/S Fast Cables.

In order of preference as approved by the Engineer. The size of the wire shall be as follows:

i) For light or fan point to point wiring with 1.5mm square with 2.5mm sq as earth conductor
ii) For light circuit wiring with 3 no 2.5mm square or as specified in the B.O.Q.
iii) For power plugs 13A wiring with 4mm square or as specified in the B.O.Q.
iv) The sizes of cables from main panel board to Sub-Main Panel Board to distribution boards shall be as shown on drawings or as specified in B.O.Q.

2.2 INSTALLATION INSTRUCTIONS.

2.2.1 The contractor shall furnish all material and labour to pull in and install wires and cables as required. The contractor shall also supply, without extra cost, wire accessories e.g. plugs, solder, clamps, supports, fixing pins, adhesive tapes. Connector's identification tags, straps, filling compound and earthling clips etc. as are required to be furnished for complete wiring installation in accordance with standard practice. The pulling of wires shall be taken in hand only when all conduit system is complete.

2.2.2 The wiring of the installation shall be strictly in accordance with scheme, cable sizes and circuit details as shown on drawings and specified in 2.1.

2.2.3 ?All wiring shall be continuous between terminations and is not allowed be allowed. Super and Tee connections are strictly prohibited. Looping in System shall be followed throughout.

2.2.4 Use boric powder or talcum powder to facilitate pulling of wires, but no. of wires should be within limit as specified by IEE U.K.

2.2.5 All wires occupying the same conduit shall be pulled together. Wires and cords at the time of pulling shall not be subjected to a bending radius more than 10 times the over all diameter of cables. Cable manufacturers recommendation of pulling speed and pulling tension on cables shall govern the pulling operation.

2.2.6 Not more than 3 circuits of same phase to be run in one conduit. Wires of two different phases, however, shall not be run or terminated in the same conduit or outlet box, for single phase wiring of lights, switches and sockets.

2.2.7 Porcelain connectors can be provided for a joint between light point wiring and light fixture wiring and housed in the outlet box provided for this purpose. The contactor after terminations are made shall be wrapped in PVC insulation tape.

2.2.8 The quantity and the size of the wire contained in any conduit shall not be in excess of the numbers permitted by I.E.E(UK) regulations.

2.2.9 All point and circuits wiring shall be solidly earthed by 2.5mm square PVC insulated wire of colour Green, Yellow to serve as CPC(ECC) which shall be run inside the conduit.

2.2.10 10A or 13A sockets can be looped as shown in the drawings with wires sizes given in single line or schematic drawings of D.B's

2.2.11 All 15A Sockets shall be wired directly from the D.B with wires as shown in single line or schematic drawings.

2.2.12 No two dissimilar phase like red & yellow or yellow & blue to run in same conduit, always use separate conduits.

2.2.13 No two dissimilar phases should be in same G.I box for switches. Where required sue separate boxes, indicating colours of phases.

2.2.14 No wiring work shall be started unless all conduit work including switch boxes is complete and cleaned of debris, oil or such impediments. Permission in writing is required from the Engineer before commencement of wiring work.

2.2.15 No extra loops of wires should be kept in switch or socket boxes.

2.2.16 No neutral wire shall be brought to switch box. If done so the cost of extra wire to be deducted from the bill of the contractor.

SECTION-3

WIRING ACCESSORIES

3.1 SWITCHES:

3.1.1 Indoor switches controlling lights and fans shall be single pole. 10A one or two ways suitable for 250V, 50Hz. The body of the switches shall be made of moulded plastic, one, two, three, four or six gang with integral built in moulded plastic face plate suitable for fixing on a G.I steel back box. The switch contacts shall be silver alloy tipped and these shall operate with snap action. The switches shall conform with BSEN60669-1, SS227.

3.1.2 Weather proof switches on external lighting circuit shall be rotary type with quick make quick break action rated 10 Amps, 250V, 50Hz.

3.2 SWITCH SOCKET OUTLET UNITS:

3.2.1 Switch and socket units shall be single pole, 3pin rated 10A, 13A or 15A, 250V, 50HZ. These shall be moulded plastic type with ivory white integral built-in face plate. Each socket shall have its control switch by the side of it. Thus the complete unit specified in B.O.Q shall be as switch and a socket outlet unit. The switch socket outlet unit shall comply with BBS 546 and BSS 1363, 1995 & SS145 and of the quality as approved by the consultant.

3.2.2 Weather proof switch units shall have a cast iron outlet box with threaded conduit entry holes or nipples, rubber gasket and a spring loaded sheet steel cover.If plastic it shall have plastic cover and to IP 66.

3.2.3 Ceiling roses shall conform to BSS 67/1969. Lamp batten holders shall conform to BSS 5024 part-1.

3.2.4 All switches & sockets should be fixed on G.I steel boxes conforming to B.S4662.

3.3 INSTALLATION INSTRUCTION:

All the switches and switch socket outlet units shall be installed on 16/18 SWG thick G.I steel outlet boxes of appropriate sizes. All sheet boxes shall have conduit entry and terminals for connecting or 2.5mm (sq) PVC insulated circuit protective conductors. (CPC)

3.4 MEASUREMENT:

3.4.1 The number of units installed shall be taken as the basis of measurement or as specified in the B.O.Q.

SECTION-04

LIGHT/ FAN POINTS, CIRCUIT & SOCKET OUTLETS WIRING

4.1 LIGHT/FAN POINTS WIRING

The wiring for lights & fan is divided in 3 steps as given below:

a) The circuit wiring is from D.B to first light point of the circuit with 3 no.'s wires of 1.5mm² or 2.5mm² in PVC conduits as mentioned in B.O.Q.
b) From first light point take 2x2.5mm² (Phase+Earth) to switch box in PVC conduit of 20mm conduit from first point to switch box.
c) From switch box take out no. of half wires for the lights/fans which are to be served by each switch, so that there should be same no. of wires as switches in the box. The conduit mentioned and measured in 4.2.1(b) is to be use for these wires.

d) From first point to next point use 3 x 1.5mm² or 2 x 2.5+1 x 1.5mm² of each light or no. of lights served by one switch. The neutral & earth wire will remain 2.5mm² of black & green colours.

4.2 SOCKET OUTLET WIRING

a) For 13A & 10A sockets use 3 x 4.00mm² copper wires in 20mm conduits upto first socket point from D.B.
b) Then from first socket point to 2nd then to 3rd (point to point3x4.00mm sq).
c) Where shown 2 sockets one of 10A & other of 13A adjacent to each other in that case loop these sockets and then go to anther point using same 3 x 4.00mm² wires.
d) Where shown 15A sockets use 3 x 6.00mm² copper wires direct from D.B to the socket in 25mm PVC conduits.

SECTION-05

FANS

5.1 GENERAL

All fans shall be capacitor type Deluxe models and suitable for operation on 200/240 Volts, 50 Hz. A.C. Supply. All ceilings fans shall have variable speed dimmers not less than 400 rating.2 gang dimmers can also used. The air displacement shall be 10,000 c.f.m. for 48" (1219mm) sweep and 12,000 c.f.m for 56" (1423mm) sweep at maximum speed. The fan motor shall be capacitor type and bearings shall be groove type to given noiseless and quiet operation. The noise level relative to a frequency range of 1000 Hz should be within the limits of ± 3 db.

5.2 DIMMERS

The dimmers shall be recessed / surface type as required or as specified in the B.O.Q.

5.2.1 The fans and dimmers shall be of MK Legrand Clipsal make of 250 watts rating or approved equipment. All the fans shall be tested at manufacturers work to Pakistan Standard specification PS-1. Five (5) fans per hundred shall be tested at factory, before dispatch, in the presence of the Engineer for noise-level performance, particularly, in addition to other routine tests without any cost to the Owner.

5.3 FAN HOOKS

The fan hook shall be of 15 (15.87mm) dia. Galvanized Mild steel rod bent to shape of approved design. It should be in the form of a loop about 80mm (87.5mm) long and about 200mm (50mm) wide. The rod shall be bent to have at least 22mm (200mm) extension on both sides for tieing it to the reinforcement steel of the slab. All ceiling fans shall be of one make only.

5.4 ISTALLATION INSTRUCTIONS

5.4.1 All fans shall be installed at a height of 300mm from the finished floor level.

5.4.2 The fan hook shall be installed in the RCC slab of the ceiling at the time of pouring concrete. The fan hook extension rods shall be tied to the reinforcement steel firmly so as not be disturbed during vibrator operation of concrete. The fan outlet box shall be installed exactly in the middle of the fan hook loop.

5.4.3 The installation of fan shall include fixing of down rod, clamp, fan, blades, fan dimmer and extension of wiring through down rod from ceiling rose to the fan terminals, testing and commissioning.

5.4.4 The down rod shall have along threads to receive checknuts 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.

5.4.5 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.

5.5 MEASUREMENT

For the purpose of measurement this item shall be as actual number of fans of various sizes installed or as specified in B.O.Q.

SECTION-06

LIGHT FIXTURES

6.1 GENERAL

Light fixture schedule is provided in the drawings alongwith catalogue numbers of the manufacturers which are meant to serve as illustrations of the types of fixtures required for various applications.

The contractor shall be required to submit samples of each and every light fixture for the approval of the Engineer, before commencing with mass production of the fixtures. The contractor should be prepared to carry out any number of modifications and improvements in the submitted sample free of cost until a finally acceptable sample in produced. Mass production shall be taken in hand only when a finished and modified sample has been produced and approved in writing by the Engineer. The contractor has the option to offer acceptable equivalent of the specified light fixtures but to be installed with prior approved from Engineer.

6.2 INCANDESCENT LIGHT FIXTURES

6.2.1 The glass globes / shades / diffusers of the incandescent light fixture shall be first class quality glass free from any air bubbles or voids. The glass shall generally be of opal white colour unless otherwise specified. The shape of the glass may be spherical, hemispherical, flattened bottom or tablet shaped as required. The glass shall be tempered for the heat emitted by the lamp, enclosed in it.

6.2.2 Surface mounted fixtures shall have stove enameled sheet body black or white. It may also be stain brass or aluminimum anodized finish as required. The fixture holes shall match the outlet box. Wall bracket light fixtures shall have back plates with matching holes of the outlet box and decorative finish as required.

6.2.3 All light fixtures shall have screw type lamp holders E 27 and Philips GLS lamp, to BSS 161/latest clear or frosted and having a minimum useful life of 1000 hours.

6.3 FLUORESCENT LIGHT FIXTURES

6.3.1 All the light fixtures shall have lamps and efficient electronic ballasts of the wattage specified. The fluorescent lamp shall be either 2 ft.-20 watts or 4 ft.40 watts and the colour shall generally be day light TLD 86, cool day light and or warm white TLD 84 in the order of preference or as mentioned specifically. The fluorescent lamps shall be Philips or OSRAM (G.E.C) to BSS 1853 but having a minimum useful life 5000 hours. The new generation of 26mm dia. 18 watts and 36 watts energy efficient lamps shall be preferred. Not more than 2 fluorescent tubes (20/40W) to be connected to one electronic ballast.

6.3.2 The ballast shall be electronic & totally enclosed efficient type suitable for operation on 240 V, 50 Hz, single phase supply, A wiring diagram, wattage, voltage and current ratings shall be printed on the body of the ballast. The power loss shall not be more than 1watts for 40 watts ballast. The ballast shall be noiseless in operation without any whistling sound. The manufacture shall be called upon to guarantee trouble free life of 3 years, effective from the date of completion Certificate.

6.3.3 All electronic ballast shall be provided with power factor improvement arrangement.

6.3.4 The lamp holder shall be lock-in rotary type.

6.3.5 The internal wiring of the light fixture shall be carried out at manufacturer's factory with heat resistance wires of size not less than 1.5mm square. A glass braided sleeve to cover these wires inside the fixture.

6.3.6 The louvers of light fixture shall be made of anodized aluminimum.

6.3.7 The body of the light fixture shall be white or gray stove enamel as required. The industrial reflector shall have white stove enamel finish inside and gray / green stove enamel finish outside. Appropriate sized bushed entry holes, and fixing holes shall be provided. The

thickness of the sheet steel used in the fabrication of the body and reflector shall not be less than 22 gauge.

6.3.8 Pendent type of fixture shall be hanged by 2 No.'s Chromium plated or galvanized pendent tubes of dia 20mm or 25mm for suspension or as per detail shown on drawings with circular G.I plates of same size as circular box fixed to it (circular box) or without direct to roof or steel structure.

6.4 DIMMABLE FLUORSCENT LIGHT FIXTURES

For areas where dimmer shall be provided the provision of fluorescent light fixtures in general and its allied control gear in particular shall be strictly in accordance with the manufacturers recommendations and to the entire satisfaction of the Engineer.

The requirement of control circuiting depending upon the type of fluorescent tubes (rods) used 38mm dia. or 26mm dia. with or without metallic firing strip (or metal net) shall be strictly conforming to manufacturers recommendations. Wiring diagrams of each light fixtures showing the relative position of ordinary and/or electronic ballast, filament transformers, base load resistors and compensating p.f. capacitor shall be submitted to the Engineer for approval alongwith detailed specification of each component and with technical brochures.

6.5 DIMMERS

The dimmers used shall be universal type i.e. suitable for use with incandescent and fluorescent lamps. The planning of making three phase assemblies and integration with relevant distribution boards specified hereinafter shall be contractor's responsibility. The dimmer rack assemblies shall be sheet steel clad, flush wall mounting type, modular in construction and solid state design comprising of automatic and slave dimmers suitable for operation on 3 phase, 415 volts, 50Hz supply. Each dimmer rack assembly shall be provided with direct or remote, as most suitable to requirement push button control plates with the following five standard options. The dimmers for chandlier should not be less than 1000W rating.

Light/ dark-preset-stop-ON/OFF.

The capacity of the dimmer rack assembly shall be commensurate with the installed lighting load.

The schematic wiring diagram of the dimmers showing the relative position of its components e.g. Isolators, thrystors, contractors, RYB indicator, instruments, fuses, relays and MCB's for final sub-circuit protection and push button controls shall be submitted to the Engineer for approval.

The dimmers shall be manufactured by M/S Polaron Controls U.K., M/S Strand Lighting U.K. and/or M/S Altenburber W. Germany. M/S Clipsal Australia or M/S MK, UK.

6.6 INTALLATION INSTRUCTIONS

6.6.1 The light fittings shall be installed according to manufacturer's recommendation or as approved by the Engineer.

6.6.2 Flexible connecting wires from outlet box to the fixture shall be provided by the Contractor, connector made of porcelain or thermoplastic material shall be provided and installed in the outlet boxes for connecting flexible wires to the point wires. But preferable method is to loop at the connector of the fixture.

6.6.3 Outlet boxes or any openings in the ceilings are walls shall be covered with plastic cover of same colour as of the wall or ceiling

6.6.4 Rawal plugs or nylon plugs of Hilti(Turkey) or Spit(France) companies with wood screws shall be used for fixing purposes

6.7 MEASUREMENT

Actual number of units installed shall be taken as the basis for measurement or as specified in B.O.Q.

SECTION-07

POWER CABLES

7.1 GENERAL

Power cables conforming to these specifications, described in the B.O.Q. and as shown on drawings shall be supplied tested and installed at manufacturer's works. The cables shall be manufactured as specified hereunder.

7.2 11KV POWER CABLES

7.2.1 All XLPE 11KV cables shall be manufactured to I.E.C. standard 502-1 or BSS-5467 and of 8700/15000V grade.

7.2.2 The XLPE cables shall be provided with extruded semi-conducting conductor screen over standard circular copper conductors before XLPE insulation is provided. On each core of conductor another layer of extruded semi-conducting core screen and copper tape screen are provided. The number of cores required than shall be put together and the antispaces filled with non hygroscopic fiber filler and binding tape. The core is extruded with another PVC bedding.

7.2.3 Galvanized steel armour is provided underneath an overall PVC sheath.

7.2.4 11KV XLPE cables shall be manufacturered by M/S Pakistan Cables Ltd. Pioneer Cables Ltd. or NewAge Cables Ltd. As approved by the Engineer.

7.3 L.T CABLES

The low tension cables shall be manufactured to the requirements of B.S 2004, B.S 6004, B.S 3346 latest or VDE 0271 and rated at 250/400 and 600/1000 Volts as the case may be. The cables for street lighting shall be with split con-centric neutral to B.S.S 4553/latest. The cables shall be manufactured by M/S Pakistan Cables Limited or Fast Cables Ltd. or NewAge Cables Ltd. order of preference as approved by the Engineer.

7.3.1 The conductors shall be annealed copper conductors, single or strandard circular or shaped as the case may be, to B.S.S. 6360/69.

7.3.2 The conductors specified for use in the cables shall be at least 99% IASC conductivity.

7.3.3 The reference temperature for the purpose of determining the standard resistance of the conductors shall be 30 degree centigrade the correction factors to be applied as per latest edition of IEE UK wiring regulations.

7.3.4 The conductors shall be insulated with poly-vinyl chloride insulation. The minimum thickness of the insulation shall be in conformity with the relevant British standards

7.3.5 On all multicore cables proper markings for core identification shall be provided to B.S. specifications.

7.3.6 Power cables shall be multicore cables, insulated and sheathed, armoured or unarmoured as required.

7.3.7 Various conductors forming the cables shall be laid together and voids shall be filled with soft plastic or fibers materials so as to give a circular shape to the cable.

7.3.8 A tough PVC shall be extruded over the cable so as to cover the insulated conductors and fillers.

7.3.9 Where armouring is required a soft PVC jacket shall be provided over the laid up cable steel wire armouring shall be applied on a tough PVC sheathed extruded over the cable so as to cover the insulated conductors, fillers, jacket and armouring.

7.3.10 Complete identification of cable together with Manufacturer’s identification markings if required shall be embossed on the final over sheath of the cable at every meter length.

7.3.11 The following tests shall be carried out by the manufacturers:-

i) Dielectric Strength Test.
ii) Instantaneous and long time break down strength test.

iii) Temperature rise test.
iv) High Voltage Test.
v) Copper/Aluminum purity test.

Test certificates covering all these tests shall accompany the cables supplied by the Contractor and the tests to be witnessed by the Engineer at manufacturer's works.

7.3.12 After carrying out the tests as laid down in these specifications both ends of the cables shall be sealed at the manufacturers work.

7.3.13 The cables shall be delivered wound over strong drums of suitable dimensions. The cables ends shall be fastened to the drums and completely protected in suitable manner to protect any injury to the cables during transportation and handling. The direction of rolling shall be clearly marked with bold arrows on both faces of the drums.

7.3.14 The owner may require the Engineer to witness the tests as specified herein and the contractor shall make necessary arrangements for the presence of the Engineer/consultant on such tests and obtain their signatures in testimony thereof without any cost to the Owner.

7.4 CABLE TERMINATIONS

All PVC power cables shall be terminated with suitable tinned brass cable glands for securing the armour wires and incorporating a packing ring for excursion of water and moisture. The cables shall be secured at required spacing by means of cleats fixed to walls or roofs or hangers and where multiple runs occur perforated metal tray made of heavy gauge galvanized steel shall be used.

7.5 CABLE MARKERS

For underground installation cable position markers shall be sited in the ground where cables change direction and at 30 meter intervals along straight runs of the cables. Markers shall also be provided to locate the position of joints. Cable markers shall be made of cost iron. Any one of the following words shall be embossed / engraved of the identification of cable routes.

11000 V cable.
440 V cable.
11000 V cable joint.
440 V cable joint.

The markers shall comprise of a cast iron circular disc of 115mm dia. and 10mm thick to which an angle iron 25 x 3mm bar 710mm long shall be riveted at one end. The end of the bar shall be frok-opened upto a length of 75mm.this end shall be embedded in a cement concrete of ratio 1:3:6 to length, of 180mm. The concrete block shall have a shape of truncated pyramid with base 152 x 152 mm and vertical height of 200 mm.
The cable marker shall be buried in the ground such that its total height above ground level is 267 mm.

7.6 CABLE JOINTS

The contractor shall be in possession of cable jointing kit and all termination shall be made by a bonafide and experienced cable jointer. All cable termination boxes kits and glands shall be of recognized makes and complete with claw clamps, ferrule, lugs, tapes, solders and jointing compounds.

7.7 INSTALLATION INSTRUCTIONS

7.7.1 The contractor shall be under obligations to provide all labour, material and accessories for the installation of cables shown on drawings and listed in the B.O.Q conforming to the specifications in this section.

The contractor shall provide without any extra cost all material for termination of cables such lugs, solders, clamps, supports, ferrules, bushes, as fluxes, taps, fixing pins, identification tags, earthing clips, straps for a complete terminal jointing operation in accordance with the best modern practice.

7.7.2 For underground cable installation the depth of digging the trench shall be such that the top surface of the cable shall not be less than 900mm and more than 1100 mm from the finished ground level. It will be contractors
Responsibility to obtain true trench levels.

7.7.3 Cable routes indicated on the drawings shall be followed unless otherwise specified or agreed to by the Engineer. Where change in direction of the cable is necessitated, the bending radius of the cable which ever is greater.

7.7.4 At all road crossing the cables shall pass through 100/150 mm dia. PVC pipes shrouded in cast concrete, the mouths of which shall be sealed with cable bitumen compound of approved quality after drawing the cable bitumen compound of approved quality after drawings the cable. The road cuts shall be first filled with mud and 50mm size ballast upto 182mmm level below the road surface and after ramming it properly 1500mm thick layer of cement concrete 1:3:6 shall be laid over it.

7.7.5 The cushion of sand to be provided in the trench before laying the cable shall not be less than 75mm and after laying the cable 150mm. The total depth of cushion of sand shall be not less than 225mm. Over the final layer of sand cable marking tiles/bricks or concrete masonry blocks of adequate strength 600mm thick and 300m x 200mm in size shall be provided to satisfaction of the Engineer. The rest of the trench shall be backfilled with earth. In 150mm layers and rammed properly before dressing.

7.7.6 All trenches and holes dug for laying the cables shall not be left open and unprotected for any length of time without completing the job and backfilling and compaction to the satisfaction of the Engineer. Where trenches are left open due to some unavoidable reasons the contractor shall exhibit suitable danger signals such as banners, red flags and red lamps etc.

7.7.7 All cables shall always be lead out or lead into the ground through 2.5 meter long PVC pipes of 100mm dia. Or suitable size as approved by the Engineer. The length of the pipe in the ground shall be 600mm. the pipe should be attached to the poles with approved clamps.

7.7.8 Marker of approved design and inscription shall be installed as specified.

7.7.9 For installation of cable in perforated metal trays, the cable shall be tied or bunched properly in an approved manner. Similarly for installation of cables on cleats or raceway approval of the Engineer shall be obtained.

7.8 MEASUREMENT

For the purposes of measurement this item shall be treated as actual lengths of cables installed in meter or in feet at site as specified in B.O.Q.

SECTION-08

DISTRIBUTION BOARDS MAIN LT PANEL & MCC's

8.1 GENERAL

The distribution boards shall be either free standing cubical type or wall mounting type suitable for surface or recessed mounting. Each distribution boards (D.B) shall be tropical in design, fully dust and vermin proof and liquid repellent. The cabinet housing the main components shall be fabricated from mild steel sheets 16 SWG thick and hinged doors, fully gasketed having one or two leafs depending upon the size of the cabinet shall be provided on each cabinet. All openable parts shall be provided with gaskets or lining and screwed to the main body with chromium plated screws. The cabinets after fabrication shall be thoroughly cleaned completely derusted and degreased before applying one coat of zinc or lead based primer and one coat of ICI red oxide then powder coated in furnace or stove enamel paint in battleship gray colour. All exposed part of the DBs shall be covered with 5mm thick bakelite sheet. A load distribution chart shall be provided in each DB showing the areas fed by each circuit and a suitably sized pocket inside the front door shall be provided for this purpose. Each DB shall be delivered complete with all instruments accessories, rating plates, designations, as approved by the Engineer.

Suitable cable entry glands shall be provided as required for floor mounted boards on incoming cables but for outgoing cables and/or wall mounted boards exact number of conduit entry holes as are required shall be provided with male brass bushes. The bushes shall be tin plated and fully shrouded or housed in gasketed compartments.

8.2 COMPONENTS

The main components e.g. earth leakage circuit breakers (ELCB / RCCB), moulded case circuit breakers, load break switches, HRC fuses and instrument drawings and as described in schedule of quantities shall be the same as described in section 9. However miniature circuit breakers (MCB's) used in db's are briefly described hereunder:-

8.3 MCB's

The incoming shall have triple mcb's suitable for use on 415V, 50Hz, AC and the outgoing mcbs shall be sigle pole or single phase for use on 220V, 50Hz, AC. The rating are as shown in drawings and/or described in the schedule of quantities.

The MCBs shall be moulded case type having hydraulic magnetic short circuit releases, contacts, operating mechanism and arcing chambers.

The MCBs shall be manufactured and tested to BSS 387/1966, and shall have a rupturing capacity of 7.5 KA or as specification B.O.Q. The final circuit mcb's on the outgoing shall however be rated 5KA. The mcb's manufactured by Merlin GERIN(Schneider electric), General Electric,Legrand France Terasaki Japan or approved equivalentby the con The distribution boards shall be manufactured by any bonafide manufacturer.

8.4 INSTALLATION INSTRUCTIONS

All labour, equipment, tools, plant and accessories required to complete the installation shall be provided by the Contractor. The distribution board shall be fixed as required in perfect line and plumb. All earth terminations shall be made on the neutral block.

8.5 TESTING

All D.Bs shall be tested at manufacturer's works and tests shall be witnessed by the Engineer with out incurring any additional expense to the Owner.

8.6 MEASUREMENT

Each distribution board for the purpose of measurement shall be treated as a lumpsum job.

8.7 MAIN LT SWITCH BOARD

8.7.1 GENERAL

The L.T switchboard shall be indoor type, free standing, free supporting, floor mounted, totally enclosed, sheet steel clad, dust and vermin proof, completely wired, factory assembled and suitable for operation on 3 phase 4 wire system, 415V, 50HZ, AC supply. The board shall be suitable for installation back to the wall the wall and capable of front attendance. The switchboard shall comprise of multi panels suitable for housing, air circuit breakers, moulded case breakers or load break switches as shown on the drawings and as listed in the schedule of quantities. The switch board shall be designed to suit service conditions and ensure security and safety during operation, inspection, operation, cleaning and maintenance. The switch board shall be designed and tested to IEC recommendations. Each panel shall withstand strain of 2000 volts insulation level for one comprise of the following main components and each removable component of the same rating shall be physically and electrically interchangeable are also acceptable. The switch board shall be as approved manufacturer.

8.7.2 AIR CIRCUIT BREAKERS

The Air Circuit Breaker shall be triple pole of specified rating, fixed type, trip free, spring charged, quick make, quick break manually operated mechanism and visual ON/OFF position indicator. The circuit breaker shall be suitable for continuous duty for the rated current for indefinite period of time under service conditions. The circuit breaker shall have 50/65 KA (or as specified) breaking capacity and shall be capable of the following make/breaker operations:-

Electrical – 500 cycles
Mechanical – 8000 cycles

The A.B.C. shall conform to BS 4752/1977. The contracts of the A.B.C. shall be heavy duty, spring charged and silver plated. Replaceable arcing contacts and arc chutes shall be provided. The operating handles if made of metal shall be either earthed or additionally insulated to withstand full insulation voltage. A certified copy of full type tests carried out by an independent agency on identical breakers shall be acceptable in lien of the following type and routine tests:-

i) Making capacity, breaking capacity and short time current tests.
ii) Mechanical and electrical life endurance tests.
iii) Temperature rise test.
iv) Power frequency with stand test.
v) Milli volt drop test.

However all other routine tests shall be witnessed by the Engineer at no additional cost to the Owner.

The relays shall have three elements, two for the over current and one for the earth fault. These shall be inverse over-current definite minimum time induction type with inverse characteristics. The relays shall be AC operated and provided with instantaneous elements which have infinity setting or lock out position to make the instantaneous element in operation. The rated error of all the relays shall not be more than 7.5% at full setting. The relay characteristics shall not change plus and minus 7.5% with changes in ambient temperature of + 10% from the reference temperature of 25 degree centigrade and with changes in the frequency of plus 2% to -6% from the rate frequency. Certified tests carried our by an independent agency shall be supplied in lien of the following type tests:-

i) Limit of error test.
ii) Temperature rise test.
iii) Overload test.
iv) Contact rating test.
v) Mechanical durability test.
vi) Variation of characteristics with ambient conditions and frequency.

The relays shall conform to BSS 142/latest.

8.7.3 Three single pole, resin filled current transformers, 15VA burden, suitable for metering and manufactured and tested to IEC publication 185 shall be provided. The standard accuracy class shall be 0.5%. The rated short time thermal current rating and the rated dynamic peak current rating shall be according to IEC recommendations. The following type tests shall be carried out on C.T's:-

i)	Short time current test	-	Clause 19
ii)	Temperature rise test	-	Clause 20
ii)	Accuracy test	-	Clause 29
iv)	Instrument Security current test	-	Clause 31

The following routine tests shall be carried out on C.T's:-

i)	Verification of terminal marking	-	Clause 14
ii)	Power frequency test at Primary & Secondary windings	-	Clause 16
iii)	Over-voltage inter-turn test	-	Clause 17

C.T's conforming to B.S. 3938/1973 are also acceptable.

8.7.5 The following instruments shall be provided unless otherwise specified:-

1- KWH meter
2- Voltmeter 0-500 volts
3- Voltmeter phase selector switch
4- Ammeter commensurate with rating of ACB
5- Ammeter phase selector switch

All the instruments shall be flush mounted and back connected in a transparent dust proof cover with 144x144mm (150x150) dial which shall have prominent black graduations on white surface. The instruments shall be manufactured and tested in accordance with IEC publications 51 or B.S. 89 Part 1/1970.

8.7.6 <u>MOULDED CASE CIRCUIT BREAKERS</u>

The moulded case circuit breakers shall be triple pole and of the rating specified in the schedule of quantities and/or shown on drawings. The M.C.C.B shall be of fixed type, having trip free, manually operated mechanism and ON/OFF/Trip position indicators. The MCCB shall comprise of adjustable hydraulic releases for overload protection and instantaneous adjustable electro-magnetic releases for short circuit protection. The tripping devices shall have related time current characteristics so that positive discrimination and selective tripping is obtained assuring the tripping under fault conditions of only the breaker in the circuit ahead of the fault location. The MCCB shall have a rupturing capacity of 35 KA (or as

specified) and shall be and manufactured tested to IEC publication 1.57-1 Part 1 or BS 4752/1977 or BSS 3871 Parts I & II. The MCCBs manufactured by as approved manufacturer.

8.7.7 LOAD BREAK SWITCHES

The load break switches shall be on load type having quick make and quick break mechanism with spring loaded handles and ON/OFF visual indications. The load break switches shall be designed for continuous operation on rated current rated voltage and rated frequency to BSS 861 (Part-2)/1972. The contacts shall be heavy duty made of silver plated copper having 98% I.A.S.C. conductivity. When the operating mechanism is in "OFF" position, the fuses shall be completely disconnected. If the handle is metallic it shall be properly earthed. Arching chambers with replaceable arching chutes shall be provided. The following type and routine tests shall be conducted on the load break switches:-

a) TYPE TESTS

i) Temperature rise test
ii) Mechanical endurance test
iii) Making/breaking capacity test
iv) Short time current test

b) ROUTINE TEST

High Voltage Tests

8.7.8 EARTHING

The Switchboard shall be effectively earthed by means of a copper strip of 25mmX3mm (25x3) cross-section boltedor 1c x 70 mmsq copper rope to connections near the bottom of the Switchboard.

8.7.9 ACCESSORIES

Designation labels, lifting lugs, foundation bolts, interconnecting nuts bolts and washers, thimbles, lugs, leveling shims cable glands and/or cable end boxes for all the sizes of incoming and outgoing cable shall be supplied with the Switchboard.

8.7.10 TESTING

The following tests shall be conducted on each completed switchboard:-

a) TYPE TESTS

v) Temperature rise test

vi) Mechanical endurance test
vii) Making/breaking capacity test
viii) Short time current test

c) ROUTINE TEST

High Voltage Tests

The Switchboard shall be tested to British/Electricity Council Standard 41-5 and manufactured by M/S Siemens (Pakistan) or AEG (Pakistan) or approved equivalent. Preference shall however be given to Switchboards fabricated from all components manufactured by only one manufacturer.

8.7.11 INSTALLATION INSTRUCTIONS

All labour, equipment, tools and plant required to complete the installation shall be provided by the Contractor. The Switchboard shall be fixed firmly on the floor in perfect line, plumb and level position. All incoming and outgoing and cable connections shall be made including Earth connections.

8.7.12 HRC FUSES

The HRC fuses shall be manufactured and tested to BSS 88/1967 (Part-1) for category of duty AC 33 (or as specified). A supplement of 100% spare fuses of each size shall be supplied with the Switch-board. The following tests shall be conducted on fuses:-

i) Time current characteristic
ii) Temperature rise test
iii) Breaking capacity tests

8.7.13 BUS BARS AND CONNECTIONS

A set of four bus bars, three for phases and one for neutral made of copper having 98% IASC conductivity shall be provided. The bus bars in panels and chambers shall be tin plated air insulated having minimum clearnance of 50mm between phase to phase and 25mm between phase to earth. The neutral bar shall be of the same section. All the bus bars shall be mounted on insulators at suitable intervals and should be extensible on both ends. The marking and arrangement of bus bars, main connections and small wiring shall conform to BS 158/1961. Bus bars and bus bar connections shall conform to BS 159/1957.

8.7.14 ENCLOSURES

The enclosures shall be fabricated from 3mm thick high grade sheet steel and shall be designed to house all the live parts which shall be accessible through

front doors. The enclosure shall be tropical in design completely dust and vermin proof and liquid repellant with special regard to danger of flashover both in service and in isolated position. Hinged lockable doors shall be provided on the front and bolted plates at the rear. Adequate air circulation by means of vent covered with suitable metal gauze shall be provided in the enclosures. All exterior and interior surfaces of the enclosure shall be thoroughly cleaned and freed of dust , rust and greasy matter. The enclosures shall be given three coats of paint. The primer shall be zinc chromate and/or iron oxide. The second and third coats shall be top quality battleship grey enamel. Enclosure for each panel shall be provided with designation labels as directed by the Engineer.

8.7.15 SUBMAIN BOARDS

The Sub-main boards shall be similar to the Main L.T. Board and the components in its fabrication may differ and shall comprise of the components as shown on drawings and as described or listed in the Schedule of quantities. The rupturing capacity of the each component for Sub-main Boards shall be as under:-

1)	Air Circuit Breakers	-	70 KA (or as specified)
2)	Moulded Case Circuit Breaker	-	27/70 KA
3)	Load Break Switches	-	25 KA
4)	HRC Fuses Category	-	AC 33
5)	MCB’s	-	10 KA

All other details and specifications as in Section E.2.8 shall be applicable to this section.

SECTION-09

LIGHTNING PROTECTION SYSTEM

9.1 Lightning Protection System

The site is located in an area where Lightning Protection strikes are about 40 per year, that is why the precious equipment & human lives inside, the buildings to be very well protected. The system adopted is cage type, in which the building is protected as in a cage, by running Copper tape at the parapet walls and drops leading to earth pits at appropriates locations with lightning arrestor at positions shown in the drawings. Fixing material, arrestors, test joints are of much importance therefore, to be imported from famous companies engaged in Lightning Protection System for years like W.J Furse U.K or Erico Australia. The copper tape can be local but tinned to the satisfaction of the consultant. Given below in detail specifications of the material required. The earth resistance of the network at any point should not be less than 7Ω. All chimneys antennas metal pipes, chillers steel stairs should be bonded to the network.

9.2 Copper Tape

The copper tape is to be run over the parapet walls exposed to sky fixed with saddles or D.C clips. The size of this tape is to be 25x3mm consisting of pure copper tinned for protection against erosion and oxidation. The same tape could be used as down conductor up to test joints on wall. The D.C clips should be fixed with Hilti/Spit plastic plugs and Brass wood screws. The weight of copper per meter should be around 0.67kg & purity 99%.

9.3 Lightning Arrestors

The lightning arrestors or air terminal are to be fixed at positions shown in the drawings with special base suitable for interconnecting copper tape. The size of the air terminal rod to be 500m length and 15mm dia, it should be tapered at top threaded at bottom and made of copper. The base should be fixed on parapet wall with Hilti/ Spit plastic plugs and brass wood screws. Air terminal and base should be of any of the famous companies (W.J Furse U.K or Erico Australia) as recommended.

9.4 D.C Tape Clips/Saddles

D.C tape clips to be made of high quality copper and aluminum alloys by W.J Furse U.K or Erico Australia. These are to be fixed over copper tape at intervals of 1000mm and at 100mm at each bend, crossing or near the base of air terminals or joints. Use plastic Rawl plugs of Hilti/Spit with brass wood screw 38mm 10 nos.

9.5 Oblong Test or junction Clamp

For straight joints of copper tape use oblong test or junction clamps of copper 26 x 8mm, 0.29kg weight of W.J Furse U.K or Erico Australia. Fix one D.C clip at each side of the joint not more than 100mm away.

9.6 Square Tape Clamp

When cross or tee joints are to be made in network then use square tape clamps of appropriate size, made of special oxidation and corrosion resistance material of W.J Furse U.K or Erico Australia, with counter sink screws of brass, fixed with plastic wall plug over parapet wall.

9.7 Disconnecting Link or Test Point

Where copper tape sown on wall at 1350 mm above finished floor level fix disconnecting link with removable copper link over insulators earth rod's resistance measurement as well as complete networks resistance. These are to be also of W.J Furse U.K or Erico Australia.

9.8 Earth Rods

Copper bended rods of 20 mm dia and 300mm length are required to be used for earthing purposes. These should be of low carbon steel with 99.9% molecularly bonded electrolytic copper over. The rods should be supplied with rod to tape clamps. Both of these should be of W.J Furse U.K or Erico Australia. These rods are to be driven in ground, the down conductor to be clamped to these and earth pit should be over it.

9.9 Earth Pits

The earth pits should be locally made of concrete same as designed W.J Furse U.K concrete inspection pit cat. No.PT005.

9.10 Testing

After completion of the lightning protection system as per drawings, B.O.Q and Specifications it should be tested with earth resistance tester using 2 rods method at each earth pit. The testing to be witnessed by the Engineer incharge and recorded and signed by all the witnesses.

SECTION-10
EARTHING SYSTEM

10.1 GENERAL

The contractor shall be under obligation to supply all material and labour for the completion of the Earthing system as shown on drawings, listed in the schedule/Bill of Quantities and conforming to specification laid down, hereinafter. The completed installation shall in general conform to British Code of Practice CP 1013/1965 and regulations of Pakistan Electricity Act. In the case of any conflict specifications laid down hereinafter shall be followed.

10.2 CIRCUIT PROTECTIVE CONDUCTOR

The Circuit Protective Conductors and earthing leads shall be solid hard drawn, insulated electrolytic copper wires of sizes given on the drawings and Bill of Quantities. All fixing accessories such as saddles, copper bolts, nuts and washers shall be provided. The size of conductor above 19/.083 shall be of 28mm flat copper strip or as specified.

10.3 EARTH POINT

The earth point shall comprise a 600 x 600 x 5mm (600x600x5mm) thick electrolytic copper plate, tinned for protection against corrosion. The edges of the copper plate shall be chamfered. The plate shall have two holes for connecting each earthing lead or tape to earth terminals. |The terminals shall comprise of 14 mm dia. Copper bolts and nuts and double spring washers.12mm dia. G.I. pipes with a tee at the top and shall be provided for watering purpose during dry seasons.

10.4 EARTH CONNECTING POINT

The earth connecting point in switch room or sub-station shall comprise 300mmx50mmx5mm (300x50x5mm) electrolytic copper bar insulators of appropriate size. The fixing bolts shall be galvanized and provided for fixing the bar on the wall. The bar shall be tinned for protection against corrosion. Copper tapes from various equipment and earth point shall be terminated on this bar.

10.5 EARTH ELECTRODE

For the earthing of poles or any devices or equipment rates less than 15 KW, earth assembly as shown on the drawing shall be installed.

10.6 MANHOLE / HAND HOLE

Cast concrete inspection manhole covers shall be provided on each earth point as shown on drawings.

10.7 INSTALLATION INSTRUCTIONS

10.7.1 The circuit protective conductor (CPC) shall be run, inside, all along the conduit installation. The CPC shall be insulated as specified elsewhere.

10.7.2 The C.P.C. or copper strip shall be laid all along the length of perforated metal tray or walls masonry ducts, fixed at 900 mm intervals. At terminations the CPC or traps shall be bolted firmly to the equipment as per standard practice. Copper tape at straight through joints shall be brazed or cad welded. Joints between standard CPC shall be avoided or cad welded.

10.7.3 Earth plate shall be buried upright 300 mm below the natural sub-soil water level but not less than 6000 mm. below the ground level. A mixture of salt and char-coal shall be laid and packed upto 300mm all around the plate. 12mm dia G.I. pipe with a tee at the top shall be provided for watering arrangement during dry seams and/or where no sub soil water is available.

10.8 MEASUREMENT

10.8.1 Each point and earth manhole shall be treated as lumpsum job for the purpose of measurement.

10.8.2 CPC or tape for the same purpose shall be measured as actual length installed.

10.8.3 For CPC in conduit wiring no separate measurement shall be taken and it shall be deemed to have been included in the rates of point wiring as in section W.

SECTION-11

DIESEL GENERATOR SET

11. *SCOPE*

The work includes supply, installation, testing and commissioning of all materials and services for a complete system of Diesel Generator Set as specified herein, and given in the bill of quantities.
The civil construction works are not included in the scope of these works. The contractor shall, however, furnish all equipment specific details required for structural design and execution of civil works to civil contractor. The scope of work briefly defined shall include but not limited to the following work delivered at site.

a) Continuous prime rating diesel generating set with residential silencer.
b) Controls, protection and other necessary equipments for manual / automatic operations with test, manual, auto, maintenance / off selector switch.
c) Fuel and lubricating oil system with all piping, including fuel day tank for 24 hours, full load operation.
d) Engine exhaust system.
e) Interconnected power and control wiring between D.G set and its control panel.
f) Installation material of D.G set such as bolts, vibration isolators/control devices, etc.
g) Spare parts and tools, as per manufacturer's recommendation, for 2500 hours operation.
h) Necessary tools - 1 set.
I) Operation & maintenance manuals (3 copies).

The Contractor / Supplier shall be responsible to furnish at no extra cost all additional pieces of equipment, not specifically mentioned in the specifications, but are required to complete the installation work and satisfactory operation of system as intended.

11.0 GENERAL

11.1 STANDARDS

The diesel engine and generator shall conform to the following standards.

a) BS 5514 - Reciprocating Internal Combustion Engine.

b) BS 4999 - General Requirements for Rotating Electrical Machines. For other equipment and material the relevant international standards shall be followed, as approved by the Consultant.

11.2 GENERAL REQUIREMENTS

The diesel generating set shall have diesel engine with a synchronous brush less alternator and associated equipment for intended operation of the system. The rating of the set specified, is the net power output after taking into account power consumption in all the auxiliaries. It shall be able to accept the application of intended load and operate satisfactorily under the surges expected during the switching of equipments (A/C load / pumps).

a) The set shall be rated for prime continuous duty and capable for up to 30% unbalanced load at the stated site conditions.
b) The set shall be designed for 10% over load for one hour continuously in any 12 hours operation.
c) 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.
d) The engine generator set shall be mounted on suitable rigid steel frame skid with vibration isolators. Any material required for foundation sets shall be provided by the Contractor. Heavy duty lifting eyes shall be provided. The foundation bolts and all other material/hardware for complete installation of the system shall be furnished with the set.
e) Complete installation details and drawings shall be furnished with the bid.

11.3 DIESEL ENGINE

a) Engine shall be four stroke, compression ignition turbo-charged and after cooled and suitable for continuous duty.

b) Starting shall be with an electric 24 V D.C starter motor, which shall be supplied from heavy-duty lead acid batteries. The engine shall be equipped with an alternator type automatic charge system to charge the battery during running of engine. The battery shall be adequate to crank the engine for 10 second at firing speed for at least three successive cranks at 30 seconds interval. Also it shall be equipped with a trickle type battery charger for charging battery during non-operation hours.

c) Air intake shall have turbo-charged and equipped with oil wetted heavy-duty filter.

d) Engine lubrication shall be forced type with a gear type lubrication pump having suitable filters. The engine shall be gravity fed from a lube oil reservoir having on oil level gauge. Size of reservoir should be suitable for 12 hours continuous full load operation of the set. The reservoir shall have suitable vent, piping connected to a manually electrically operated pump to fill the reservoir from lube oil bulk containers (by others) and high & low level indicators with inter connected piping material etc.
e) Engine shall have water-cooled tropical radiator for 50 Celsius ambient temperature with a forced draft fan and core guard. Cooling system shall have an engine driven pump for water circulation. An engine shut down timer shall be provided to keep the engine running on no-load on receipt of a normal shut down signal so that the engine is sufficiently cooled to start again instantly, if required.
f) Engine governor shall have electronic suitable characteristics to enable parallel operation with other sets and also maintain the generator frequency within plus or minus 2% of the rated frequency. Stable engine speed shall be attained within 15 second maximum after the engine has received starting command. The governor shall be Woodward's Electronic Type. Complete details of governing system shall be furnished with the tender bid.

g) Fly wheel to control cyclic irregularities shall be provided.
h) The set shall have an instrument panel and shall have gauges/meters for the following.
   i) Speed.
   ii) Lube oil pressure.
   iii) Lube oil temperature.
   iv) Cooling water temperature.

v) Alternator charging current.

i) Engine shall operate on commercial high speed, locally available diesel Oil.

j) The day tank shall be separately mounted on steel frame with a capacity of 24 hours operation at rated output. The tank shall have high and low level switches for monitoring the fuel level in the tank. The tank shall have valves, inspection cover, drain valve and glass sight gauges.

h) An 8-hours capacity fuel tank shall be integral with the set

11.4 GENERATOR

a) Generator shall be synchronous with excitation from brush less rotating diodes for 3-phase full wave rectification.

b) Alternator winding shall have minimum class F insulation and shall be for tropical conditions designed so that temperature rise of windings is restricted to class-B operation, Stator windings shall have embedded thermistors to give an alarm and after adjustable time lapse of 2 to 5 minutes to stop the set, in case the temperature of winding rises above the safe working value.

c) Voltage regulator shall be solid-state automatic type with provision for manual setting also. Voltage regulation shall be plus or minus 2.5%. Transient voltage drop shall not exceed 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.

d) 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.

e) The deviation factor of the open-circuit line-to-line terminal voltage shall not exceed 0.1

11.5 CONTROL PANEL

Control panel shall be furnished to controls, monitoring and protection components for the set. The control panel shall be set mounted, front access, completely assembled and wired.

A control panel shall be provided for auto operation, synchronization and load management..

The supplier shall ensure that any additional device for safe and reliable operation of system is also furnished at no extra cost.

11.5.1 Engine Controls

The parameters to be monitored shall include but not limited to:

- Engine speed
- Lub oil pressure
- High water temperature
- Low fuel oil level
- Battery charger voltage/current

The above parameters shall also have provision to activate the protection device during abnormal conditions.

Controls shall also be provided for voltage regulator, governor control, battery charger, indications, etc.

11.5.2 Synchronizing and Load Management Panel

The synchronizing and load management panel (SLMP) shall comply with the construction requirements as stated for he LV Switchboards. The principal features are specified in the following sections.

11.5.3 GENERAL

T

c) The safety devices to be provided for the set are as under. Each device shall initiate an alarm (A) only and operate annunciation, where stated, the set shall stop immediately (S) or after a time delay (DS). Operation of each safety device shall initiate a flickering lamp and an audible alarm. Provision for alarm accept, reset and alarm / lamp test facility shall be provided. At least two enunciators shall be furnished as spare.

I)	Engine over speed.	S
ii)	Low lube oil pressure.	DS
iii)	High water temperature.	DS
iv)	Low level in fuel day tank.	DS
v)	High level in fuel storage tank.	A
vi)	Over crank.	S (Lockout)
vii)	High temperature of windings.	DS
viii)	Under voltage.	DS
ix)	Battery charger failure.	A

The requirements stated are minimum and the contractor shall ensure that any additional device for safe and reliable operation of system is also furnished at no extra cost.

11.5.4 AUTO-MAIN FAILURE (AMF) & AUTO-TRANSFER (ATS) PANEL

The AMF panel shall incorporate automatic changeover system, which 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 370 volts or rise to 420 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 + 5% 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 following operation: -

i) ***AUTOMATIC***

As described in 5.2 (a) to (f) above.

ii) ***MANUAL***

Manual starting have the set and load transfer from utility to generator 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.

h) Two normally open and two normally close potentially 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.

i) The ATS panel shall consist of four pole magnetic contactors and other necessary hard ware components. The ATS panel shall be complete in all respects and suitable for operation with above stated AMF panel.

11.6 ACOUSTIC CANOPY FOR DIESEL GENERATOR SET

11.6.1 GENERAL

Acoustic canopy shall be of drop over or slip on design. This should have provision to be removed during overhaul of engine. It shall be designed to reduce the engine and the alternator sound to approx. 85 dB at 1 m. There shall be a suitable quantity of doors for maintenance.

11.6.2 CONSTRUCTION

a) The canopy shall be constructed from pre-formed heavy gauge mild steel sections. The entire structure shall be weather proof, scratch proof and corrosion resistant. The interior including roof shall be lined with a high-density layer of sound absorbing material with perforated metal sheets and spray painted to minimize fire hazards. The design of canopy shall be subjected to Consultant's approval.

b) The mineral wool in the canopy shall be retained in position with perforated minimum 22 SWG steel sheeting having an area not less than 40% Airtight rubber seals shall be applied to all external points. The canopy shall have 2 feet of walking space around the generator set. Full rated continuous running of the set shall be possible with all doors and access panels in place.

c) Forced air inlet for ventilation and combustion air shall be provided through the bottom of the canopy at the generator end by two sound attenuated ventilation fans. The exhaust will be forced through openings provided on the Canopy top at the engine remote end.

11.6.3 INSTALLATION

Care shall be taken during installation that no damage is done to the generator set and to the canopy body during installation. Sealing material to provide the attenuation level desired shall seal space between the floor and canopy. Body of canopy shall be connected to the earthing system. Suitable vibration isolators shall be provided in order to avoid transmission of vibration to the building structure.

11.7 SPARE PARTS

The contractor shall furnish spare parts for 1000 hours operation of the system in accordance with the recommendations of equipment manufacturer and supported by authenticated documents of the manufacturer. The proposal shall be submitted with bid. The cost of each spare shall be separately listed along with the bid.

Spare parts shall be individually identified by name and part number and shall be suitably packed in heavy gauge sealed plastic bags to protect from dust, moisture etc.

11.8 TOOLS

One set of all necessary tools required for maintenance of D.G set shall be furnished. List of tools supported and certified by manufacturer must be submitted with the bid.

11.9 INSTALLATION

The installation of D.G. Set shall be carried out by the contractor as per the recommendations / instructions of manufacturer. The contractor shall carry out power cable terminations at the D.G. Set end. Power cable from D.G. Set to L.T. Panel shall be supplied and installed by other Contractor. Control cables and other accessories required for the installation shall be supplied / installed by the contractor.

11.10 TESTING & COMMISSIONING

Representative of manufacturer shall carry out the testing and commissioning of D.G set. The supplier shall be responsible for carrying minimum four hours full load test. The contractor shall supply fuel and lubricants required for testing.

11.11 WARRANTY

All equipments / components shall be warranted for 12 Months after the satisfactory completion of works.

11.12 NAME OF APPROVED MAKES

ENGINE (First Choice):	**CUMMINS**	**-**	**UK**
	CATERPILLAR	**-**	**USA**
ENGINE (Second Choice):	**JOHNDERE**	**-**	**UK**
	PERKINS	**-**	**UK**
ALTERNATOR :	**STAMFORD**	**-**	**UK**
	CATERPILLAR	**-**	**USA**

NOTE:

Whatever is applicable in the project should be considered.

11.13 FUEL SYSTEM

11.13.1 SCOPE

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:

a) Fuel transfer pump.
b) Fuel pipe.
c) Fuel storage tank.

11.13.2 FUEL TRANSFER PUMP

A manual fuel pump of suitable capacity to fill the fuel day tank from the fuel storage tank.

11.13.3 FUEL PIPE

The fuel pipe for D.G. set to be furnished shall be from storage tank to the skid of the D.G. set, over flow pipe and the drain pipe from the tank to a location approved by the site 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 line with a by-pass arrangement.

11.13.4 FUEL STORAGE TANK

The fuel storage tank for D.G. Sets shall have capacity to store fuel as shown on drawing for the 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 D.G. set and to stop the D.G.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 fabricated of 6mm thick sheet with external sand blasting, 2 coats of primer and 2 coats of synthetic enamel paint. The fuel storage tank shall be tested after fabrication as per relevant standards.

SECTION-12

MV (11 KV) PANELS & POWER TRANSFORMER

MEDIUM VOLTAGE SWITCH GEAR

12.1 SCOPE OF WORK

The work under this section consists of supplying, installation, testing & commissioning of all material and services of the complete MV switchboards and accessories as specified herein or as shown on the tender 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 location and position of the MV panels.

The MV Switchboard with accessories shall also comply with the General Specifications for Electrical Works Section # 16001 and with other relevant provisions of the Tender Document.

12.2 GENERAL

The HT switchboard shall be sheet steel fabricated cubicle type totally enclosed type with IP classification IP44 dust tight and vermin proof. It shall be complete in all respect with material and accessories factory assembled, tested and finished according to the specifications and to the normal requirements.

The switchboard shall be suitable for front operation and shall be suitable for addition of units on either side. The switchgear shall be provided with adequate clearance from live parts so that flashover cannot be caused by switching surges, vermin, pests, etc.

The MV Switchgear shall be designed for flush mounting of all instruments on the front door. The incoming and out going cable connections shall be from the bottom of the switchgear.

The components shall be mounted so as to facilitate ease of maintenance from the front. The MV Switchgear shall have provision for lamp test, alarm test, alarm accept and reset facility.

The enclosures shall be suitable for mounting on cable trenches.

The MV Switchgear shall be provided with anti-condensate heaters controlled automatically through adjustable thermostats for maintaining required safe operating temperature inside the panel and also avoid condensation. The heater shall also be manually operable and provided with protective miniature circuit breaker and **ON** indication lamp.

12.3 APPLICABLE STANDARDS/CODES

Latest editions of the following standards and codes shall be applicable for the materials within the scope of this section.

BS 3245	Bus bars
BS 30	Meters
IEC 56	High voltage AC circuit breaker
IEC 44, 185	Current transformers
IEC 186- BS 3941	Potential transformers
P-44:96	Wapda Specifications as amended 1998

12.4 MATERIAL

12.4.1 MV Switchboard

The switchboard shall be manufactured and fabricated with angle-iron framework, welded, grounded, finished and cladded with **12 SWG** sheet steel.

The switchboard shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories.

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 size of 15kV XLPE cable. Adequate number of eyebolts shall be provided to facilitate handling.

An earth bar of appropriate cross section shall be provided and connected to the body of all sections of the switchboard. The external earth terminal 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 labeled with clear indelible printing, indicating the rating and designation of fuses, switches 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, switchboard/ panel identification shall be of sufficient size, legible from a distance of 10 meters.

All metal work of the switchboard shall be;

- cleaned down to bare shining metal

- De-rusted and de-greased
- Two base coats of anti-corrosive **RED OXIDE** paint.
- Finished inside and outside with powder paint as approved by the Engineer

Any interlocking if required inside the HT switchboard and between HT switchboard and other equipment shall be provided.

12.4.2 **Capacity and Basic Data**

The switchboard shall be designed to conform to the following requirements;

Rated Current	:	As shown on drawings.
Rated Nominal Voltage	:	11 KV
Rated Maximum Voltage	:	12 KV
Power Frequency Withstand Voltage.	:	27 KV for 1 minute
Rated Short Circuit Capacity	:	350 MVA at 11 KV for one second.

Rated Breaking Currents (1 second rating)

a.	Symmetrical	:	18.4 kA
b.	Asymmetrical	:	22.4 kA

Rated Making Current	:	2.55 times rated symmetrical Breaking current.
Operating Duty	:	B-3 -MB-3 -MB
Impulse withstand Voltage	:	75 KV

Control Voltages

Indication/Metering	:	110 VAC from secondary of PT
Tripping Voltage Capacitor trip unit.	:	Series tripping or 110 VDC from

12.4.3 **Circuit Breaker**

The circuit breakers shall be triple pole, with-draw able type with arc interruption in

vacuum. The operating characteristics and technical data shall be as given in art. 4.1.1 of this section. The bidder shall submit with his offer the type and details of equipment proposed.

The circuit breaker shall have trip free, direct acting and manually operated drive mechanism. For manual operation a handle shall be provided. The unit shall have roll-out 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 contacts as the circuit breaker is withdrawn other interlocks as essentially required for safe and proper operation of circuit breaker shall be provided. Barriers of approved heat resisting, non-tracking-insulating material shall separate the circuit breaker phases.

A triple pole grounding switch or a suitable Earthing device shall be provided for cable and bus bar Earthing and shall be rated to safely carry the fault current due to inadvertent closing of supply circuit breaker and also for making duty on a fault.

A triple pole grounding switch or a suitable Earthing device shall be provided for cable and bus bars 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 circuit breaker shall have automatic mechanically operated **ON** and **OFF** position indications. Luminous indications shall be provided with **ON/ OFF** and **TRIP** position. Additional indication lamps as shown on the drawings shall also be furnished. The circuit breakers shall be provided with **ON-OFF** push buttons.

Each circuit breaker shall be provided with at least three normally closed and three normally open potential free auxiliary contacts rated for 10 Amp.230V AC. Provision shall be made for remote indication of the circuit breakers position/status.

A test circuit 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.

12.4.3.1 Bus Bars

The bus bars shall be made of high conductivity electrolytic copper and shall be completely insulated 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 by the colors applied on the full length and these shall be red yellow and blue. The clearances shall not be reduced on account of the busbar insulation or the phase barriers.

12.4.3.2 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	5% for protection and 1% for measuring with security factor 5.
Duty	For operating relays and instruments
CT ratio	As shows on drawings
No. of cores	As shows on drawings
Rating and Insulation	As shows on drawings
Rated dynamic Current	2.50 times rated symmetrical short circuit current

12.4.3.3 **Potential Transformers**

Potential transformers (PTs shall be provided as shown on the Tender 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 and instruments. Each PT shall be designed to have independent secondary Windings of specified ratio for connection in star / open delta.
Voltage ratio	11KV/110V-110V
Rated voltage factor	1.2 continuous and 1.0 for 30 seconds
Rating & insulation	As shows on drawings requirements
Rated dynamic Current	2.50 times rated symmetrical short circuit current

12.4.3.4 **Capacitor Shunt Trip Unit**

In case series tripping is not provided then each circuit breaker in the HT switchboard shall be provided with 110 VDC trip coils which will supply power through the capacitor trip units. The trip coils shall be fed through the relay contacts and the 'OFF' push button.

The capacitor trip unit will be fed from 110 volts secondary of potential transformer. The capacitor trip unit shall be suitable for performing two successive tripping operations carried out within five minutes.

12.4.3.5 Protective relays

The circuit breakers shall be provided with inverse definite minimum time non-directional over-current relays for phase and earth fault protection .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	:	20-800 of CT secondary rating.

The instantaneous elements shall also have infinity setting to Block their operation.

Ground-fault	:	20-80% of CT secondary rating with instantaneous element as for phase fault unit.
Time setting range	:	0-1 second
Connection	:	Am secondary of CT
Auxiliary supply	:	Series tripping or through 110V

Tripping DC from capacitor trip units in each breaker panel.

Indications/control	:	110VDC from secondary of PT.
Heaters and alarm	:	220VDC from LT switchboard.
Auxiliary Contacts	:	Provision for remote indication as required

The relay shall preferably be triple pole type and have positive action without chatter.

12.4.3.6 Ammeter and Voltmeter

The ammeter and voltmeter shall be moving iron spring controlled having front dimensions of 144 x 144 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.

12.4.3.7 Selector Switches

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 plate and operating lever.

12.4.3.8 kWh and kVarh Meters

Kilowatt-hour (kWh and Kilo volt 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 3 minutes.

12.4.3.9 Alarm Indication

On occurrence of any fault in the system and subsequent tripping of circuit breakers audio alarm shall be provided on the HT Switch board. 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.

12.4.3.10 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. HT switchboard shall be provided with independent set of tools placed in suitable box. The bidder shall furnish details of tools with his offer.

12.4.4 INSTALLATION

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 civil works for providing and openings, holes, etc., in time to avoid and breakage/damage 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 and approval of Engineer.

The Contractor shall provide foundation bolts and grout the 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. And 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 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 section "Testing" of these Specifications shall be carried out.

12.5 MEASUREMENT AND PAYMENT

12.5.1 General

The Contractor's bid amount against each Bill of Quantities item as given below shall include design supplying, installation, testing, commissioning and completion for all work specified herein and/or as shown on the Tender Drawing related to the item.

12.5.2 HT Switchboard

12.5.3 Measurement:

Measurement shall be made for the complete job of MV Switchboard including all mounting, installation and operational accessories acceptably supplied as a complete job.

12.5.4 Payment:

Payment shall be made for the total number of jobs measured as provided above at the Contract unit price each and shall constitute full compensation for supplying, installation, testing and commissioning of the MV switchboard including all mounting, installation and operational accessories.

12.6 INDOOR TYPE 11/0.4 KV POWER TRANSFORMER

12.6.1 SCOPE OF WORK

The work under this section consists of design, manufacturing, fabrication, supplying, installation, testing & commissioning of all materials and accessories for the complete Power Transformers as specifications herein and stated in the respective items of the Bill of Quantities.

12.6.2 GENERAL

The capacity of transformer to be provided is mentioned in the respective item of the Bill of Quantities. The transformers shall be complete, with all accessories and attachments as detailed in these specifications or otherwise required for satisfactory operation, service and maintenance.

All details, drawings, data, etc. for each type and rating of the Power Transformer shall be furnished with the bid.

12.6.3 APPLICABLESTANDARDS/CODES

Latest editions of the following standards and codes shall be applicable for all materials in scope of this section:

BS90 - Power transformers

BS14 - Transformer oil

BS171 - Specifications for power transformer

BS223 - High voltage bushings

IEC76 - Power transformers

P-44:96 Wapda Specifications as amended 1998

12.6.4 MATERIAL

12.6.4.1 Power Transformer

The transformer tank shall be constructed of welded boiler plates and provided with external radiating tubes. The tank and radiating tubes shall be designed to withstand, without developing any deformation, pressure atleast 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 at the base of the tank. The tank shall be anti-corrosive painted and finished in gray colour. The oil preservation system shall have a conservator tank fitted with silica gel breather, oil level indicator and a drain valve.

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 (HT) lead on indoor transformer shall be brought out to glazed porcelain insulator bushings for external connections to cables. Protective spark gaps of suitable design shall be connected in parallel to the HT bushings to protect the transformer from surge voltages. The three LT and one neutral phase leads shall be brought out and terminated at glazed porcelain insulator bushings for Connection to LT side by copper conductor cables.

Off-load tap changer shall be provided on HT 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 on the transformer. It shall have required number of contacts for connection to tripping and alarm circuits.

The transformer shall be provided with the following accessories;

- Oil filling valve for vacuum filling of oil.
- Oil drain valve with sampling device.
- Bi-directional rollers.
- Lifting lugs.
- Dial type thermometer which shall have maximum temperature indicator pointer.
- Stem type thermometer fitted in a pocket for indicating the oil temperature.
- Diagram and rating plate.
- Jacking pads.
- Pressure release safety valve.

12.6.4.2 Principal Data of Power Transformer

The Power 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 Power transformers shall meet the minimum technical specifications but not limited to the following:

Description	**Data suggested**	**Data submitted**
Type		
Capacity (Rated continuous)	As stated in BOQ	
Voltage ratio at no-load	11000/415 Volts	
Frequency	50 Hz	
Vector group	Dy 11	
Off load tapping arrangement (on HT side)	-7.5%, -5%, -2.5%, 0% +2.5%, +5%,	
HT connection	11 kV Delta	
LT connection	400V with grounded star point.	
Temperature rise of oil	40^0 C maximum	

over ambient temperature		
Temperature rise of winding over ambient temperature	50^0 C maximum	
Impedance voltage (%)	4	
Voltage regulation for normal operating conditions	Not to exceed 2.5% of no-load	
Voltage regulation at 85% pf at full load (%)	3.5	
Rated maximum voltage HT/LT	15kV/0.6 kV	
Rated short-time current (KA)		
Switching inrush current (Amps)	6-7 times of HV line current	
Power losses at full load (Watts)		
Iron losses at unity pf	_	
Iron losses at 0.85 pf	_	
Copper losses at unity pf	_	
Copper losses at 0.85 pf	_	
Efficiency at 0.85 pf %		
At 25% of rated load	_	
At 50% of rated load	_	
At 75% of rated load	_	
At 100% of rated load	_	
Transformer Weight (Kg)		
Total	_	
Weight of oil	_	
Windings	_	
Transformer Oil		
Type	_	
Quantity for one complete filling	_	

12.6.5 INSTALLATION

Transformers shall be installed at locations shown on drawings. All civil works including provision of under-floor 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.

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.

12.7 MEASUREMENT AND PAYMENT

12.7.1 General

The Manufacturer's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing & commissioning of power transformer including all required accessories as stated in these specifications related to the item.

12.7.2 Power Transformer

12.7.3 Measurement

Measurement shall be made for each size of Power Transformer including required accessories acceptably designed, manufactured, fabricated, supplied, tested & commissioned by the Contractor as a complete job.

12.7.4 Payment

Payment shall be made for the number of each size of units measured as provided above at the Contract unit price each and shall constitute full compensation for design, manufacturing, fabrication, supplying, installation, testing & commissioning of the Power Transformer with all accessories.

12.8 INDOOR TYPE 11/0.4 KV POWER TRANSFORMER

12.8.1 *SCOPE OF WORK*

The work under this section consists of design, manufacturing, fabrication, supplying, installation, testing & commissioning of all materials and accessories for the complete Power Transformers as specifications herein and stated in the respective items of the Bill of Quantities.

12.8.2 GENERAL

The capacity of transformer to be provided is mentioned in the respective item of the Bill of Quantities. The transformers shall be complete, with all accessories and

attachments as detailed in these specifications or otherwise required for satisfactory operation, service and maintenance.

All details, drawings, data, etc. for each type and rating of the Power Transformer shall be furnished with the bid.

12.8.3 APPLICABLESTANDARDS/CODES

Latest editions of the following standards and codes shall be applicable for all materials in scope of this section:

BS90 - Power transformers

BS14 - Transformer oil

BS171 - Specifications for power transformer

BS223 - High voltage bushings

IEC76 - Power transformers

12.8.4 MATERIAL

12.8.5 Power Transformer

The transformer tank shall be constructed of welded boiler plates and provided with external radiating tubes. The tank and radiating tubes shall be designed to withstand, without developing any deformation, pressure atleast 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 at the base of the tank. The tank shall be anti-corrosive painted and finished in gray colour. The oil preservation system shall have a conservator tank fitted with silica gel breather, oil level indicator and a drain valve.

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 (HT) lead on indoor transformer shall be brought out to glazed porcelain insulator bushings for external connections to cables. Protective spark gaps of suitable design shall be connected in parallel to the HT bushings to protect the transformer from surge voltages. The three LT and one neutral phase leads shall be brought out and terminated at glazed porcelain insulator bushings for Connection to LT side by copper conductor cables.

Off-load tap changer shall be provided on HT 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 on the transformer. It shall have required number of contacts for connection to tripping and alarm circuits.

The transformer shall be provided with the following accessories;

- Oil filling valve for vacuum filling of oil.
- Oil drain valve with sampling device.
- Bi-directional rollers.
- Lifting lugs.
- Dial type thermometer which shall have maximum temperature indicator pointer.
- Stem type thermometer fitted in a pocket for indicating the oil temperature.
- Diagram and rating plate.
- Jacking pads.
- Pressure release safety valve.

12.8.6 Principal Data of Power Transformer

The Power 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 Power transformers shall meet the minimum technical specifications but not limited to the following:

Description	**Data suggested**	**Data submitted**
Type		
Capacity (Rated continuous)	As stated in BOQ	
Voltage ratio at no-load	11000/415 Volts	
Frequency	50 Hz	
Vector group	Dy 11	
Off load tapping arrangement (on HT side)	-7.5%, -5%, -2.5%, 0% +2.5%, +5%,	
HT connection	11 kV Delta	

LT connection	400V with grounded star point.	
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	
Voltage regulation for normal operating conditions	Not to exceed 2.5% of no-load	
Voltage regulation at 85% pf at full load (%)	3.5	
Rated maximum voltage HT/LT	15kV/0.6 kV	
Rated short-time current (KA)		
Switching inrush current (Amps)	6-7 times of HV line current	
Power losses at full load (Watts)		
Iron losses at unity pf	_	
Iron losses at 0.85 pf	_	
Copper losses at unity pf	_	
Copper losses at 0.85 pf	_	
Efficiency at 0.85 pf %		
At 25% of rated load	_	
At 50% of rated load	_	
At 75% of rated load	_	
At 100% of rated load	_	
Transformer Weight (Kg)		
Total	_	
Weight of oil	_	
Windings	_	
Transformer Oil		
Type	_	
Quantity for one complete filling	_	

12.8.7 INSTALLATION

Transformers shall be installed at locations shown on drawings. All civil works including provision of under-floor 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.

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.

12.9 MEASUREMENT AND PAYMENT

12.9.1 General

The Manufacturer's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing & commissioning of power transformer including all required accessories as stated in these specifications related to the item.

12.9.2 Power Transformer

12.9.3 Measurement

Measurement shall be made for each size of Power Transformer including required accessories acceptably designed, manufactured, fabricated, supplied, tested & commissioned by the Contractor as a complete job.

12.9.4 Payment

Payment shall be made for the number of each size of units measured as provided above at the Contract unit price each and shall constitute full compensation for design, manufacturing, fabrication, supplying, installation, testing & commissioning of the Power Transformer with all accessories.

SECTIONS-13

TELEPHONE & DATA NETWORKING SYSTEM

13.1 SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of complete telephone system as specified herein, as shown on Tender Drawings and stated in Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer & coordinate at site with other services for exact route, location and position of the system.

The telephone system with accessories shall also comply with the General Specifications Section # 16001 and with other provisions of the Tender Document.

The work shall be undertaken in accordance with applicable rules and regulations of Pakistan Telecommunications Corporation limited.

13.2 GENERAL

Telephone System under the present contract shall comprise:

13.2.1 Concealed Conduits,

13.2.2 Multi-Pair Telephone Cables,

13.2.3 Outlet Boxes

13.2.4 Telephone Junction Boxes

13.3 APPLICABLE STANDARDS / CODES

The latest editions of the following standards / codes shall be applicable for the materials covered within the scope this section:

13.3.1 ***VDE 0816, BS 6360,***
IEC 189 BS 7640 - Telephone cables

13.3.2 DIN 47615 - Junction boxes

13.3.3 DIN 47614 - Terminal strips

13.3.4 DIN 40040 - Class & Reliability of units in Telecommunication

13.3. 5	DIN 5800	-	Regulations for installation operation of Telecom.
13.3.6	CCITT	-	Recommendations and local T&T regulations.

13.4 MATERIAL

13.4.1 Conduit, Pipes and Accessories

The specifications for conduits, pipes and accessories shall be same as given for electrical conduits in section "Conduits and Pipes" of these specifications.

13.4.2 Telephone Socket/Outlet Boxes

The telephone sockets shall be digital types as per BOQ or approved equivalent. The telephone socket outlets shall be provided with terminals for connecting the telephone cables. The telephone outlet boxes shall have appropriate dimensions made of 16 SWG sheet steel and suitable arrangements for termination of conduits.

13.4.3 Junction Box

Telephone junction box shall be made of 16 SWG (1.63mm) sheet steel having required dimensions to accommodate the terminal strips with adequate space available for wiring. The terminal strips shall be of solder less type with suitable capacity for terminating all incoming and outgoing cables. FIVE sets of terminals shall be provided as spares for outgoing connections. The strip shall be installed on insulated material sheet inside the sheet steel boxes.

The steel box shall be provided with a lockable hinged door. The junction box shall be suitable for recess mounting.

13.4.4 Telephone Cable

Telephone cables shall be PVC insulated, PVC sheathed multi pair 0.6mm diameter tinned copper conductor conforming to IEC publication 189.

The PVC insulation shall comply with BS 6746. The conductor shall be tinned solid high conductivity soft annealed copper complying with BS 6360. The insulation of conductors shall be colour coded as per above-mentioned publications. The Contractor shall install approved cable of the Pakistan Telecommunication Corporation.

13.5 INSTALLATION

13.5.1 Conduit

The telephone conduit shall be installed in accordance with the instructions and details given in section Conduit and Pipes' of these Specifications. Telephone conduit shall be laid 150mm (6 inches) away from the electrical conduits or cables, and wherever electrical conduits or cables, and telephone conduits cross each other, they shall do so at right angles.

Identification marking shall be given at the termination or free end of conduit so that it may not be confused with the electrical conduits. The marking shall be both by colour and by attaching an approved brass tag using brass or bronze tie wire. Each tag shall be clearly stamped with "T" for telephone conduit.

13.5.2 Telephone Sockets

These shall be installed on the outlet box fixed to the wall/column or in floor outlet boxes.

13.5.3 Telephone Junction Box

Junction boxes for telephone cables shall be recessed. The recessed type boxes shall finish flush with the surface of wall. The junction boxes can be surface mounted in case they are installed above false ceiling.

All screws, nuts and bolts used for fixing the box shall be galvanized. Soft metal bushes shall be used at conduit entries in the box.

13.5.4 Telephone Cable

The multi pair telephone cable shall, in general, be installed as outlined in Section `LT Cables' of these specifications. All cables shall be provided with plastic identification tags at terminations that shall be clearly shown on the as-built drawings. The complete wiring shall be checked for continuity, identification and insulation resistance before connections are made.

13.6 MEASUREMENT AND PAYMENT

13.6.1 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.

13.6.2 Conduits and Pipes

13.6.3 Measurement:

Measurement shall be made for the number of running meters or running feet for each type and size of conduits & pipes acceptably supplied and installed by the Contractor.

13.6.4 Payment:

Payment shall be made for the number of running meters or running feet for each type and size of conduit or pipe, measured as provided above at the Contract unit price and shall constitute full compensation for supplying, installing and completion of the laying of the conduits and pipes including jointing materials and accessories, cutting chasing of civil works, excavation and backfilling of ground, sand bed and cover for underground PVC pipes, painting, plugging, tagging, etc., as applicable for each type of work.

13.6.5 Telephone Cable

13.6.6 Measurement:

Measurement shall be made of the total number of running meters or running feet for each type and size of telephone cable acceptably supplied and installed by the Contractor.

13.6.7 Payment:

Payment shall be made for the number of running meters or running feet of each type and size of cable at the Contract unit price and shall constitute full compensation for supply, installing, testing and commissioning of the telephone cables including all accessories.

13.6.8 **Telephone Junction Box**

13.6.9 **Measurement**:

Measurement shall be made for each type and size of Telephone Junction box acceptably supplied and installed by the Contractor as a complete unit.

13.6.10 **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 and completion of the telephone junction box including all required accessories.

13.6.11 **Telephone Sockets**

13.6.12 **Measurement**:

Measurement shall be made for each type and size of Telephone socket acceptably supplied and installed by the Contractor as a complete unit.

13.6.13 **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 and completion of the telephone socket including all required accessories.

13.6.14 **Telephone Outlet boxes**

13.6.15 **Measurement**:

Measurement shall be made for each type and size of Telephone outlet box acceptably supplied and installed by the Contractor as a complete unit.

13.6.16 **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 and completion of the telephone outlet including all required accessories.

SECTION-14

FIRE ALARM SYSTEM

14.0 SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and services of complete Fire Detection & Alarm System as stated herein, shown on drawings and stated in Bill of Quantities.

The Contractor shall discuss the electrical layout with Engineer and coordinate at site with other services for exact route, location and position of electrical lines and detectors.

The Fire Detection and Alarm System with accessories shall also comply with the general specifications section # 16001 and with other relevant provisions of the Tender Documents.

02.00 GENERAL

The Fire Detection & Alarm system shall be intelligent, addressable, pre-signal circuit, class A wired and supervised system. The system shall operate on 24V DC from a battery charger with stand-by batteries. The incoming supply shall be 220VAC.

The supply, installation, testing & commissioning of he Addressable Fire Detection & Alarm system shall comprise of the following but not limited to;

02.001 Main Fire Alarm Control Panel (MFACP)
02.002 Repeater Panels
02.003 Intelligent Smoke Sensor
02.004 Intelligent Heat Sensor
02.005 Addressable Sounder
02.006 Manual Call Point
02.007 Addressable Plant Interface
02.008 Short Circuit Isolator
02.009 Addressable Remote Sensor Indicator
02.010 Intelligent Power Supplies
02.011 Electrical Installation
02.012 System Programming
02.013 Testing & Commissioning

The system shall monitor and report the status of manual calls stations and automatic fire detectors. The system shall also perform control functions as alarm indications, etc.

All automatic fire detectors shall

02.01 be suitable for mounting on false ceiling or RCC ceiling surface.

02.02 have visual alarm indicator with a 360° field of view

02.03 have provision for remote alarm indicator

02.04 be self resetting

02.05 have strong weather resistant casing

The Contractor shall provide wall chart for the Fire Detection and Alarm System operation and maintenance. The wall chart shall contain following minimum information in both English and Urdu languages. The characters of written instructions shall be minimum 6 mm high.

02.06 Complete layout of Fire Detection and Alarm system showing locations of all fire zones, and bells zones in two different colors.

02.07 Operating and maintenance instruction in BLACK colour.

02.08 Emergency instructions in RED color.

The Complete Fire Alarm System shall be fully integrated with Public Address System

The System shall comprise of a range of Analogue Addressable, Microprocessor based Fire Alarm Control equipment to offer flexibility in both design and operation.

The System shall be of modular concept for easy tailoring of System design, to meet the full requirements of the Project

The System shall be designed to provide early warning Smoke Detection, to quickly identify the Location of Fire and provide user definable text informing the occupants of the Building of potential Smoke Spread. Simultaneously, the System shall alert and evacuate the occupants, and Control all necessary auxiliary command functions such as elevator Control, air handling shut down, gas shut off & damper Control, as per the cause and effects requirement of the Building.

The complete facility shall be protected by a fully Analogue Addressable Fire detection & Alarm System. A range of Smoke and Heat Detectors shall be installed in all areas of the Building.

The complete Analogue Addressable Fire Detection System shall report to the Main Fire Alarm Control Panel.

03.00 APPLICABLE STANDARDS AND CODES

The latest editions of following standards codes shall be applicable for the materials covered within the scope of this section:

03.01 BS 5839 Part 4: 1988 to meet a type P1 System.

03.02 NFPA 70-National Electrical Code 1993.

03.03 NFPA 72-National Electrical Code 1993.

03.04 LPC (Formerly F.O.C) Loss prevention council LPS1014 UK.

03.05 UL (Underwriters Laboratories Inc.) USA.

03.06 FM (Factory Mutual) USA.

03.07 UL 38 - Manual call station

03.08 UL 268 - Ionization smoke detectors.

03.09 UL 464 - Chimes, bells and horns for fire alarm system.

03.10 UL 521 - Heat Detectors

03.11 UL 864 - Fire Detection and Alarm Control Panel

03.12 UL 864 - Annunciation Panel

03.13 NFPA – F - Installation of Fire detection and Alarm System

03.14 NFPA – H - Testing of Fire Detection and Alarm System

04.00 MATERIAL

04.001 **Ionization Smoke Detector**

The Photoelectric Smoke Sensor shall operate on a “Fuzzy Logic Technology”, by the use of a minimum of an 8 bit processor, to enable the Sensors to store and Analyze Fire scenarios, thereby reducing susceptibility to false Alarms and improve the sensitivity.

The sensitivity of the Device shall be variable. The Addressable code for the Device shall be electronically programmed and stored in the Sensor and be non-volatile.

The programming of this code shall be facilitated by a digital electronic hand held Device.

04.002 Sensitivity variable

04.003 Operating voltage 24VDC

04.004 Standby Condition ≤ 600µA

04.005 Alarm Condition ≤2mA

04.006 Transmission Method Digital Communications

04.007 Maximum Humidity 95% RH- Non Condensing (at 40◦C)

04.008 Temperature range -10◦C - + 50◦C

04.009 Operating Voltage 17 to 32 V DC

04.010 Radio Activity Less than 1.0 micro curie

04.011 Integral Alarm Indicator LED

04.012 External Alarm 30 to 120 mA at 6 to 24 V DC

04.013 Detector Coverage 80 m2 with flat ceiling of 4.5 m height

04.10 **Fixed Temperature/Rate of Rise Heat Detector**

The Heat Sensor shall incorporate a highly linear thermostat Circuit. A voltage is produced proportional to temperature which shall be scaled, linearised and transmitted as an Analogue value.

The Sensor software shall allow the Device to operate as both a rate of rise Sensor and or a fixed temperature Sensor. It shall be possible to de-select the rate of rise for specific locations. The Addressable code for the Device shall be stored in the Sensor and be non-volatile.
The programming of this code shall be facilitated by a hand held Device.

04.11 Voltage 24VDC

04.12 Standby Condition ≤800µA

04.13 Alarm Condition ≤1.4mA

04.14 Transmission Method Digital Communications

04.15 Maximum Humidity 95% RH- Non Condensing (at 40◦C)

04.16 Temperature range -10◦C - + 50◦C

The Sensor shall be used to provide early warning of a possible hazardous situation and, shall have hardwired failsafe outputs for closure of the relevant gas valve. The reset for the valve must be by Manual reset only.

04.20 **Manual Call Station**

Manual Call Points shall be installed at every exit from the Building. MCP shall be installed in all major plant rooms to decrease the notification time. Call Points shall be installed within 30 meters of any point in the Building to minimize the delay in notification.

The Manual Break Glass Call Points shall and shall have a very low standby current. Incorporating a status LED, which flashes when, polled or is continuously lit when operated. An additional set of volt free change over contacts shall be incorporated for additional local signaling as required. The Addressable code for the Device shall be electronically programmed and stored in the Sensor and be non- Volatile. The programming of this code shall be facilitated by a digital electronic hand held Device.

04.201	Operating voltage	24VDC
04.202	Standby Condition	≤800µA
04.203	Alarm Condition	≤2mA
04.204	Transmission Method	Digital Communications
04.205	Maximum Humidity 40◦C)	95% RH- Non Condensing (at
04.206	Temperature range	-10◦C - + 50◦C
04.207	Ancillary contact rating	60v DC 0.1Amp
04.208	Transmission Method	Digital Communications
04.209	Maximum Humidity 40◦C)	95% RH- Non Condensing (at
04.210	Temperature range	-10◦C - + 50◦C
04.211	Operating voltage	24VDC
04.212	Standby Condition	≤0.8mA
04.213	Alarm Condition	≤2mA
04.214	Transmission Method	Digital Communications
04.215	Maximum Humidity 40◦C)	95% RH- Non Condensing (at
04.216	Temperature range	-10◦C - + 50◦C

04.30 **Alarm Bell**

The Sounder shall be low profile design and shall incorporate an individual loop Address; the unit shall neatly be incorporated within the Sensor to ensure aesthetics are Maintained.

The Addressable code for the Device shall be stored in the Sensor and be-non volatile. The programming of this code shall be facilitated by a hand held Device.

04.31	Operating Voltage	24VDC
04.32	Current Consumption	Normal: 220µA
04.33	Low Power Mode:	40µA (typical)
04.34	Alarm	2.7mA @ 85dB (A) ± 2dB (A)
		11 mA @ 95dB (A) ± 2dB (A)
04.35	Maximum Humidity	95% RH- Non Condensing (at 40◦C)
04.36	Temperature range	-10◦C - + 50◦C
04.37	Case Material	ABS

04.40 **Visual Alarm Signal**

Visual alarm signal shall be installed at locations shown on the plans. Visual alarm signal shall have a high intensity flashing light, The electronic light shall be protected by lexan lens. The word FIRE shall appear on the lens. The visual alarm signal shall be semi flush mounted type & have the following minimum technical specifications.

04.41 Rated voltage 24V DC

04.42 Operating voltage 18 to 30V DC

04.43 Flashing Frequency two flashes per second

04.50 **Fire Detection & Alarm Control Panel**

The complete Analogue Addressable Fire Detection System shall report to the Main Fire Alarm Control Panel. The Main Control Panel will be equipped with sufficient loop cards to meet the need of the Entire Project

There shall be sufficient spare capacity to cater for at least the full requirement plus 20%spare.

The FACP shall have the capability of being integrated into a Building management System. Each device shall be fully reporting and accessible from the BMS System.

The MFACP shall incorporate a number of features to allow easy operation through a user friendly menu. It shall have a LCD display and non –tactile membrane type Switches/keypad in durable plastic. For reliability it shall have its own on-board Circuit protection and multiprocessor Architecture.

The System shall be on and off-site programmable by using the membrane keypad and also by connecting a PC to the communication port on the main processor/display board. All configuration information shall be protected from loss in the event of a total mains and Stand-by Power Supply failure.

The MFACP shall be of modular construction; capable of monitoring 20 monitored Detection loops. Each loop shall be capable to accommodate a minimum of 200 Addressable Devices. The System shall be capable to handling a minimum of 32 networked Panels. Therefore the System shall as a stand alone solution is capable of 4,700 Devices and as a network solution is capable of over 150,000 Devices.

Each input Device shall have its own 32 character text message all location, each Device Shall be linked to a software zone. The MFACP shall have integral facilities for control of output to Sounder, Strobes and auxiliary Device.

The MFACP shall be capable of a minimum of 60 zones expandable to a minimum of 240 zones per Panel and have 4 common 1-amps rated Sounder Circuits and 4 –amps rated auxiliary relay Contacts. The Panel shall have an internal event printer; this shall be mounted within the same enclosure.

The Printer shall have the facility to be programmed to print alarms only: failure of the printer must not affect any other part of the System. The MFACP shall have a walk test facility to periodically test the Detectors without having to continually manually reset from the Panel.

The MFACP shall automatically program to switch the Sounders to Day/Night mode whereby Any Alarm condition is recognized outside normal hours shall provide an evacuation signal throughout the Entire premises.

The MFACP shall have a large Graphical liquid Crystal display .the display shall illuminate to Assist View under dim ambient lighting conditions. The MFACP shall have internal memory lock to prevent unauthorized data entry and shall also have 700-memory event log for system information.
The FACP shall have the facility to networking on RS 485 to other Panels and repeaters, while Communication to color Graphics shall be via RS 232. Pre-Warning and faults shall be indicated as for a Fire Alarm via the LCD along with an associated LED and Printer.

A buzzer shall Sound in the event of an Alarm, pre –warning of fault.

In the event of a Fire Alarm the MFACP unit shall Signal the local Fire brigade via Auto Dialer.

Operate the Alarm signal throughout the Building in accordance with the cause and effects and any additional requirement laid down by the Civil defense.

The System shall provide three levels of Control to allow varying access to the System operating Functions in line with the BS 5939 Part 4: 1988.Access to the first level shall be via level one pass Code, the second shall be by entering a eight-digit security code. The third level is accessible from level two by connecting a software controlled PC.

An internally mounted audible annunciation shall be provided to notify any changes in System Status or operation of the keypad. This shall have 4 distinguishable tones for the different type of Alarm /Condition/Fault.

The Control Panel shall have the capability of showing in Graph format the trend of each Device. This facility shall enable an Engineer to track the performance of the Device real time to ensure each Device is working to its optimum. The display of the Analogue count in numerical form only will not be expectable.

The Batteries and Charger shall maintain the Entire System, plus 20% for a minimum period of 24 Hours stand by in the event of mains failure. After 24 hours has elapsed the System shall be
Capable of initiating a full global alert and evacuate for a minimum period of 30 minutes.

04.60 REPEATER PANELS

The Repeater Panel shall have basic Control, and have a LCD large display. The Repeater Panels shall be installed in slim line, aesthetically pleasing enclosures.

LCD Repeater display Panels shall be installed on any floor these shall be mounted as shown on the Drawings. The LCD Panel shall show all Alarms and faults. The LCD display Panels are not required to have any Control. The Panel must be connected to a suitable supply that will in the event of a Mains Power failure, be capable of Maintaining its self for 24 hours plus ½ hour in Alarm condition. Should the PSU be in fault the condition must be automatically reported and the information on displayed on the FACP.

04.70 ADDRESSABLE PLANT INTERFACE

The Interface shall have a relay inputs with NO and NC volt free contacts, these shall be separately driven under the control of the Fire Alarm Panel.

The output relay shall be rated to switch up to 5A 240V AC. A single input shall be provided with an open and short Circuit Monitoring, which shall enable Monitoring for confirmation signal that the plant under control has operated. If the relay has not operated within a programmed period of time a specific fault shall be generated.

The event will be also displayed on the MFACP in the form of a Manual intervention and indication Panel that will display the request for the Interface to operate by illuminating a GREEN LED, then once the plant has responded an adjacent RED LED will illuminate. It shall be possible to have Manual Control of the Interface via the intervention Panel Integrated with the FACP.

04.71	Operating voltage	24VDC
04.72	Standby Condition	≤0.8mA
04.73	Alarm Condition	≤2mA
04.74	Transmission Method	Digital Communications
04.75	Maximum Humidity 40◦C)	95% RH- Non Condensing (at
04.76	Temperature range	-10◦C - + 50◦C

04.80 **SHORT CIRCUIT ISOLATOR**

The Short Circuit Isolator shall be installed at least every twenty Devices and or each separate Fire zone and between floors. The Circuit Isolator shall be used to protect the installation wiring in the event of a short in the cables. Should a fault occur the Isolator shall automatically disconnect the loop either side of the short, the Control Panel shall recognize this disconnection and shall communicate in both directions. This process will enable a limited number of Devices to be off line whilst the fault is being investigated and repaired. Once the short is removed the Isolators shall automatically reinstate the loop connection. The Isolator shall incorporate an LED, which illuminate when the short is detected on the loop Circuit.

04.81	Operating voltage		24VDC
04.82	Current rating	Standby: IN SHORT CIRCUIT:	170µA (Typical) ≤ 2.7 m A
04.83	Max .short circuit:		1A
04.84	Maximum Humidity 40◦C)		95% RH- Non Condensing (at
04.85	Maximum No of Isolator per Loop		30(Typical)

04.90 **ADDRESSABLE REMOTE SENSOR INDICATOR**

Remote Indicator shall be installed as shown on the Drawings. The Remote Indicators shall be Addressable linked to any number of Detectors within the given location. The Remote Indicator shall be installed in a clearly identifiable location. The Remote Indicator shall fit onto a standard electrical accessory box.

04.100 **INTELLIGENT POWER SUPPLIES**

The specialist shall determine how many distributed Power supplies shall be required for the complete Project. Each Power supply shall be fully monitored by the Fire Detection System for:

04.101 Mains Healthy

04.102 Mains Fail
04.103 Charger Mail Function (Low Voltage)
04.104 Batteries Mail Function (Low Amperage)

The Batteries and Charger shall maintain the full load of the connected load, plus 20% for a minimum period of 24 hours stand-by, in the event of mains failure. After 24 hours has elapsed the System shall be capable of initiating a full global alert and evacuate or operation of all equipment reliant on the PSU for its supply for a minimum period of 30 minutes.

05.00 Wiring and Conduiting

The system wiring and installation shall be in compliance with all applicable codes, and the manufacturer's recommendations. 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 in terminal cabinets 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 or junction boxes. The wiring for alarm indication and initiating circuits shall be with PVC insulated single core cables in PVC conduits conforming to requirements given in relevant section of these specifications.

06.00 INSTALLATION

The Fire Alarm System shall be installed with Fire rated cable. The Fire rated cable shall be a minimum of 1.2 mm and shall be RED LOW Smoke and Fume (LSF) outer sheaf. The Fire rated capable shall be clipped directly to the Building fabric for single and double cable runs. The clips shall be Fire rated metal with a LSF Coated RED finish. The clips shall be fixed suitably and shall be no greater than 300mm between fixings.

Where there are more than 2 cables, the cables shall be installed on suitable galvanized tray or in Trunking. Where cables run below 2.4 meters from finished floor level then all cables shall be installed within galvanized conduit.

Correct corresponding termination Devices and boxes shall be used. All Devices shall be terminated using a compression lock gland colored RED manufactured in LSF material. Where Devices are fixed surface a suitable LSF shroud shall be used.

Before any Devices are connected the Contractor must fully Demonstrate and prove the quality of the installation for loop integrity, continuity, resistance and capacitance.

The System specialist shall install all Devices: this shall include 2nd fix and 3rd fix. Prior to completion of the Project the System specialist must demonstrate the Entire System to approval of the Consultant. The Entire System shall have been 100% tested independently prior to the Demonstration to the Consultant. Should any items fail during the test a new and complete 100% re-test shall be carried. The specialist will be responsible for any costs involved with re-testing of the System.

The System specialist will be responsible for providing complete and detailed Manuals for the Entire System. The Manuals shall be fully detailed and shall describe the operation and function of each part of the System.

The System supplier shall completely program the Entire Integrated System to meet the full needs of the specification; this shall be done off site and proven to the Consultant.

The complete system shall be providing a complete off site witness test of the Entire Integrated
System.

The Entire System should be provide the full packaging for the Entire consignment, the packaging shall be weather resistant and shall be suitable to ensure all goods are in complete and perfect condition ready for installation.

The supplier shall fully test the entire system and when satisfied offer the Entire System to the
Consultant for the complete witness testing. Should any failure occur then a complete retest shall be carried out at the cost of the specialist. The test must for the Entire Integrated System; partial test will not be acceptable.

The specialist shall allow for an internal authorized and certified quality control inspector to ensure that all QA guidelines a being followed. Only ISO approved supplier will be considered for these Works. A certified report shall be forwarded to the professional team.

The System supplier shall allow for on site and off site intensive Training for a period of One Week for a minimum of 4 people. The Training procedures shall be submitted to the consultant for approval before Training will commence. The Training shall be carried out by a professional and approved Training Manager.

The Supplier shall submit a proposal for complete and comprehensive service and maintenance for the Entire System. The maintenance shall be at least quarterly and a complete detailed report shall be issued in triplicate following the visit. As a minimum 25% of all Devices shall be tested every quarter.

The Electrical installation will be as specified earlier for each System. The specialist is to ensure that the Entire System is complete and installed in accordance with correct installation policies. Only approved installation teams shall be utilized with the installation of the complete Integrated System.

The Complete services shall be supplied; configured and commissioned by an approved, Trained and Certified Local Distributor.

07.00 TESTING

The testing of Fire Detection and Alarm System equipment shall be in strict compliance with the relevant standards and regulations. During testing of equipment, emphasis is laid on the following points:

07.01 Operational Safety

07.02 Regular functioning of the system and devices

07.03 Protection against false alarms.

07.04 Various detectors like smoke, heat, etc. shall be subjected to the basic tests and sensitivity tests. The detectors shall be tested in various ways to check real and false alarm behaviors.

07.11 The control panels shall be subjected to the following tests:

07.12 Power failure test.

07.13 Battery failure test.

07.14 Real alarm and real trouble test.

07.15 Ground Fault test.

07.15 Zone wise and General alarm test.

07.16 Lamp test (only for alarm lamps/LED'S).

07.17 Field modifiable programming test.

07.18 Function test of each board.

08.00 TRAINING

A training session shall be presented by a fully qualified, trained representative of the equipment manufacture/supplier who is thoroughly knowledgeable of the specific installation. The training shall be given to personnel responsible for operation and maintenance of the Fire Detection and Alarm system.

The training session shall include but not limited to the following:

08.01 Detailed explanation of wall charts as mentioned in Article 2.0 of this section.

08.02 Function of each control switch.

08.03 Periodic operational testing of panel/devices.

08.04 Maintenance of fire log book supplied by manufacturer.

08.10 Actions to be taken upon receiving following signals:

08.11 False alarm indication

08.12 Trouble on any initiating or indicating zone

08.13 Common alarm or common trouble indication

08.14 Low battery voltage indication

08.15 Field modifiable programming

08.16 How to perform periodic testing of panel and devices

09.00 MEASUREMENT AND PAYMENT

09.01 **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.

09.11 **Fire Detection and Alarm Control Panel**:

09.12 **Measurement:**

Measurement shall be made as complete job for Fire Detection and Alarm control panel including all related equipment such as power supply, relays, batteries, etc. alongwith all accessories acceptably supplied and installed by the Contractor as a complete unit.

09.13 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning alongwith all accessories.

09.21 **Automatic Detectors**

09.22 **Measurement:**

Measurement shall be made for the number of automatic detectors acceptably supplied and installed by the Contractor as complete unit.

09.23 **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 the automatic detectors and accessories.

09.31 **Manual Call Station**

09.32 **Measurement:**

Measurement shall be made for the number of manual call stations acceptably supplied and installed by the Contractor as complete unit.

09.33 **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 all manual call stations.

09.41 **Junction Boxes**

09.42 **Measurement:**

Measurement shall be made for the number of junction boxes acceptably supplied and installed by the Contractor as complete unit.

09.43 **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 all junction boxes and accessories.

09.51 **Alarm Bell, Alarm Buzzer, Visual Alarm Signal**

09.52 **Measurement:**

Measurement shall be made for the number of alarm bells, buzzers and visual alarm signals acceptably supplied and installed by the Contractor as complete unit.

09.53 **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, testing and commissioning of all alarm bells, buzzers and visual alarm signals including all mounting accessories.

09.61 **Wires and Conduits**

09.62 **Measurement:**

Measurement shall be made for the total number of running meters of wires and conduits acceptably supplied and installed by the Contractor.

09.63 **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, connecting, testing and commissioning including all the accessories.

SECTION-15

CCTV SECURITY SYSTEM

15.1 SCOPE OF WORK:

The work under this section consists of supplying, installing, testing and commissioning of all material and services of complete close circuit television (CCTV) system as specified herein, as shown on Tender Drawings and stated in Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer & coordinate at site with other services for exact route, location and position of the system.

The close circuit television (CCTV) system with accessories shall also comply with the General Specifications Section # 16001 and with other provisions of the Tender Document.

15.2 GENERAL:

The close circuit television (CCTV) system, in general, shall be use for indoor & outdoor surveillance including monitoring of all entry points of the project.

All equipment provided under this shall conform to relevant standards i.e. CE & UL listed.

The Contractor shall furnish with the tender bid complete with Detail / Data of Equipment, Material etc which they are offering.

The successful bidders shall inform Performance / Reliability / Factory acceptance test of all Electronic / Electrical Software and Hardware. Equipment installed / required in the Entire System of this turnkey Project.

The successful Bidder shall ensure the satisfactory, reliability of the System under all weather condition i.e. strong wind / storm, hot and cold weather conditions and the specified ambient temperatures.

Bidder will also ensure performance durability of all the Electrical / Electronic Software and Hardware equipment installed in the Entire System.

15.3 SYSTEM:

The Entire System shall provide Color CCTV surveillance of specified area by mean of Color IP Cameras. The Central Control shall be located in the Security room on Ground Floor. It shall house the Color Monitors with all related CCTV equipment.

15.4 MATERIAL

15.4.1 Fixed Type Camera:

The Camera shall be colored IP camera conforming to the CCIR standards. The Camera shall be compact rugged design, high sensitivity advanced Digital signal processing high resolution with outstanding picture quality extended sensitivity with night sense.

The Camera shall require only 1.0 LUX for usable Video. All the Control shall be concealed. Other standard feature shall back light condensation, automatic shutter, selectable Electronic shutter, Digital adjustment Control, automatic white balance and double installation.

The Camera shall be line locked to the power line zero crossing to ensure roll free vertical interval Video switching and Recording. A vertical phase adjustment potentiometer shall be accessible through a opening in the side of the Camera to allow for Camera synchronization in multi phase power installation.

The rated voltage shall be 12VDC, 24 VAC 50 Hz. The operating temperature shall be -20 to 50 degree Celsius. Humidity shall be 5 to 93% non-condensing. Shock resistance shall be minimum 50 gm.

15.4.1.1 Signal to Noise Ratio: 50 dB AGC: 21 dB (Max)

15.4.1.2 Electronic Shutter : Automatic, 1/50 to 1 /125,000 –sec

15.4.1.3 White Balance : Automatic Sensing, (2500 – 9000K)

15.4.1.4 Video Output : Composite Video 1.0 Vpp, 75 ohms.

The Camera shall have an on screen menu with following Controls.

15.4.1.5 Video Level :

15.4.1.6 AGC : On /off

15.4.1.7 BLC : On / off

15.4.1.8 ATW : On/ hold

15.4.1.9 Shutter : AES / off/ Flicker less

15.4.1.10 R- Offset :

15.4.1.11 B-Offset :

15.4.1.12 V-Phase Adjustment : 0-358 degrees.

15.4.2 Auto Dome Camera:

15.4.2.1 Auto Dome Camera out Door Type:

The IP Camera shall consist an imager of 4mm IT CCD with a resolution of (752 X 582 PAL)/ (768 X 494 NTSC). Having a Lens of 25 X zoom (2.4 – 60mm) F1.6 to F27 It should consist an automatic with manual override. Focus and iris adjustment with a field of view of 2.0 Degree to 45 Degree

The Camera shall be operational between – 40 Degree C to 50 Degree C (-40 Degree F to 122 Degree F) under 100% relative condensing humidity, the ingress protection should be less than IP 66 (NEMA 4X)

The IP Camera shall be able to PAN 360 Degree continuous and till from horizontal plane -5 Degree to 90 Degree during a guard tour the Camera speed should be 360 Degree per second, I 0.50 accuracy and having a variable speed of 120 Degree per second.

The IP Camera shall be capable of creating 16 independent sectors with 16-character title. The Camera should be remotely controlled through either Biphase or via RS-232. Pre position should be at least 99 each with 16-character title.

The IP Camera shall be able to create two Types of tours one Recorded tour with totally 15 Min during both and preset tour that consist up to 99 Scenes consecutively.

The IP Camera shall have the following minimum specifications;

15.4.2.2	Video Output :	1.0 Vp-p; 75 ohms
15.4.2.3	Gain Control :	Off / Auto (with Adjustable Limit)
15.4.2.4	Synchronization:	Line Lock (-120 to 120 Degree Vertical Phase Adjust) or Internal Crystal.
15.4.2.5	Aperture Correction:	Horizontal and Vertical.
15.4.2.6	Digital Zoom: 12X	
15.4.2.7	Horizontal Resolution: 470 TVL (NTSC) / 460 TVL (PAL)	
15.4.2.8	Sensitivity (Usable Video):	
15.4.2.9	Day Mode W/Slow Shutter Off	0.2 fc / 2.0 Lx
15.4.2.10	Night Mode W/Slow Shutter Off	0.025 fc / 0.25 Lx
15.4.2.11	Day Mode W/Slow Shutter On	0.013 fc / 0.13 Lx
15.4.2.12	Night Mode W/Slow Shutter Off	0.0016 fc / 0.016 Lx
15.4.2.13	SNR	:> 50 db
15.4.2.14	White Balance	: 2000 K to 10000 K

15.4.3 AUTO DOME CONTROLLER:

The Digital key boards shall have full function multi purpose used for System Control and programming. The key board shall includes an integral variable speed Pan / Till zoom joy stick and a splash resistant.

The Auto Dome Controller shall have following features;

15.4.3.1 Control Multiple Products with One Key Board

15.4.3.2 Soft Keys Allow for Product Specific Menus.

15.4.3.3 Back Lit Keys and Easy-to-Read Displays.

15.4.3.4 Simplified System Programming with an Intuitive Interface.

15.4.3.5 Multilingual Support.

15.4.3.6 Plug & Play with DVR & Multiplexer.

15.4.3.7 Optional PC Software Allows for Customizable Keys for Use with Command Scripts.

15.4.4 Digital Video Recorder/Network Video Recorder (NVR):

Digital video recorder should have the following features.

15.4.4.1 Standalone DVR Functionality

15.4.4.2 LAN Based Expansion & Direct PC Interfacing

15.4.4.3 50 Frames per second

15.4.4.4 Software for Remote Accessing LAN Environment.

15.4.4.5 Snap Shots

15.4.4.6 RAID 5 Expandability.

15.4.4.7 Motion Detection Feature

15.4.4.8 I/Contacts for Interfacing Devices.

15.4.4.9 Auto Dome Controlling Using Keypad or DVR Software.

15.4.4.10 6/9/16 Channel Models.

15.4.4.11 Recording Schedule.

15.4.4.12 Video Loss Notification.

15.4.4.13 Smart Motion Search in Play Back Mode

15.4.4.14 Authenticity of Recorded Video.

15.4.4.15 Protected Recording.

15.4.4.16 Password Protection.

15.4.4.17 Multi-Screen, Full Screen, Sequence, Image Freezing and Zoom Options.

15.4.4.18 External CD/DVD Writer Attachment.

15.4.4.19 Adjustment of IPS per Camera.

15.4.4.20 Recording Rates of 50 IPS (PAL) or 60 IPS (NTSC)

15.4.4.21 Fully Compatible with any Standard 10/100 Base – T network

15.4.4.22 PAL/NTSC Auto Added

15.4.5 CCTV MONITOR/ PC MONITOR:

Color Monitor is multi standard compatibility with a built-in loud Speaker and in puts able to accept NTSC, PAL and S-Video standard in 450 TV line of Horizontal resolution is housed in a Compact, Space- saving metal cabinet for rugged reliability.

15.4.6 PAN / TILT MOTOR

The Weatherproof outdoor Pan / Tilts are low profile, economical, compact units constructed with corrosion-resistant hardware. These remote positioning Devices are fully System compatible with CCD Cameras, Lenses & housing combinations.

15.4.7 VIDEO CABLE

The cable for CCTV system shall be 4 pair UTP cat-6 cable.

15.4.8 POWER CABLE

PVC insulated PVC sheathed unarmored Multicore 600/ 1000 Volts grade with standard Copper Conductors according to latest standard specification.

15.4.9 LENSES:

Lenses shall be of c and CS mount and following types.

15.4.9.1 4 or 8 mm Fixed Focal Length and Manual Iris Lens.

15.4.9.2 3.5-8 mm Vari Focal Auto Iris Lens.

15.4.9.3 **SYSTEM RACK**

The System rack shall incorporate the Monitor, Digital Video Recorder and all Controlling accessories. It shall be of 483mm standard Mounting System, all Material casing with Front Glass Door. All rack shall be supplied with Lock & Key arrangement.

15.5 SPECIAL REQUIRMENT

The Central Control Room i.e. the Guard room at the main entrance of the facility shall be properly Air Conditioned to meet the CCTV equipments' specified temperature ranges.

15.6 TESTING & COMMISIONING

The Entire normal Test as recommended by the manufacturer shall be carried out on the System. The System shall be Commissioning by the Authorized Personnel Only.

15.7 MEASUREMENT AND PAYMENT

15.7.1 **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.

15.7.2 **Fixed Type camera**:

15.7.3 **Measurement:**

Measurement shall be made as complete job for Fixed Type camera including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.4 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at

the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

15.7.5 **Auto Dome camera**:

15.7.6 **Measurement:**

Measurement shall be made as complete job for Auto Dome camera including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.7 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

15.7.8 **Auto Dome Controller**:

15.7.9 **Measurement:**

Measurement shall be made as complete job for Auto Dome Controller including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.10 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

15.7.11 **Digital Video Recorder**:

15.7.12 **Measurement:**

Measurement shall be made as complete job for Digital Video recorder including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.13 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

15.7.14 **CCTV Monitor**:

15.7.15 **Measurement:**

Measurement shall be made as complete job for CCTV Monitor including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.16 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

15.7.17 **PAN/TILT Motor**:

15.7.18 **Measurement:**

Measurement shall be made as complete job for PAN/ TILT Motor including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.19 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

15.7.20 **Video Cable**:

15.7.21 **Measurement:**

Measurement shall be made for the running meters length for Video cable including all related materials etc. along with all accessories acceptably supplied and installed by the Contractor as a complete unit.

15.7.22 **Payment:**

Payment shall be made for the number of units measured, as provided alone, at the contract unit price and shall constitute full compensation for supplying, installing, testing and commissioning along with all accessories.

SECTIONS-16

MATV SYSTEM

16.1 System

MATV system shall consist of RF TV coaxial cable outlets splitters drop taps and amplifiers as required.
The complete system shall be dimensioned installed and commission to provide following performance specification.
Signal level at each TV outlet shall be +12db mV±3dbmV across 75'Ω for the all VHF and UHF bands (47 MHz to 862 MHz)
The system shall be suitable for feed from the buildings own independent system.

16.2 Installation

The contractor shall prepare detail shop drawings laying out the work with comprehensive technical submittals and calculations of d.bs drops etc in triplicate for the approval of the Engineer/Consultant. The final shop drawings & technical submittals shall be submitted in triplicate

All installation and termination work shall be undertaken by the contractor under the supervision of a qualified engineer who has been trained by the manufacturer.

16.3 Testing & Commissioning

The contractor shall arrange to have testing and commission of the system carried out by the manufacturer's representative and the test report shall be submitted to the Engineer/Consultant .the Employer Personnel shall be trained in the operation programming and maintenance of the system, and shall be provided with complete set of record as built drawings schematics operation and maintenance documentation in triplicate through consultant.

16.4 Guarantee & Maintenance

The contractor shall provide an on-site warrant and free service & maintenance (1 visit/3 months) covering materials and labour valid for 1 year from the data of commissioning for the entire MATV system.

SECTION-17

TESTING

17.1 GENERAL

Upon completion of the installation the contractor shall perform field tests on all equipment material and systems. All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with specifications.

The contractor shall furnish, install and maintain all tools, instruments, test equipment, material, connections etc. and furnish all personnel including supervision and 'Stand by' labour required for the testing setting and adjustment of all electrical facilities and their component parts including putting the same into operation.

All tests shall be made with the proper regard for the protection of the equipment giving both "as found" and "as left" conditions. Three (3) copies of all test data shall be given to the Engineer for record purposes.

The witnessing of any test by the Engineer do not relieve the contractor of his guarantees for materials, equipment and workmanship as specified in the Conditions of Contract.

17.2 INSULATION TESTS

Insulation resistance tests shall be made on all electrical equipment using a self-contained instrument such as the direct indicating ohm-meter of the generator type direct current potentials shall be used in these tests shall be as follows:-

Circuit under 110 volts – 500 volts test.

Circuit 220 volts to 400 volts – 1000 volts test.

The minimum acceptable insulation resistance value will be 5 Megaohms.

The test equipment for insulation testing will be furnished by the contractor.

Before making connection at the ends of each cable run, the insulation resistance test of each cable shall be made. Each conductor of multicore cable shall be tested individually to each other conductor of the group and also to earth. If insulation resistance test reading are found to be less than the specified minimum in any conductor, the entire cable shall be replaced and the new cable tested.

All transformers, switchgear shall be given an insulation resistance measurement test to ground after installation but before any wiring is energized. 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 that specifies above, the cause of the low reading shall be determined and removed. Corrective measure shall include dryout procedure by means of heaters if equipment is found to contain moisture. Where corrective measures have been necessary and the insulation resistance reading taken the correction has been made it should satisfy the requirements specified herein. Repeated insulation resistance maintenance test shall be made twice and at least 12 hours apart. The maximum rage for each reading on the 3 successive test s shall not exceed 20% of the average value. After all tasts have been made successfully the equipment shall be reconnected.

17.3 EARTH RESISTANCE TESTS

Earth resistance tests shall be made by the contractor on the earthing system, separating and reconnecting each earth connection as may be required by the Engineer. 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 |ECP together with the resistance of the earthing lead measured from the connection with earth electrode to any other position in the completed installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical inspector’s requirements. Where more than one earting sets are installed, the earth resistance test between two sets shall be measured by means of resistance bridge instrument. The earth resistance between two sets shall not exceed one ohm.

17.4 TRANSFORMER & SWITCHGEAR

In addition to the insulation resistance tests on the transformer, a polarity or phase rotation test shall also be made. Auxiliary devices, breather, bucholz relay etc. shall be tested for satisfactory operation.

Each air circuit breaker shall be operated electrically, ascertaining that handle mechanisms are operating. All interlock control circuit shall be checked out for proper connections in accordance with the wiring diagrams given by the manufacturer.

The contractor shall identify the phase of all switchgear and power cables by stenciling the switchgear and tagging the cables so that the phases can be identified for connections to give proper phase sequence.

Series over current trip elements shall be checked against rating of equipment served. Also to checked for correct size function of fuses disconnect switches, number of inter locks indicating lights, alarms and remote control devices. Name plates shall be checked for proper designation of equipment served.

17.5 OPERATING TESTS

Current load measurement shall be made on equipment and on all power and lighting feeders.

The current reading shall be taken in each phase wire and in each neutral wire while the circuit or equipment is operating under actual load conditions. Clip on ammeters may be used to take current readings. All light fittings shall be tested electrically and mechanically to check whether they comply with the standard of specifications. Fluorescent light fittings shall be tested so that when functioning properly no flickering is observed or choke noise is heard.

The lightning protection system shall be tested for earth resistance and for electrical and mechanical joints. The combined resistance to earth to the whole lightning protection system shall not exceed 5 ohms.

The alarm system, telephone system, sound distribution system shall be checked and tested as per manufacturer's instruction and in the presence of the Engineer or his representative.

After any equipment has been tested, checked for operation etc. and is accepted by the Owner's representative the contractor shall be responsible for the proper protection of such equipment for assurance that subsequent testing of other equipment of system do not disturb the completed work.

TABLE OF CONTENTS

PLUMBING SPECIFICATIONS

TECHNICAL SPECIFICATIONS **No. Of Pages**

101	Painting, Coating & Stencilling	4
102	Motors.	1
103	Valves.	2
104	Geysers and Hot Water heaters.	8
105	End Suction Centrifugal Pump	3
106	Automatic Pump controller and level indicator	1
107	Sump Pump sewerage	1
108	Fire Pump set, Electric motor Operation (Hydrant & Hose reel application)	6
109	Site Potable water and Fire Fighting Piping	3
110	Building water, natural Gas and Fire protection piping	4
111	Site Sewerage and Storm Water Piping	4
112	Building Drainage Piping	3
113	Meters and Gages	1
114	Support s and Anchors	2
115	Portable Fire extinguishers and Accessories	3
116	Building Hose Cabinet and External Hydrants	2
117	Piping insulation	2
118	Plumbing Specialities	1
119	Sewerage line Specialities	2
120	Plumbing Fixtures & Accessories	2
121	Disinfection Of Water Distribution System.	2
129	FIRE PUMP (DIESEL ENGINE).	5

PAINTING, COATING AND STENCILLING

1. General

Painting shall include furnishing labour, materials, equipment, ladders, scaffolding, protective covers, other items required to prepare and finish surfaces of work specified herein or in any of the other sections. Paint colour scheme shall be specified at the time of painting or earlier and shall be based on American Standard "Scheme for Identifications of Piping System" ASA A-13.1 of 1975.

2. Surface Preparation

a) Surface to be painted shall be dry and free from burrs, weld spatter, flux, dirt, dust, rust, loose mill scale, grease, oil and other foreign matter before any paint is applied.

b) All rust and loose mill scale etc. shall be removed by thoroughly chipping, scraping and wire brushing. Oil, grease, dust etc. shall be removed by washing down with a suitable solvent, as recommended by the paint manufacturer, and wiping with clean rags.

c) The minimum acceptable standard for surface preparation shall be SSPC-SP2, 'Hard Tool Cleaning'.

d) All tools shall be used in such a manner so as not to leave rough or sharp surfaces. No cuts shall be made on steel surfaces.

e) Before applying the finish coat the primed surface shall be scuffed lightly with sand paper recommended by the paint manufacturer.

3. Application

a) All material shall be applied in strict accordance with the paint manufacturer's directions unless otherwise specified.

b) Paint shall be applied by brush, spray or any other paint manufacturer's approved method in such a manner that a uniform thickness (as per manufacturer's recommendation) is maintained in each coat and no defects are produced in the previous coats.

c) Each coat shall preferably be of a different colour so as to produce a contrast assuring complete covering by the next coat. Sufficient time shall be allowed between coats to permit drying. A minimum of 24 hours between application on any one surface shall be allowed unless otherwise specified by the manufacturer.

d) No painting work shall be done on exterior surfaces during rainy, damp, foggy or dusty weather and no painting material shall be applied if the

temperature is above 122°F (50°C) or below 41°F (5°C). Painting work shall be avoided in cases where the surface is damp or when there is dirt and dust deposition due to blowing winds. The Owner's representative shall determine whether the conditions are suitable for painting or not.

e) The primer coat of paint shall be applied as soon as possible after the surface preparation but, in any case, on the same day.

f) Before application of painting material, the Owner's/Engineer's representative shall inspect and approve the quality of surface preparation and the preparation of painting material.

4. Paint System

a) Materials & Equipment: All materials & equipment factory fabricated, imported or otherwise shall be provided with a fresh coat of paint of same colour as the original factory paint, if in the opinion of the Consultant the same has deteriorated to an extent to require fresh painting. Paint shall be applied as per the accepted norms and as directed by the Consultant. The items covered under this head shall include chillers, air handling units, fan coil units, pumps, cooling tower, fans and other equipment which are a part of this contract.

b) Un-insulated Surfaces: including piping, valves, and fittings, tanks, etc., shall be painted with two coats of primer followed by two coats of enamel paint.

c) Insulated Surfaces including piping, valves, fittings, vessels, etc., shall be painted with two coats of primer.

d) Underground Piping shall be painted with one coat of asphalt based primer followed by two layers of PVC anti-corrosion tape of approved quality.

e) Galvanised Piping exposed to view shall be painted with special primer and two coats of enamel paint.

f) Hangers & supports for ducting and piping shall be galvanised, and need not be painted.

g) Galvanised Sheet Metal Duct work need not generally be painted except in finished areas, other than mechanical room where the ducting is exposed, the ducting & support system shall be painted with galvanising primer and two finish coats of enamel paint.

5. Paint

a) Primer for Iron Surfaces shall be Dulux Synthetic Red Lead Primer as manufactured by ICI.

b) Primer for Galvanised Surfaces shall be ETCH PRIMER AND "ZINC CHROMATE YELLOW PRIMER" as manufactured by ICI.

c) Finishing Paint shall be generally enamel paint, unless the application requires special paint, in which case suitable special paint shall be used.

d) All paint supplied from factory shall be ready for application. The application of thinners or any other material shall be subject to approval by the Contractor. In any case all instructions of the paints manufacturer shall be strictly followed.

6. Galvanising

Galvanising shall comply with BS 729. The term 'galvanised' shall apply to hot dip or electrolytic galvanising, zinc spraying or cadmium plating. All surfaces shall be degreased, washed with mineral turpentine and given a coat of latex based primer prior to the application of final coats.

After fabrication, pickle or abrasive blast clean all steelworks to be hot dipped galvanised

7. Powder Coating

All surfaces to be powder coated shall be cleaned as for galvanising.

It shall be applied by using an electrostatic gun in a clean atmosphere to ensure that no dust particles or other impurities blemish the final product.

It shall be baked in special ovens at controlled and accurately predetermined temperatures.

It shall be applied to a thickness of 0.0125mm on wearing surfaces and 0.01mm on non-wearing surfaces, unless otherwise specified.

8. Stencilling

a) Piping: The Contractor shall attach a sheet metal label near each valve on the pipe, indicating the name of the fluid. Also an arrow should be painted next to the legend indicating the direction of flow in pipe. The legend shall be placed in a location so that it can be easily read from the floor. The legend shall conform in size of letters and colour to ASA A-13.1 of 1975, "Scheme for the Identification of Piping System".

b) Equipment: All equipment shall be provided with rating shields to be fixed at a suitable external location of the equipment. Rating shield shall be of galvanised steel of suitable size with the ratings painted on. The shields shall generally display the following data:

i) Fluid flow rates.

ii) Pressure, pressure drops.

iii) Cooling capacities or other capacities.

iv) Motor data.

v) Equipment identification symbol/number.

9. Identification Tags

shall be installed on all valves, controls and other parts of the system. Tags shall be of engraved laminated plastic (black in front and white behind) 1.6 inches (40mm) round or square with letters or numbers 0.5 inches (12mm) high and fastened securely with brass "S" hooks or chains.

The Contractor shall further provide charts, diagrams, of size and type as approved designating numbers, service or function and location of each tagged item.

MOTORS

Motors shall be of the type and sizes as specified for all air-conditioning equipment and shall comply with rules of electrical machines as stated in VDE 0530/59 and BS 2613.

Adjustment in motor HP or speed shall be allowed to meet the system requirements, and site conditions. Generally all motors shall be constant speed, 3 phase, squirrel-cage induction type unless otherwise specifically noted.

The motors offered shall be of the 400V, 3-phase, 50 Hertz AC system type and shall be suitable for operation at 400V $\pm$10% .

The motors shall be suitable and able to give required output under site conditions i.e. maximum ambient temperature of 120°F. (50°C) and altitude 1700 feet (518 meters).

The motors where specified to be single phase should be suitable for operation at 230 $\pm$ 10% volts, 50 Hertz, AC System.

The motors shall be tropicalised, Class 'B' or 'F' insulated and fungus proof, unless otherwise specified. The motors shall have a totally enclosed fan-cooled (TEFC) construction.

All motors should be arranged for quiet operation and guaranteed to give the required output and fulfil the requirements of the machineries without producing any sound outside the machine room.

Motors rated 25HP and above shall be fitted with thermistors in the three phase windings, along with a suitable relay in the MCC to trip the starter if the motor overheats.

Motors being started with Variable Frequency Drives (VFD) shall be confirmed by the manufacturer not to derate or otherwise be adversely affected on being operated through a VFD.

VALVES & STRAINERS

1. Gate Valves:

   a) Ø 50mm (2 inch) & Smaller:

   125 psi (860 kPa) SWP, 250°F (120°C), threaded ends, bronze body, union bonnet, non-rising stem, wedge disc. Hand wheel nut, packing nut, gland, stuffing box, bonnet, bonnet ring, disc and body shall be of bronze. Hand wheel shall be of malleable iron. Packing shall be suitable for specified usage but shall not use asbestos. Stem shall be manganese bronze.

   b) Ø 65mm (2 ½ inch) & Larger:

   125 psi (860 kPa) SWP, 250°F (120°C), cast iron body bronze mounted with flanged ends. These shall be of solid wedge disc type, with outside screw and yoke (rising stem). Body and bonnet shall be of cast iron. Wedge shall be of cast iron with bronze disc. Seat rings shall be bronze. Packing shall be suitable for specified usage but shall not use asbestos. Packing gland shall be cast iron. Yoke shall be of cast iron and yoke nuts shall be of bronze. Hand wheel shall be of cast iron.

2. Globe Valves:

   a) Ø 50mm (2 inch) & Smaller:

   125 psi (860 kPa) SWP, 250°F (120°C), bronze, threaded ends. Body, bonnet, disc holder, stem lock nut, packing nut and disc lock nut shall be of bronze. Hand wheel shall be of malleable iron with stem of manganese bronze. Renewable composition disc shall be provided suitable for water & steam. Packing shall be suitable for specified usage, but shall not use asbestos.

   b) Ø 65mm (2 ½ inch) & Larger:

   125 psi (860 kPa) SWP, 250°F (120°C), cast iron body, bronze mounted with bronze faced disc and yoke bonnet, and shall be flanged. Hand wheel, gland, bonnet and body shall be of cast iron. Stem shall be of manganese bronze. Packing shall be suitable for specified usage but shall not use asbestos. Stem lock nut, disc and seat ring shall be of bronze. Disc shall be renewable composition type.

3. Swing Check Valves:

   a) Ø 50mm (2 inch) & Smaller:

   125 psi (860 kPa) SWP; 250°F (120°C), threaded ends. Cap, hinge pin, body, hinge, disc nut and disc shall be of bronze.

   b) Ø 65mm (2 ½ inch) & Larger: Ø 50mm (2 inch) & Smaller:

   125 psi (860 kPa) SWP; 250°F (120°C), cast iron body, including valve cap and disc. Hinge pin, seat ring and disc ring shall be of bronze. Ends shall be flanged.

4. Ball Valves:

   a) Ø 50mm (2 inch) & Smaller:

125 (860 kPa) SWP, Screwed; two-piece cast bronze body, chrome plated brass ball, teflon ball and flange seals, rods silicon brass stem, teflon and Viton "O" ring stem seals, zinc plated carbon steel handle with vinyl grip and brass handle nut.

5. Float Valve:

shall be best quality heavy duty type provided with Ø 150mm copper ball and heavy duty bronze float arm. Valve shall provide tight shut off at full closed position.

6. Foot Valve for Pump Suction Line:

shall be installed where required or indicated on the drawing. Foot valve shall be of brass, 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.

7. Gaskets:

General: non-asbestos, compressed gasket material with high-strength aramid fibres bonded with high grade nitrite NBR synthetic rubber, suitable for 750°F (400°C) and 1450 psi (10000 kPa).

8. Thread Lubricant:

General: non-hardening, non-poisonous as approved.

9. Installation of Valves and Strainers:

All gate valves, globe valves, check valves, control valves, butterfly valves, drain cocks, etc. necessary for satisfactory operation of the system shall be provided whether indicated or not. All valves having stem over 2m height shall be provided with galvanised chain operators. Valves in horizontal lines shall be installed with stem horizontal or above. Isolation gate valves shall be installed on each side of each piece of equipment as pumps, coils and other similar items; at the midpoint of all looped mains; and at any other points indicated or as required for draining, isolation or sectionalising purposes. Each valve shall be identified with not less than 35mm round or square black over white laminated plastic tags secured to valve with a suitable brass chain. Tags shall be engraved to identify valve by number and valve function. Strainers shall be installed wherever necessary to protect equipment and control valve, where proper functioning would be affected by dirt on the seat or scoring of the seat. Strainers shall be arranged not to clog piping and allow easy disconnection for change. All strainers 50mm and above shall be provided with Ø 20mm ball valves for blow-off. Strainers shall allow removal of accumulated dirt and screen replacement without disconnecting main piping.

10. All valves for Fire fighting system shall be as per N.F.P.A. Standards and UL listed.

1.0 GEYSERS (GAS OPERATED)

Storage type Gas operated Water Heater of capacity as shown on drawings & shall be supplied and installed where shown on the drawings.

The storage tank shall be constructed of 10 gage galvanised sheet steel. The storage heater shall be provided with 50mm thick fibreglass insulation protected with a jacket of mild steel and provided with two coats of stove enamelled paint over primer.

The storage heaters shall be provided with a dial type insertion thermometer on the tank and imported thermostat to maintain water temperature at 140 deg.F on peak demand. Thermometer, thermostats, relief valve (safely valve) and such other accessories shall be provided with the heater within the cost quoted for the heater.

All heaters, after installation, shall be subjected to an operation test to determine the efficient working of the recovery side, thermostat, etc; to the satisfaction of the Consultant. Heaters shall be approved by the Consultant prior to supply and installation. The exhaust from the heater shall be ducted using 20 gages G.I. sheet, as shown on the plans.

2.0 GEYSERS (ELECTRIC OPERATED)

The heater shall be a direct fired, vertical, high-recovery commercial application unit with storage & recovery rates as specified under EQUIPMENT & MATERIAL SCHEDULE (Section 2). Unit shall be furnished complete in all respect and be suitable for upto 190°F temperature & 60 PSI SWP & tested at 90 PSI. Unit shall be supplied as a complete package with neat & compact finish.

Storage type electric water heater of capacity shown on drawings / B.O.Q. and shall be supplied and installed where shown on the drawings.

The storage tank shall be constructed of 14 gage galvanised sheet steel. The heater shall be provided with 50 mm thick fibre glass insulation protected with a 20 gage galvanised steel and provided with two coats of stove enamelled paint over primer.

The heating element shall be top quality and enclosed in a copper or brass tube chromium plated.

The storage heater shall be provided with an insertion thermometer on the storage and imported thermostat to maintain water temperature at 140 degree F on peak demand. Thermometers, thermostats, relief valves (safety valve) and such other

accessories shall be provided with the heater with in the cost quoted for the heater.

All heaters, after installation, shall be subjected to an operation test determine the efficient working of the recovery side, thermostat, etc; to the satisfaction of the consultant. Heaters shall be approved by the consultant prior to supply and installation.

Payment shall be made shall be made for unit item price quoted in the bill of Quantities. Which shall include the supply and installation of water piping connections, relief valve, thermostat, etc. as specified and /or directed by the consultant.

3. HIGH-RECOVERY WATER STORAGE HEATER

(GAS OPERATED)

3.0 General

The heater shall be a direct fired, vertical, high-recovery commercial application unit with storage & recovery rates as specified under EQUIPMENT & MATERIAL SCHEDULE (Section 2). Unit shall be furnished complete in all respect and be suitable for upto 190°F temperature & 60 PSI SWP & tested at 90 PSI. Unit shall be supplied as a complete package with neat & compact finish.

3.1 Storage Heater:

Storage heater shall be fabricated from a minimum of 12, gage G.I sheet with welded construction. Storage capacity shall be met after excluding the heat exchanger volume. Cold galvanising compound shall be applied on all welded surfaces.

Tank shall include dished heads with collar of dish & tank welded from outside and not to come in contact with stored water.

Minimum of 2 Nos hand holes at top and bottom shall be provided with adequate gaskets for internal visual inspection.

All longitudinal weld of the tank and flue tube outlets shall be properly galvanized using an approved cold galvanizing compound.

Outside of the tank shall be adequately braced using M.S flat iron as a protection against “bulges” while the entire system is under test pressure exceeding 90 PSI.

All nozzles welded to storage tanks shall be of stainless steel.

Storage tank after testing shall be painted from outside with 2 coats of antirust & heat resistant paint. Entire storage tank, combustion chamber, draft collector, shall be encased in a 16 gage painted sheet metal removable jacket. The external jacket shall be internally lined with 2 inch thick, 80kg/m^3 density rock-wool wire-reinforced insulation.

3.3 Heat Exchanger:

Multiple vertical fire tube heat exchanger in the heater shall be fabricated from minimum 12 gage G.I. sheet steel welded at top and bottom heads of the shell.

All tubes shall include longitudinal full length turbulators to maximise heat transfer from products of combustion to the water to be heated and further prevent excess cold air flowing through the heat exchanger while the unit is not firing.

3.4 Burner:

Natural gas firing shall be either single stage or two stage as per heat input. Unit shall consist of a combination main gas & pilot diaphragm gas type valve suitable for a remote mounted snap actuating liquid immersion adjustable thermostat utilising conventional rod & tube element & independent thermo-electric automatic pilot.

Gas valves shall be suitable for up to 4" W.G gas pressure and if needed a separate natural gas pressure regulator shall be supplied with the unit suitable for a maximum inlet pressure of 10 PSI.

Main gas to the burner shall cut off in event of pilot failure.

Unit shall include an arrangement to control the combustion and provision shall be made to observe the flame when unit is in operation.

Each stage of firing shall use its independent cast iron or stainless steel ribbon burners and gas valves.

Burner with 50000 to 100,000 Btu/h input to be single stage, single flue.

Burner with110,000 Btu/h or larger to be two stage multiflue type.

3.5 Trim & Accessories:

3.5.1 Following trim & accessories shall be provided:

a)`water temperature indicating thermometer
b)`temperature pressure relief valve
c)`feed water check valve
d)`drain outlet, plugged
e)`recirculating water inlet, plugged

f)`external draft diverter

3.6 Foundation:

Heater shall be installed on 100mm high concrete pads. Pads shall be constructed of 1:2:4 cement concrete with nominal reinforcement. Pads shall be finished with 5mm cement plaster. Edges shall be provided with 25×25×3mm angle-iron frame, suitably painted.

3.7 Installation:

The Contractor shall be responsible for the complete installation in all respects. He shall be responsible for making water connection, installing heater flue duct, electrical control, drain lines, gas piping, safety relief valve lines vented to atmosphere, complete in all respects.

3.8 Commissioning & Testing:

The Contractor shall be responsible for commissioning the heater as per manufacturer's recommendations. This Contractor shall be responsible for cleaning the heater, checking out all controls, wiring, installing all connecting wire between heater and supporting system, special draft controls, etc., so that the work is completed in all respects. This Contractor shall be required to test the heater in the presence of the Engineer/Consultant representative, set all control and safety devices to correct setting positions, and submit test reports in forms to be supplied later by the Consultant. It is the intent of these specifications that the contractor shall supply a completely functional heater as specified.

3.9 Spares:

Supply spares as per manufacturer's recommendations for one year operation.

4.0 HIGH-RECOVERY WATER STORAGE HEATER (COMBINATION ELECTRIC AND DIESEL OIL FIRED).

4.1 General:

Indirect dual fuel fired (Diesel or Electric) 500 gallons storage water heater system to deliver 350GPH of water from 0°C to 60°C consisting of following major components:

4.2 HEATER PRIMARY

(When Firing Diesel)

Two stage, hi-speed diesel oil fired auto-ignition, fully packaged, four pass flexible water tube designed hot water boiler complete with following:

- Hi-altitude de-rated, for 8000 feet, Imported, front end mounted hi-speed diesel oil fired single stage burner Complete with flame safeguard controller, ignition transformer, control transformer, flame scanner, blower, motor, oil valves, fuel oil pump all pre-piped & wired at factory, power inlet 220V / 50Hz, single phase.
- On / off type operating thermostat.
- Stage thermostat
- Hi-limit Thermostat.
- Lo-water cut-off controller.
- Hi-pressure safety relief valve.
- Heater mounted temperature & pressure gauge.
- Pre-wired unit mounted power & indication panel including Audible Alarm (Hooter) for low-water in boiler & hi-temperature in boiler with manual reset.
- Power & Alarm indicator Lamps.
- Panel mounted Digital water inlet & outlet indicating thermometers.

Unit shall be complete in all respect with double insulation of ceramic wool internally & rock wool on inside of external body. All painted to white color.

Unit shall have a minimum efficiency of 80% & suitable for an outlet temperature of up to 60°C (Field adjustable from 0°C to 80°C) & generally as per literature enclosed.

4.3 OIL CONSUMPTION

Manufacturer / supplier shall provide fuel consumption date along with technical submittal.

4.4 STORAGE TANK

(500 US-GALLONS)

A Pre-installed, piped vertical M.S. plate welded construction storage tank shall be supplied including with following major components:

- Installation: Dished heads.
- 3mm thick fiber glass lined from inside.
- 18" diameter Man hole with fiber glass lined cover. - 2" thick rock wool insulation.
- M.S. pre-painted sheet jacketing. - Auto air vent.
- Pressure gauge.

- Tank water thermometer bi-metal type.
- Valved drain at bottom of tank.
- Flanged, Stainless Steel In/Out/re-circulation water connections.

4.5 HEAT EXCHANGER

A removable copper tube bundle type Heat Exchanger shall be pre-installed and piped with in / out water thermometer and brass wells.

Unit shall have a heat exchanger suitable for capacity of the primary water Heater.

Complete heat exchanger shall be installed in a Stainless steel housing to avoid mixing of cold water with hot water in the tank.

This way cold water first get heated and then stored. There is no temperature dilution of the stored hot water.

4.6 EXPANSION TANK

An expansion tank with gauge glass shall be installed and piped to the boiler.

4.7 CIRCULATION PUMP

Water heater and storage section will include a imported, in line type stainless steel impeller and stainless steel shaft with mechanical seal, circulation pump with associated disconnect

Contactor overload, inter-locked with the heater with all M.S. Piping and electrical connections.

4.8 ELECTRIC FIRING

Unit shall be three stage operations, suitable to heat 350GPH of water from 0°C to 60°C

Electric portion shall include following major components, controls & safeties: -

- Immersion heating elements of required capacity, grouped for stated steps of operation, assembled on tank mounted flanges, all individual elements replaceable.
- Three step immersion thermostats. (Same as for diesel)
- Hi-Limit manual reset thermostat. (Same as for diesel)
- Tank water digital thermometer. (Same as for diesel)
- Low Water Cut-off with manual re-set. (Same as for diesel)

- Pre-wired 400/50/3 electric power and control panel will be consisting of following:
  - Main incoming M.C.C.B.
  - Phase indicator lamp.
  - M.C.C.B for individual outgoing circuits.
  - Outgoing Buss.
  - D.O.L. magnetic contractors for each stake.
  - Hi temperature' alarm lamp & audible alarm, (Same as for diesel)
  - Low water' alarm lamp & audible alarm. (Same as for diesel)
  - Audible alarm hooter with reset switch. (Same as for diesel)

4.9 SKID

All above shall be assembled on a single M.S. channel skid pre-piped, pre-wired for field installation including power in/out and water connections. Unit will be painted as per engineer instructions.

The Contractor shall be responsible for the complete installation in all respects. He shall be responsible for making water connection, installing heater flue duct, electrical control, drain lines, gas piping, safety relief valve lines vented to atmosphere, complete in all respects.

4.10 Commissioning & Testing:

The Contractor shall be responsible for commissioning the heater as per manufacturer's recommendations. This Contractor shall be responsible for cleaning the heater, checking out all controls, wiring, installing all connecting wire between heater and supporting system, special draft controls, etc., so that the work is completed in all respects. This Contractor shall be required to test the heater in the presence of the Engineer/Consultant representative, set all control and safety devices to correct setting positions, and submit test reports in forms to be supplied later by the Consultant. It is the intent of these specifications that the contractor shall supply a completely functional heater as specified.

4.11 Spares:

Supply spares as per manufacturer's recommendations for one year operation.

END SUCTION CENTRIFUGAL PUMPS
(CLOSE COUPLED)

1 Scope:

These specifications cover vertical split case end suction centrifugal pumps for hydronic applications. Pump curves certifying pump operation, BHP & NPSH curves shall be submitted to the Consultant for approval.

2 Service Condition:

Pumps shall be designed and constructed to operate satisfactorily in a typical hydronic application, and shall be the product of a manufacturer regularly engaged in the production and marketing of these pumps.

3 Operating Conditions:

The flow rate, pump head & other required data are indicated in the EQUIPMENT & MATERIAL SCHEDULE (Section-2) and the pumps supplied shall conform to these requirements. The Contractor is required to ensure non-overloading selection of motor for parallel pumping operation.

NPSH required by the pump shall be stated & the NPSH as available checked by the Contractor for the specific application. The pump RPM shall be as specified in the EQUIPMENT & MATERIAL SCHEDULE (Section-2). Pump casing shall be designed to withstand the discharge pressure specified on the Schedule Sheet plus the static head on the system, plus 50% of the total head, but not less than 125 psi (8.5 bars).

4 Pump Construction:

Details of pump construction shall be as follows:

a) Casing shall be vertical split with centreline discharge, foot-supported and made of cast iron. Casings shall be provided with tapped & plugged holes for priming, vent & drain.

b) Casing Connections: shall be ANSI B16.1, 125PSI (8.5 bars), ASA Standard flat face flanges.

c) Casing Wearing Rings: Easily replaceable casing wearing rings of suitable material for service shall be provided in front and rear of impeller.

d) Casing Joint Gasket: An O-ring shall be provided at the casing joint to prevent leakage.

e) Impeller: shall be the single section enclosed type of bronze. Impeller shall be statically and hydraulically balanced. Drilled holes shall be provided through the impeller hub to balance axial thrust loads and keep positive pressure on the stuffing box. Impeller shall be keyed & locked to the shaft

with a hexagonal head impeller nut and shall be easily removable without the use of special tools.

f) Shaft: Pump shaft shall be high strength stainless steel sized to provide a minimum amount of deflection. Shaft shall be protected in the stuffing box area by a replaceable shaft sleeve.

g) Seal: Pumps shall be provided with gland packing seal or mechanical seal as indicated in the EQUIPMENT & MATERIAL SCHEDULE (Section-2).

h) Bearing Frame: shall be rigid, one piece cast iron construction. Frame shall be provided with catch basin reservoir with tapped drain hole to collect and pipe away stuffing box leakage.

i) Bearings: shall be ball type on both ends of the frame. Both bearings shall be locked in place and be sized to provide long life under thrust loads encountered. Both bearings shall be enclosed by replaceable box.

j) Bearing Lubrication: Ball bearings shall be grease lubricated with provisions for the addition & relief of grease.

k) Deflector: A replaceable shaft deflector of non corrosive material shall be provided to prevent the entrance of contaminants into the pump bearings at the inboard end of the bearing frame.

5 Baseplate & Coupling:

a) Baseplate: shall be of heavy duty, fabricated steel or cast iron, sufficiently rigid to support the pump and the driving motor with tap hole to pipe away leakage and condensation.

b) Coupling: shall be spacer type.

c) Coupling Guard: shall be metallic and fastened to baseplate and conform to the requirements of ANSI B.15.1.

6 Rotation:

Pump shall have clockwise rotation viewed from its driven end.

7 Motor:

Motor shall conform to specifications given under “Motors” (Section 15024). It shall be selected in accordance with the pumps non-overloading performance characteristics. Motors shall be mounted with pump on baseplate in manufacturer's plant and shipped as one unit.

8 Foundation:

Foundation for the pump shall be 1:2:4 concrete, sized to provide an inertia block having a mass equal to 3 times the weight of the pump and motor. The foundation shall be isolated from the structure and plant room floor by using 40mm thick high density cork. Edges of the foundation shall be provided with 25×25×3mm angle iron frame work and painted with two coats of oil paint. When shown on drawings, or with pumps mounted on upper floors, the pump's concrete foundation shall be supported on four suitably sized spring isolators.

9 Installation:

During installation, the pump shall be properly levelled, grouted in and realigned before operation in accordance with the manufacturer's recommendations. Suction & discharge connections shall be installed through flexible connectors, and electrical wiring shall be done. Drain lines from pump base plate at drip pocket shall be installed equal to the size of the opening.

10 Commissioning and Testing:

The pump shall be commissioned and tested by the Contractor, in accordance with the manufacturer's recommendations. The pump operational curve shall be identified by taking no-flow reading and shall be charted on the pump curve. Operational point at full flow shall be identified and submitted to the Consultant. Tests shall be conducted and test reports submitted to the Consultants and approval obtained.

11 Spares:

Provide spares as indicated under EQUIPMENT & MATERIAL SCHEDULE (Section-2).

AUTOMATIC PUMP CONTROLLER & LEVEL INDICATOR

1. Pump Controller:

   The automatic pump control system shall be of the solid-state type, with low-voltage electrodes in the UG tanks, and an electronic controller.

   The level sensors shall be adjustable for high and low water levels, and shall be installed in weather-proof boxes (IP 54) above each tank, with electrodes installed in PVC pipe into the tanks or as shown on drawings.

   The pump controller shall start pump at a adjustable low level, stop pump at an adjustable high level and provide alarm at an adjustable low-low level, and switch off the pump.

2. Level Indicator:

   The liquid level indicators system shall be of the solid-state type, showing the levels in the UG tanks through LEDs, and have the provisions for low and high level alarm with a 90 dBA hooter and alarm cancel button Suitable low-voltage electrodes shall be mounted on each tank, and the indicator in the pump-room.

SUMP PUMPS (SUBMERSIBLE TYPE)

1. General:

   Supply and install where shown on the drawings Submersible Sump Pumps of the capacities indicated in the EQUIPMENT & MATERIAL SCHEDULE (Section 2), for pumping out waste water containing up to 2 inch solids.

2. Construction:

   The sump pump shall be a single stage submersible pump and shall be suitable for operation with pump and motor fully submersed in water. The impeller shall be of special design.

   Materials used shall be as followings:

   a) Stator Housing ..... Stainless Steel/Cast-Iron

   b) Pump Housing ..... Stainless Steel/Cast-Iron

   c) Impeller..... Stainless Steel/Cast-Iron

   d) Shaft..... Stainless Steel/Chromium Steel

   e) Bearing ..... Heavy Duty Pre-Lubricated Ball Bearings

   f) Shaft Seal ..... Mechanical

   The motor shall be specially designed for submersible application. The stator housing shall be stainless steel, hermetically sealed and embedded in synthetic materials, to protect the winding against penetrating water and condensation.

   A built-in motor protection shall safeguard against over-load, voltage drop/rise, phase failure, excessive liquid temperature & locked rotor. The pump shall be provided with 2m of power cable.

   Pump shall also be provided with a built-in level switch for automatic ON/OFF operation between two liquid levels. The levels shall be field adjustable. In the event that built-in switch cannot be provided, the Contractor shall install an automatic pump controller to operate pumps automatically when required.

3. Installation:

   The pump shall be installed in accordance with pump manufacturer's recommendations and the Contractor shall install all supports & anchors as necessary.

FIRE PUMP SET, ELECTRIC MOTOR OPERATION

1. General:

Scope: The contractor shall supply & install a packaged fire pump set consisting of electric motor driven fire pump(s), jockey pump and a fire pump control panel along with controls, instrumentation, piping, valving all factory installed on a suitable steel skid. The entire packaged set shall be hydraulically tested at 150% of the operating pressure at the factory. All steel surfaces shall be sand blasted and painted with two coats of primer and finish paint of fire red colour.

Service Condition & Design Standard: Fire Pump Set shall be designed and constructed to operate satisfactorily in a typical fire protection application. Pumps, motors & controllers shall be the product of a manufacturer regularly engaged in the production and marketing. Fire pump set shall conform to the requirements of the latest edition of NFPA-20 (Standard for the installation of Centrifugal Fire Pumps).

If so indicated in the EQUIPMENT & MATERIAL TECHNICAL DATA (Section-2), the Fire Pump Set shall be listed for fire protection service and so certified by Factory Mutual or NFPA or Under-writers Laboratories.

2. Fire Pump:

Operating Conditions: The pump(s) shall be sized to provide a flow rate and total head as scheduled under Section 2, EQUIPMENT & MATERIAL TECHNICAL DATA. At 150% of the rated capacity the fire pump shall develop at-least 65% of its rated head and shall not exceed 140% of its rated head at zero capacity. Each pump shall be furnished with a certified performance curve indicating pressure, capacity & horsepower requirements.

Casing shall be vertical or horizontally split, with centreline discharge, foot-supported and made of cast iron. Casing shall be provided with tapped ad plugged holes for priming vent an drain.

Impeller: shall be the single section enclosed type of bronze. Impeller shall be statically and hydraulically balanced. Drilled holes shall be provided through the impeller hub to balance axial thrust loads and keep positive pressure on the stuffing box. Impeller shall be keyed & locked to the shaft with a hexagonal head impeller nut, and shall be easily removable without the use of special tools.

Shaft: Pump shaft shall be high strength stainless steel sized to provide a minimum amount of deflection. Shaft shall be protected in the stuffing box area by a replaceable shaft sleeve.

Stuffing: Pumps shall be provided with stuffing box with gland packed seat.

Bearing Frame: shall be rigid, one-piece cast iron construction. Frame shall be provided with catch basin reservoir with tapped drain hole to collect and pipe away drip.

Bearings: shall be ball type on both ends of the frame. Both bearings shall be locked in place and be sized to provide long life under thrust loads encountered. Both the bearings shall be enclosed by replaceable box.

Bearing Lubrication: Ball bearing shall be grease lubricated with provisions for the addition and relief of grease.

Baseplate: shall be fabricated steel centre drain or cast iron drip lip sufficiently rigid to support the pump and the driving motor with tap hole to pipe away leakage and condensation.

Coupling: shall be flexible type.

Coupling-Guard: shall be all metal and fastened to the base plate.

Motor-Drive: Motor horsepower & locked rotor current shall be as per Table 6-4.1.1 of NFPA 20 (1996). Motor shall be TEFC, IP-54 with class F insulation with a maximum temperature rise of 80 C in an ambient of 40 C, conforming to specifications under Section 102 (Motors). All motors shall be specifically listed for fire pump service. Conduit termination shall be arranged to prevent entrance of water. Motor hip shall be suitable to enter own-overloading operation of the motor at any point of the pump operation curve.

3. Jockey Pump

Selection Data: The jockey pump shall be suitable for providing a flow rate and total head as scheduled in Section 2, EQUIPMENT AND MATERIAL TECHNICAL DATA.

Type: Pump shall be vertical multi stage type with direct mounted motor, similar to Grundfos Model CP or approved equivalent.

Casing: Suction and delivery chambers shall be of cast iron, with intermediate and diffusers of stainless steel.

- Impellers : Stainless steel
- Shaft : Stainless steel
- Shaft-seal : Mechanical
- Bearings : Bronze

Motor: Totally enclosed, fan cooled squirrel cage to IP54 suitable for operation at 400 volts, 3 phase, 50Hz, at an ambient temperature of 40 C, conforming to specifications under Section -102 (Motors).

4. Fire pump Controller:

The Fire Pump Controller shall be as per NFPA standard & must be listed by Underwriters Laboratories or approved by Factory Mutual.

Operational System: The Fire Pump Controller shall be designed to operate the Electric Operated jockey pump automatically through a pressure switch control to maintain constant pre-set pressures in the fire mains. The main electric operated pump shall be started automatically when the pressure in the fire mains drops to preset low level, and shall continue to run the electric fire pump until at shutdown manually. Whenever the main fire-pump operates, an audible signal shall be activated. In case electric driven jockey and main fire pump failed to start due to any reasons, Diesel engine driven fire pump shall come on duty automatically. All the fire pump shall also start thru panel mounted push-buttons, remote break-glass switch, flow-switch or deluge valve switch. An override emergency manual start facility shall also be provided for all pumps.

Enclosure: The enclosure shall be constructed of 14 gauge steel, provided with baked enamel paint, with fully gasketed lockable hinged door and removable un-drilled gland plate located in the base. Degree of protection shall be IP-54.

Configuration:

Mounted on the front of the controller panel:

1- start-stop push button(s) for fire pump(s). Stop push button shall be inoperative when pump is on demand.

1- start-stop push button for jockey pump.

1- Lamps, normally lit to provide visual indication of all three phases and control circuit healthy.

1- Lamps to indicate jockey pump overload.

1- Lamp to indicate low fire water in storage tank.

1- Ammeter(s) to give indication of fire-pump motor(s) current, with selector switch.

1- Label engraved 'FIREHYDRANT PUMP MOTOR SUPPLY – NOT TO BE SWITCHED OFF IN THE EVENT OF FIRE'.

Mounted inside the controller panel:

1- Triple pole incoming isolator, door interlocked.

1- Control circuit fuses.

1- Electronic phase monitor, giving phase failure & phase reversal alarm.

1- Set of main power terminals.

1- Set of control and alarm terminals.

1- Minimum run timer (adjustable) for fire pump.

1- Sets of volt-free contact(s) shall be provided in the controller to pre-signal the starting of the main fire-pump or power supply failure.

The starters for fire & jockey pumps shall be wired to give a signal to remote (mounted at suitable remote location, and wired to the panel) alarm bell (90 dBA at 3 meters) in the event of 'pump on demand' or of a 'power failure' in any one phase of the supply, or over-load of the jockey pump, or any other alarm condition.

For Fire Pump(s):

1- Triple pole, MCCB of suitable size for carrying the stalled current of the motor for a period of not less than 75% of the period which such a current would cause the motor windings to fail.

2. DOL triple pole contactor.

   Note: Control system shall be designed to limit start/stop per hour for manual starting. However in auto position, pump start thru pressure switch will not have this limitation and will start regardless of lockout time.

3. Hand-off-Auto switch

4. Auto-start/manual stop pressure switch.

For Jockey Pump:

1- Triple pole MCCB of suitable size.

2. DOL starting system comprising:
   1- Triple pole contactor

   2. Overload thermal relay

3. Hand-off-auto switch

4. Auto-reset pressure switch

Remote Break-glass switch: The fire pump set manufacturer shall supply an additional break glass switch unit, for mounting at a suitable remote location. This unit shall be provided with one audible alarm to sound in parallel with the fire controller alarm.

5. <u>Piping, Valves & Fittings:</u>

   a) Piping material & standard shall be as indicated in EQUIPMENT & MATERIAL SCHEDULE

   Adequate provision shall be made to disassemble the piping through flanges and unions. The size of the pump suction & discharge piping & fittings shall not be less than that given in Table..

b) Valve shall conform to specifications given under Section 103. The pump set shall be furnished with:

- Gate valve on pump discharge.
- Check valve on pump discharge.
- Tee before gate valve to pipe to hose header.

c) Fittings: The pump set shall be furnished with:

- Automatic air release valve.
- Compound pressure gage on suction, (Dial size 4 ½"), ¼ inch gate valve.
- Pressure gage on discharge: (Dial size 4 ½") range approx. twice the working pressure, but not less than 200 psi, ¼ inch gate valve.
- Automatic Circulation relief valve, set below the shut-off pressure at minimum suction pressure. It shall provide sufficient flow to prevent the pump from overheating when operating with no discharge. Minimum size shall be ¾ " dia.

6. Testing at Manufacturers Works

The fire pumps & controller shall be subjected to complete testing at the manufacturers works. To determine conformance to specifications.

7. Foundation:

Foundation shall be 1:2:4 concrete sized to provide an inertia block having a mass equal to 3 times the weight of the pump and motor. The foundation shall be isolated from the structure and plant room floor by using 50mm thick high-density cork. Edges of the foundation shall be provided with a 25-25-3mm angle-iron frame and the same shall be provided with two coats of oil paint.

8. Installation:

During installation pump shall be properly levelled, grouted in and realigned before operation in accordance with the manufacturer's recommendations. Suction and discharge connections shall be installed through flexible connectors, and electrical wiring shall be done.

For pumps taking suction from a stored water tank, an anti-vortex suction plate shall be installed at the entrance to the suction pipe.

9. Commissioning and Testing:

The pump shall be commissioned and tested by the Contractor, in accordance with the manufacturer's recommendations. The pump operational curve shall be identified by taking no-flow reading and shall be charted on the pump curve. Operational point at full flow shall be identified

and submitted to the Consultant. Tests shall be conducted and test reports submitted to the Consultant and approval obtained.

10. Spares:

Spares shall be supplied as per manufacturer recommendations for one year operation.

An "Operation and Maintenance" manual shall be supplied with the fire pump set.

SITE POTABLE WATER AND FIRE FIGHTING PIPING

1. Scope of Work:

The Contractor shall furnish all labor, materials, tools, and equipment to complete the plumbing work as shown on drawings and as herein described, ready for service to the satisfaction of the Consultant.

The work includes, in general, the following:

a) Site Cold Water AND fire Fighting Piping System.

b) All valves, strainers, etc., shown, specified or needed.

c) Services and connections to utilities.

d) Other items as may be specified or shown on the drawings.

2. Piping Material:

a) 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 manufacturer. 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 Consultant. Approval of materials under this provision shall not be constructed as authorising any deviations from specifications.

b) Polyethylene Pipe (HDPE) conforming to BS 3580 & suitable for water supply application. Fittings shall be dezincification-resistant brass compression sleeves.

c) M.S. PIPES. shall conform to BS 1387, ASTM a53, Schedule-40 welded jointing system. Fittings shall be imported for high pressure, shall conforming to BS 21.

d) PVC Piping shall conform to ASTM D1785 or BS 3505 of 1968, Class 'E' upto Ø 25mm (1 inch) Class 'D' upto Ø 40mm (1½ inch), Class 'C' upto Ø 65mm (2½ inch) and Class 'B', for Ø 75mm (3 inch) & above. Jointing shall be solvent welded. Fittings shall be injection moulded of high density & shall be imported.

e) Fibre Cement Piping shall conform to PS 428:1984 & ISO 160, and shall be manufactured from cement with asbestos fibre reinforcement. Jointing shall be by using comet couplings using synthetic rubber rings conforming to PS 1915:1987.

f) Polyethylene (PE) Pipes and fittings shall confirm to ISO 4427,1996,DIN8074/8075 for water supply, potable / drinking water system. Jointing shall be done by "BUTT FUSION" method. Fittings shall be injection moulded of high density and imported. Pipes and Fittings shall be suitable to work on normal pressure of 12 Bars and 50 deg. C. All supports channels, hangers and fasteners shall be as per manufacturers recommendation. Special tools are recommended by the manufacturer shall be used for installation.

3. Piping Application:

   For piping application refer PIPING SCHEDULE given under EQUIPMENT & MATERIAL SCHEDULE (Section 2).

4. Valves and Strainers:

   Refer SECTION -103.

5. Installation of Piping, Valves & Fittings:

   For installation of pipe line BS CP 312 Part 3 & CP 2010 Part I shall be followed wherever applicable.

   The pipes shall be laid in place true to location, alignment and grade in accordance with the Contract Documents, manufacturer's recommendations, and as approved by the Consultant. Pipes shall be protected by sand cushioned as shown on drawings. Great care shall be taken to avoid abrasion of pipes. Pipes, that have the grades or joints disturbed or dislocated after laying, shall be corrected to the satisfaction of the Consultant. All pipelines and accessories shall be lowered into the trench with great care and by methods approved by the Consultant.

   At all times, when the work of installing pipeline is not in progress, exposed ends of the pipeline already laid shall be kept tightly closed to prevent the entry of animals and/or foreign materials. The Contractor shall ensure that the interior of all pipes is free from dust, dirt, debris and any other foreign materials and pipes shall be kept clean in hygienic conditions.

   Road Crossing Sleeves: Supply and install reinforced cement concrete pipes of diameter shown on the drawings to serve as road crossing sleeves. RCC Pipes shall be pressure pipes with rubber ring joints, suitable for an internal pressure head of 250 ft head. Top of pipe shall be 2 ft 6 inch below road grade, and back-fill shall be tampered in 6-inch (150mm) layers.

6. Painting, Coating & Wrapping:

   Refer SECTION-102.

7. <u>Testing:</u>

   The completed pipe line or each completed section as convenient to the Contractor or as necessary in Consultant's opinion due to differences in elevation shall be subjected to hydrostatic pressure test at 10 bar pressure as specified herein. All fittings, specials, valves, etc. shall also be subjected to hydrostatic testing while installed in the pipe line. Before testing, the pipe line shall be cleaned as specified in CP 2010: Part 2.

   The buried pipe may be back filled except at the field welds, which shall be left open for inspection.

   Before starting of the test, the whole of the pipeline shall be inspected with particular emphasis on installation of expansion joints as well as anchors, guides, supports, etc.

   The final hydrostatic testing procedure as recommended in CP 2010: Part 2 shall be adopted. The Contractor may, however, opt for cyclic testing method referred in

CP 2010: Part 2, the time duration within range specified in the above code shall be as directed by the Consultant.

Each section of the pipeline shall be slowly filled with water and test pressure of 10 bars shall be applied by means of pump connected to the pipe in a manner satisfactory to the Consultant. The Contractor at no extra cost shall furnish the pump, pipe connection and all apparatus necessary for the test including gauges and recorders to the Employer. The whole of the pipe line shall be inspected with particular emphasis to the behaviour of expansion bellows and anchors as regard its stability. If any abnormal movement, distortion or squirm, or any leakage is detected, the test pressure shall be dropped immediately and the cause of such abnormal behaviour investigated and rectified, in consultation and with the approval of the Consultant.

At the end of 24 hours of the test, if the quantity of water required to be added to maintain test pressure does not exceed 113 liters per meter of pipe diameter per kilometres of length per 30-meter head of test pressure, the section of pipeline under test will be accepted.

8. Measurement & Payment:

a) General: Except otherwise specified herein or else where in the Contract Documents, no separate measurement and payment will be made for the under mentioned works related to the relevant BOQ items but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- Excavation & back filling.
- Pipe fittings, cutting, jointing, flanges, gaskets, welding etc..
- Thrust blocks.
- Cutting and breaking concrete and then making it good.
- Cleaning and testing.

b) Measurement: Measurement for acceptably supplied quantity of pipes and pipes fittings for system will be made in running meter/foot and shall be for the full work specified herein.

c) Payment: Payment will be made for acceptably supplied quantity at the unit rate of bid per running meter/foot length of pipes and pipe fittings for system. The amount bid shall be the full payment for completion of the work in all respects as specified herein.

BUILDING WATER, NATURAL GAS & FIRE PROTECTION PIPING

1. Scope of Work:

The work includes in general the following:

a) Internal cold & hot water piping.

b) Internal Gas Piping.

c) Internal Potable Water Piping.

d) Internal Natural Gas Piping.

e) Internal Fire Protection Piping.

f) All specially shown specified or needed.

g) Services & Connection to site piping.

h) Other items specified or show on drawings.

2. Piping Material:

a) Galvanised Iron Pipes: G.I. pipes shall conform to BSS 1387 of 1957 (medium series); fittings shall be screwed of galvanised malleable iron.

b) Mild Steel Pipe conforming to BS 1387 (medium series), screwed upto 50mm (2 inch) & welded above dia 50mm (2 inch).

c) Mild Steel Pipe conforming to ASTM A53, Schedule 40, screwed upto 50mm (2 inch) & welded above dia 50mm (2 inch).

d) Polypropylene Random Co-Polymer: Conforming to BS 4991/DIN 8087 or equivalent.
Fittings & pipe shall be suitable to work on normal operating pressure of 10 bars and 79 deg C.
All supports channels, hangers and fasteners shall be as per manufacturers recommendations. Special tools as recommended by the manufacturer shall be used for installation.

e) PVC Piping shall conform to ASTM D1785 or BS 3505 of 1968, Class 'E' upto dia 25mm (1" inch) Class 'D' upto dia 40mm (1 ½ inch), Class 'C' upto dia 65mm (2 ½ inch) and Class 'B' for dia 75mm (3 inch) & above. Jointing shall be solvent welded. Fittings shall be injection moulded of high density & shall be imported.

f) Cross linked Polyethylene Pipes. conforming to BS 3580 & suitable for under floor heating and water supply application. Fittings shall be dezincification-resistant brass compression sleeves. (for under floor heating system).

3. Piping Materials Application:
   Refer PIPING SCHEDULE under EQUIPMENT & MATERIAL SCHEDULE, Section 2.

4. Valve and Strainers:
   Refer Section 104.

5. Installation of Piping, Valves and Fittings:
   a) General: Pipes shall be cut accurately to measurements established at the job site and worked into place without springing or forcing. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Shop drawings by Contractor shall show locations of all supports, typical details for special anchorages for suspended piping, valves, tank, pumps, converters, and other mechanical equipment. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided and detailed. Pipe shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints and hangers. Changes in direction shall be made with fittings. All piping shall be installed with sufficient pitch to ensure adequate drainage and venting. Piping connections to equipment shall be provided with unions or flanges. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

   b) Screwed joints shall be used on metallic pipes of diameter 50mm and below. Joints shall be made tight with approved thread joint compound applied to the male thread only.

   c) Flanges and Unions shall be faced true. Flanges shall be provided with 1.6mm asbestos-free gasket, and made square and tight. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment such as coils, pumps, control valves & other similar items.

   d) The run and arrangement of all pipes shall be approximately as shown on the drawings and as directed during installation and shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and shall be neatly spaced. Offsets will be permitted only where required to permit the pipes to follow wall, standard fittings shall be used for offsets. All risers shall be erected plumb and true, and shall be parallel with walls and other pipes and shall be neatly spaced.

   e) All of the pipes shall be concealed in walls, slabs unless otherwise shown on drawings or directed by the Engineer.

f) Special precaution shall be taken in the installation of piping concealed underground or in the building construction, to see that the piping is properly installed. Should it be necessary to correct piping so installed, this Contractor shall be held liable for any injury caused to other work in the correction of his piping.

g) Reducing fittings, unless otherwise approved in special cases, shall be used in making reduction in size of pipe. Bushings will not be allowed unless specifically approved.

6. Installation of Non-Metallic Piping:

a) The complete installation of the non-metallic piping system shall be in accordance with recommendations of the manufacturer.

b) All accessories, compression fitting, tees, elbows, supports, etc. shall be original manufacturer's products.

c) The Contractors shall ensure that all plumbers are trained by the manufacturer or there local agent and that only manufacturer's recommended tools are used. The Contractor shall establish a close co-ordination with the manufacturer/local agent to ensure all work to comply with manufacturer's recommendations and Consultants approval.

7. Pipe Supports:

Refer Section 114.

8. Protective Painting & Coating:

Protective Painting & Coating shall be carried out on pipes as specified in clause "Painting, Coating & Stencilling" Clause 101.

9. Testing:

a) Hydraulic testing to following pressures shall be carried out on the complete piping.

For Cold water, Hot Water, Potable Water and Fire Protection piping- minimum 100Psi or 1.5 times maximum operating pressure, whichever is maximum.

No loss of pressure shall be indicated for 2 hours. Tests shall be conducted in the presence the Engineer/Engineers Representative.

b) Defects disclosed by the tests shall be repaired or if required by the Engineer, defective work shall be replaced with new work without any extra charge to the Employer. Test shall be repeated as directed, until all work is proven satisfactory.

c) This Contractor shall furnish & pay for all devices, materials, supplies, labor required in connection with all tests.

10. Payments

All payment for metallic & non-metallic pipes shall be made per running foot/meter of the installed length of the pipes, which shall include all fittings such as elbows, wyes, tees, collars, junction boxes, etc., including supports, excavation and back filling, concrete bedding, testing and any other work required for the Piping, and the rates per foot/meter submitted by the Contractor for this item of the Bill of Quantities shall be deemed to include all such ancillary requirements.

SITE SANITARY SEWERAGE & STORM WATER PIPING

1. Scope of Work:

The work includes in general the following:

- External Soil, Waste Water & Storm Water Piping.
- All specials shown, specified or needed.
- Services and connection to Utilities.
- Other items specified, or shown on drawings.

2. Piping Material:

a) 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 manufacturer. 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 Consultant. Approval of materials under this provision shall not be construed as authorising any deviations from specifications.

b) uPVC Piping shall conform to ASTM D1785 or BS 3505 of 1968, Class 'E' upto Ø 25mm (1 inch) Class 'D' upto Ø 40mm (1 ½ inch), Class 'C' upto Ø 65mm (2 ½ inch) and Class 'B' for Ø 75mm (3 inch) & above. Jointly shall be solvent welded. Fittings shall be infection moulded of high density & shall be imported.

c) Fibre Cement Piping shall conform to PS 428:1984 & ISO 160, and shall be manufacture from cement with asbestos fibre reinforcement. Jointly shall be by using comet couplings using synthetic rubber rings conforming to PS 1915:1987.

d) Concrete Piping shall be manufactured by the spun process & shall conform to the following standards:

i) upto ø 250mm (10 inch) - ASTM C14-73, Class 3, with plain collars.

ii) ø 300mm (12 inch) & above - ASTM C76-73, Class III, wall B, with rubber O-rings joint.

3. Piping Application:

for piping application refer PIPING SCHEDULE given under EQUIPMENT & MATERIAL SCHEDULE.

4. Installation:

a) General:

i) Each pipe shall be examined on arrival; defective pipes shall not be used. Drain shall be laid in straight lines and to even gradients between the levels shown, with pipes and fittings, of the type and diameter as shown on the drawings. Great care shall be exercised in setting out and determining the levels of the pipes and the Contractor shall provide suitable instruments and set up and maintain and sight rails, and bench marks etc., necessary for the purpose. Cut pipe shall have smooth regular ends at right angles to length of pipe. All drain shall be kept free from earth, debris, superfluous cement and other obstructions during laying and until the completion of the contract when they shall be handed over in a clean condition. Pipes shall be laid with the sockets leading uphill and the sockets shall rest on solid and even concrete foundations.

ii) Drainage line shall be accurately laid and shall be perfectly true to line and gradient from point to point in both vertical and horizontal planes. Every main shall be straight from manhole and any change in direction shall take place inside the manhole by the use of the curved main channels, similar changes in internal diameter in drain shall be made in manhole by the use of tapers or bends.

All sewer pipe crossing roads shall be completely encased in concrete.

b) Back filling shall be carried out in 6mm layers, tamped & compacted using earth without rocks.

5. Testing and Inspection:

a) The entire drainage sewer shall be subjected to testing after installation to ensure a leak-proof installation under operation conditions.

b) The drainage pipe will be inspected for slopes which must conform to the slopes specified. The slopes will be checked with precision angle measuring equivalent like universal protector, plumb and level. Any portion found not laid according to the given slope will be rectified at the Contractor's expenses. The Contractor shall be required to inform the Engineer before any laid pipes are back filled and approval obtained.

c) After the pipe is laid, the joints completed between manholes, and the trench practically back filled leaving the joints exposed for examination, the newly laid piping shall be checked for alignment by flashing a light between manhole. If illuminated interior of the pipe line shows poor alignment, the displaced pipe, or any other defects, shall also be checked for the given slopes, and if found unsatisfactory, shall be repaired at the Contractor's expense.

d) This Contractor shall furnish & pay for all devices, materials, supplies, labor and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

e) This Contractor shall also be responsible for the work of other trades that may be damaged or disturbed by the tests, or the repair or replacement of his work and he shall, without extra charge to the Employer, restore to its original condition, work of the trades so damaged and disturbed, engaging the original contractors to do the work of restoration.

f) Defects disclosed by the tests shall be repaired, or if required by the Engineer. Defective work shall be replaced with new work without extra charge to the Employer. Test shall be repeated as directed, until all work is proven satisfactory. replaced with new work without extra charge to the Employer. Test shall be repeated as directed, until all work is proven satisfactory.

g) This Contractor shall notify the Engineer, Plumbing Inspector and others having jurisdiction at least ten days in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.

6. Connection To Utilities:

The Contractor shall be responsible, to make application/notices, in all respects, to the utility company/corporation/authority/board/or any other body having jurisdiction, for obtaining connection from the sewerage mains required for the works. The Contractor shall further pursue and liase with the body having jurisdiction in providing connection permission, make all necessary payments, obtain necessary permission, and obtain the sewerage connection. The extent of work specified represents the minimum requirements and the extent of the work shall be extended as required to include, at no increase in cost to the Employer, the compliance and fulfilment of the requirements of the local authority for an installation of this type. Official fees against challan shall be paid by the Employer at actual.

7. Measurement & Payment:

a) General: Except otherwise specified herein or else where in the Contract Documents, no separate measurement and payment will be made for the under mentioned works related to the relevant BOQ items but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- Excavation & back filling.
- Pipe fittings, cutting, jointing, flanges, gaskets, welding etc..
- Thrust blocks.

- Cutting and breaking concrete and then making it good.
- Cleaning and testing.

b) Measurement: Measurement for acceptably supplied quantity of pipes and pipes fittings for gas distribution system will be made in running meter/foot and shall be for the full work specified herein.

c) Payment: Payment will be made for acceptably supplied quantity at the unit rate of bid per running meter/foot length of MS pipes and pipe fittings for gas system. The amount bid shall be the full payment for completion of the work in all respects as specified herein.

BUILDING DRAINAGE PIPING

1. Scope of Work:

The work include in general the following:

a) Internal Soil, Waste Water, Vent Piping.

b) Internal Rainwater Drainage Piping.

c) All special shown, specified or needed.

d) Services and connection to site piping.

e) Other items specified, or shown on drawings.

2. Piping Material:

a) Cast Iron Pipes shall be manufactured by the centrifugal spun casting process and shall conform to standard DIN 1172 or BSS 416, heavy duty, of the bell and spigot type. Each pipe and fitting shall be class 20 psig and tested at the manufacturer's works at 20 psig and show no leakage, sweating or other defects. Pipes shall be coated by immersion in a bath containing a uniformly heated composition of bitumastic base. Pipes supplied shall be accompanied by a test certificate and each pipe shall be so stamped.

b) Non-mettallic Drainage Piping:

i) Polypropylene pipes to DIN 19560, with synthetic rubber seal rings to DIN 4060 (Part 1). All fittings shall be injection moulded push-fit type.

ii) uPVC Pipes to BS 4514, with synthetic rubber seal rings to BS 2494. All fittings shall be injection moulded push-fit type.

3. Piping Materials Application:

For piping application refer PIPING SCHEDULE under EQUIPMENT & MATERIAL SCHEDULE, Section-2.

4. Installation:

a) Each pipe shall be examined on arrival; defective pipes shall not be used. Drain shall be laid in straight lines and to even gradients between the levels shown, with pipes and fittings, of the type and diameter as shown on the drawings. Great care shall be exercised in setting out and determining the levels of the pipes and the Contractor shall provide suitable instruments, set

up and maintain sight rails, and bench marks etc., necessary for the purpose. Cut pipe shall have smooth regular ends at right angles to length of pipe. All pipes to be cut with an approved cutter. All drains shall be kept free from earth, debris, superfluous cement and other obstructions during laying and until the completion of the Contract when they shall be handed over in a clean condition. Pipes shall be laid with the sockets leading upstream.

No pipes shall be laid on their collar or on blocks, tiles or other temporary supports.

b) Drainage line shall be accurately laid and shall be perfectly true to line and gradient from point to point in both vertical and horizontal planes.

c) Easily accessible clean-outs, flush with the floor finish should be provided at each bend and bottom of stacks and at all points shown on drawings. The clean-outs should be made of "WYE" of full size, the minimum size shall be dia 75mm.

d) Special fittings required in the installation not generally cast by manufacturers shall be got specially cast by Contractor matching with the shell thickness specified.

e) Short bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only. All fittings shall conform to code requirements.

f) All soil and waste lines hung from the ceiling shall be supported at not more than 3'-0" centers for horizontal pipe and 2m for vertical pipes. Provide supports at all special fittings.

5. Testing and Inspection:

a) The entire drainage and vent system shall be subjected to testing after installation to ensure a leak-proof installation under operating conditions.

All the openings in the piping system shall be tightly closed by inserting test plugs of heavy rubber gasket that fit snugly all around the opening. The highest point will be left open to supply water and may be raised if necessary by temporary jointing to develop a minimum head of five(5) meters 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 30 minutes. No section will be tested at a pressure more than 6m of water. High stacks will be tested in sections, starting from the top section and then connecting top section to next lower section.

b) This Contractor shall furnish & pay for all devices, materials, supplies, labor required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

c) This Contractor shall also be responsible for the work of other trades.

d) The Contractor shall submit test certificates to the Engineer or Engineers representative & obtain his certification that the tested piping system have passed the prescribed tests.

6. Payments

All payment for metallic & non metallic pipes shall be made per running foot/meter of the installed length of the pipes, which shall include all fittings such as elbows, wyes, tees, collars, junction boxes, etc., including supports, excavation and back filling, concrete bedding, testing and any other work required for the Piping, and the rates per foot/meter submitted by the Contractor for this item of the Bill of Quantities shall be deemed to include all such ancillary requirements.

.

METERS & GAUGES

1. Thermometers:

   The ranges of thermometers shall comply with the system parameters ensuring normal indication in the mid-region. Ranges much under or above the required readings shall not be acceptable, unless specifically approved by the Consultant.

   a) Pipe Thermometers: These shall be adjustable angle type, with brass separable socket. Case shall be smooth die cast aluminium with metallic blue-black finish. Window shall be clear acrylic plastic or double strength glass, held in place with removable stainless steel caps. Tube shall have lens front with red appearing mercury tubing. Scale shall be on white background with jet black embossed figures and markings, of specified or suitable scale, in combination of °F-°C.

      - Scale size 175mm
      - Stem length..... 150mm
      - Insertion length 125mm

   b) Thermometer Wells: These shall be of brass suitable for pipe line mounting. Wells for insulated piping shall be provided with extension necks compatible to insulation thickness, to allow thermometer to clear the insulation.

   c) Installation: Thermometers shall be installed wherever shown on the drawings. Installation on both ducts and piping shall conform to the manufacturer's recommendations. On thermally insulated ducts, casing, equipment or piping, stand off mounting brackets, bases, adopters or extended tubes shall be provided. These items shall provide clearance not less than the thickness of the insulation. Thermometers shall have ranges suitable for the fluid being served.

2. Pressure Gauges

   Pressure gauges shall be of scale range as required, for service condition, graduated in both Psi and Kg/cm². On open circuit pump suction line and wherever necessary install compound gauges.

   a) Case shall be of cast aluminium, black finished. Ring shall be close type, chrome plated. Window shall be clear acrylic. Dial shall be white with jet black embossed figures and graduations. Pointer shall be micrometer type, black finished and red tipped. Movement shall be stainless steel, rotary type. Bourdon tube shall be phosphor bronze. Socket shall be forged brass. Accuracy shall be 1% of the scale range. Connection shall be 6mm NPT. Dial size shall be ø 4.5 inches.

   b) Installation: Pressure gauges shall be installed where shown on drawings. These shall be installed with ball valves to serve as gauge cocks. For pressure gauges installed on steam line, a coil siphon shall be installed. Gauges shall be screwed in so that no leakage exists, and shall be installed in a neat and workmanlike manner and the dials aligned for convenient reading.

SUPPORTS & ANCHORS

1. General:

   Pipe hangers, brackets, saddles, inserts, clamps and pipe rolls including rods, bolts, turn buckles, bases and protection shields shall conform to standard recommended engineering practice. Design generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilised wherever possible. Chain, wire, strap or other make shift devices will not be permitted as hangers or supports. Pipe hangers shall be capable of supporting the pipe in all conditions of operations. Hangers shall be supported with beam-clamps, concrete inserts, Phillips concrete fasteners, or rawl-bolts. Concrete inserts when used shall be installed in the exact location prior to the pouring of the concrete.

2. Suspended Piping Supports:

   a) Piping shall be supported by adjustable hangers or supports, which shall provide a means of vertical adjustment after erection. Unless otherwise indicated on drawings maximum spacing between pipe supports for straight runs of steel pipe shall be in accordance with recommended spacing shown in the table given below:

	Nominal Pipe Size, Ø mm											
	13	20	25	40	50	65	75	100	125	150	200	250
Maximum Span, m	1.5	1.8	2.1	2.7	3	3.3	3.6	4.2	4.8	5.1	5.2	6.7
Rod Size, Ø mm	10	10	10	10	10	13	13	16	16	19	22	22

Pipe hangers and supports shall be spaced not over 1.5m apart at heavy fittings and valves. A hanger shall be installed at not over 300mm from each change in direction of piping.

Vertical Piping shall be guided or supported in the centre of each riser but not over 4.5m on centres and shall be supported at the base of the riser on a base elbow or tee with a pipe stand only where required.

b) CI Piping shall be supported at not more than 2m for horizontal piping and 3m for vertical piping.

c) PVC Piping shall be supported so as not to cause any deflection and adequate support spacing shall be ensured but shall not exceed 3 feet.

d) Polyethylene piping shall be supported as per manufacturers recommendations.

3. Pipe Sleeves:

Pipes passing through concrete or masonary walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction or afterwards if necessary. Each sleeve shall extend through its respective wall, floor or roof and shall be cut flush with each surface. Sleeves shall be of such size as to provide a minimum of 6mm all around clearance between bare pipe and sleeve or between jacket over insulation and sleeve. Sleeves shall be of steel pipe or cast iron pipe.

Sleeves in exterior below ground, walls, pits and tanks shall be similar to 'Doyma' but locally manufactured, consisting of a galvanised steel sleeve to be embedded in concrete, with the pipe passing through synthetic rubber rings that are compressed using galvanised steel pressure plates on both sides of the rubber ring.

4. Other Supports:

Equipment and any other plant component requiring supporting and anchoring shall be provided with properly engineered supports and anchors, as shown on the drawings, or as per manufacturer's recommendation or as directed by the Consultant/Engineer in all cases drawings & submittals for supports & anchor system shall be submitted to the consultant and approval obtained.

5. Payments:

No separate payment shall be made for supports, hangers, sleeves, etc. and cost for these shall be part of the price quoted for the supported piping, equipment, etc.. Payment shall however be made for Doyma sleeves as indicated in the BOQ.

PORTABLE FIRE EXTINGUISHING EQUIPMENT

1. Portable Fire Extinguishers:

   a) General: Specific type Portable Fire Extinguishers shall be installed at locations shown on the drawings. All extinguishers shall be of suitable construction tested to at least 20 bars pressure, and shall have suitable anti-corrosive protection and shall have powder coated red finish with non-damaging instruction label. Extinguishers shall be installed on purpose made hooks at a suitable height as approved by the Engineer. The extinguishers shall be provided complete with initial charge. In each case provide refill kits where available, suitable for one recharging. The extinguishers shall be of the following types.

   a) Dry Chemical Powder Fire Extinguishers: Extinguisher shall conform to BS 3465 and shall contain Dry Chemical Powder in main body and carbon dioxide gas in external steel bottle, powder content as indicated in the BOQ.

   b) Chemical Foam Fire Extinguishers: Conforming to BS 740 (Part 1), having a capacity as indicated in the BOQ.

   c) Carbon Dioxide Fire Extinguisher: complete with hose and horn, of capacity as indicated in the BOQ.

   d) Trolley Chemical Foam Extinguisher: Provide steel tubular frame trolley with 2 rubber tyres of 16 inch diameter, mounted with Chemical Foam extinguisher having a capacity of 150 litres (34 gallons) Extinguisher main body shall be of 10 SWG M.S sheet, electrically welded and tested to 20 bars, and internally and externally powder coated. Cap and other parts shall be of gun-metal. Provide a minimum length of 20ft (6.0m) long high pressure hose, with open and shut-off control cock and discharge nozzle.

   e) Trolley Mounted Dry Chemical Powder: Similar to Clause ‘e’ above, except Dry Chemical Powder Extinguishers having a capacity of 50kg.

2. Fire Buckets:

   Fire Bucket sets shall consist of each consisting of 8 Nos. of 2 IGAL Galvanised Iron bucket, hung on ø 40mm G.I. pipe stand. The stand and buckets shall be painted with two coats of primer and two finish coat of red paint, and on each bucket the word “FIRE” shall be painted.

3. Fire Fighting Accessories:

   The Contractor shall supply the following fire fighting accessories and shall store them at a suitable location indicated by the Employer.

a) 2 Nos. Crow bar

b) 2 Nos. Fire Beater

c) 2 Nos. Fire Hook

d) 2 Nos. Fire man's axe with rubberised handle

e) 3 Nos. Gas Masks, haled face, Model 'TRILLIX-II' 'AVER' brand West Germany with gas filter and 2 spare filter elements for each mask.

f) 3 Pairs gloves, asbestos, heat resistant, size 400mm.

g) 3 Pairs gloves, rubber suitable for 11000 volts

h) 3 Pairs Boot Cover, asbestos with rubber boots.

i) 3 Nos. Steel Helmets.

j) 4 Nos. - 30m long, Ø 65mm imported fire hose, rubber lined with nylon top, fitted with couplings.

k) 4 Nos. - Ø 65mm London gun metal nozzle with hand controlled branch pipe for jet/spray.

l) Glass fronted steel cabinet to house above accessories.

HOSE REEL & EXTERNAL HYDRANTS

1. Fire Brigade Connection:

Supply & install where shown on the drawings a ∅ 65mm×∅ 65mm x ∅ 100mm Fire Department Connection, rated for use upto a maximum pressure of 175 psi. The inlet connections shall be ∅ 65mm with threads compatible for use with Pakistan Fire Brigade Standards, and the outlet connections shall be ∅100mm. The connection body, clapper, swivel, and swivel plug shall be cast from an aluminium magnesium alloy. Escutcheon plate shall also be provided. Connections shall be straight, red painted, with standpipe identification.

2. Fire Hose Reel:

The Contractor shall supply and install recessed, swinging arm type, Fire Hose Reels, where indicated on the drawing. The Hose Reels shall conform to BS 5274:1985 and shall consist of:

a) Hose Reel Lock Shield Valve: manufactured from materials resistant to de-zincification, ∅25mm, threaded.

b) Side Disks: 18 SWG, galvanised steel sheets, powder coated, post office red color.

c) Hose: Red rubber smooth, covered to BS3169 Type 1, Class –B. ∅25mm and 30.5m long.

d) Control Nozzle: Nylon lever operated jet/spray

3. Fire Hose Reel Cabinet:

Fire Hose Reel Cabinet constructed from 16SWG galvanised sheet steel, powder coated to BS18 B25.

a) Water Entry: Top, bottom, back or side, 50 dia knockouts to suit pipework requirements.

b) Architrave: 20SWG stainless steel, brushed satin finish.

c) Door: 20 SWG stain less steel, brushed satin finish.

d) Concealed Hinges: Concealed hinges, left or right as required.

e) Name Panel/Finger Pull: Recessed stainless steel, brushed satin finish. Words FIRE HOSE in red 45mm high.

f) Instruction on reverse of panel: "IN CASE OF FIRE PULL HOSE FROM REEL AND WATER WILL TURN ON AUTOMATICALLY".

3. Fire Hydrant Cabinet (In-door Use).

Specifications shall be same as Fire Hose Reel Cabinet.

Provide cabinet with following accessories:

1 No. - 30m long, ∅ 65mm imported fire hose rubber lined with nylon top, fitted with couplings.

1 No. - Dia 65mm. London gun metal nozzle with hand controlled branch pipe for jet/spray.

1 No. - ∅ 65mm Landing/Hydrant valve with quick connect coupling.

4. Orifice Plates:

Where the dynamic pressure at the inlet to Fire Hose Reel exceeds 2.75 bars (40 psi) an orifice plate shall be installed prior to the inlet of Fire Hose Reel. The orifice plate shall be fabricated of 6mm thick stainless steel (SS 304) and installed between steel flanges. Size of the bore shall be determined by the contractor. Shop drawing shall be submitted to the Consultant for approval prior to the fabrication.

5. Pressure reducing Valves.

Pressure reducing valves shall capable of reducing fire water pressure from 20 Bars to 1 bar. The pressure reducing valve will be installed in Dia 1" (inch) fire hose.

PIPING INSULATION

1. Installation of Pipe Insulation:

No insulation shall be applied to any system of piping until all foreign matter has been removed from the surface to be insulated, and until the piping has been tested, cleaned out and made tight. All insulation shall be applied in a manner consistent with good practice and methods. All longitudinal joints of pipe shall be top and bottom. Insulation shall be continuous through walls, floors, ceiling and partitions etc.

2. Valves And Fittings:

and other specialities shall be insulated with preformed sections of adjoining insulation, cut to suitable shapes and sections, to closely fit around valves and fittings. Insulation thickness shall not be less than the adjoining straight pipe insulation thickness. The adjoining insulation near these fittings shall be metered and trimmed into suitable sections to fit closely around the valves, flanges and fittings. All trimmed sections shall be secured by wrapping of approved type of self-adhesive tape. Insulation at valves, unions, flanges and any other pipe line mounted component is required to be removed the adjoining pipe line insulation shall not be damaged. A clear line of demarcation shall be inherent between the pipe line insulation and pipe line mounted components.

3. Hot Water Piping Insulation:

The supply and return hot water pipe line shall be provided with closed cell foam rubber insulation in preformed sections. Insulation thickness shall be as noted below:

a) For embedded pipes in floors and walls - None

b) For pipes in shafts, exposed installation & buried in ground - 20mm thick

c) Insulation shall be slipped on to its hot water piping before installation. Fittings shall be insulated with slit insulation installed with rubber glue and wrapped with PVC tape of approved quality.

d) Where the insulation sleeves are longitudinally cut, the insulation shall be wrapped with PVC tape with 20% over lap along its entire length. At circumferential joints PVC tape shall be wrapped upto 150mm on either side of the joint.

4. Potable Chilled Water Piping Insulation:

a) Supply and chilled water pipe lines shall be provided with closed cell foam insulation in preformed sections, and shall be wrapped with self adhesive vapour barrier tape consisting of aluminium foil backed by white kraft paper, insulation thickness shall be 20mm.

b) Insulation shall be shipped on to its hot water piping before installation. Fittings shall be insulated with slit insulation installed with rubber glue and wrapped with PVC tape of approved quality.

c) Where the insulation sleeves are longitudinally cut, the insulation shall be wrapped with PVC tape with 20% over lap along its entire length. At circumferential joints PVC tape shall be wrapped upto 150mm on either side of the joint.

5. Payment:

Payment will be made for acceptable measured quantity of piping insulation, laying, fitting, jointing & testing on the basis of unit rate per running metre/foot quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items, including all fittings and specials.

PLUMBING SPECIALITIES

1. Trapped Floor Gully:

Shall be of uPVC similar to Nikkasi, Hepworth, Terrine with dia 50mmx3 inlets and 70 mm outlet. The drain shall be provided with a trap having a minimum water seal of 50mm. The drain grating and all visible parts shall be of S.S. with level adjusting threads.

2. Vent Cowls:

All vent-lines terminating above the building shall be provided with best quality uPVC vent cowls similar to Terrain model 150.

3. Clean-out for Finished Floor Areas:

Shall be similar to ZURN Model No. Z 1323. These shall be of cast iron, designed to provide an air tight seal. The clean-out shall be provided with a threaded brass plug that shall fit into the hub and provide an airtight seal. A key to unscrew the plug shall be provided. A brass ferrule shall be provided, that shall screw into the hub with the capacity of level adjustment. The ferrule shall be provided with a round scoriated brass top and a long brass screw threaded into the plug below, shall hold down the top cover. All visible parts shall be chrome plated.

4. Stainless Steel Floor Trap/Waste:

These shall be fabricated out of SS 304 and as approved by Engineer / Consultant.

5. Stainless Steel Floor Outlet:

These shall be fabricated out of SS 304 and as approved by Engineer /Consultant.

6. Roof Drain:

Shall be similar to "HEPWORTH, UK, TERRINE SPD, SPAIN uPVC body with combination membrane flashing clamp/gravel guard and low Silhouette Polly-dove.

7. Drain Gratings:

top. Grating length shall not exceed 4ft, & each grating shall fit level & smoothly on the support member. Drain gratings shall be installed on open channel drains where shown on the drawings. These shall be fabricated out of mild steel formed members &

hot dipped galvanised after fabrication, in accordance with details shown on the drawings. Support angle iron member shall be grouted into the concrete edge of the channel, and the drain gratings laid loose on

SEWERAGE LINE SPECIALITIES

1. Manhole:

   Manhole chambers shall conform to BS 556: Part 2 (Concrete Manholes for Drainage purposes),

   Type-I: heavy duty for use under road

   Type-II: light duty for use in any situation not being a road.

   Manhole shall be constructed of 200mm thick masonry walls. Bottom of manholes shall be 150mm thick 1:2:4 RCC pad with nominal reinforcement. Top slab of the manhole shall be 150mm thick 1:2:4 RCC slab. The depth of the manhole shall be upto the invert level shown on the drawings. The civil construction shall conform to the specs of the Civil Works. The internal surface of the manhole shall be provided with 15mm thick Puddlo plaster.

   Manhole shall be constructed with cast iron frames and covers as shown on the drawings & BOQ. The invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the adjacent sewer section. Inverts shall be formed directly in the concrete of the manhole base. Steep slopes outside the invert channels shall be avoided. Changes in size and grade shall be made gradually and evenly. Changes in direction of the sewer and entering branches shall have true curves of a radius as large as the size of the manhole will permit. Manhole shall be provided with built-in steps of Galvanized iron. The rungs shall be not less than 250mm in width and spaced at intervals of approximately 300mm and alternative rungs shall be staggered or off-set 150mm. Bars or rods when used for steps shall not be less than 20mm in diameter.

   The manhole frame shall be carefully embedded in the top slab of the manhole as neatly as possible.

2. Intercepting Manhole:

   Intercepting manhole shall conform to specification given above except that it shall be provided with an uPVC intercepting trap of the same diameter as the main pipeline.

3. Storm Water Drainage Manhole:

   These shall be constructed to conform to specifications given for Manhole at Clause 1, except that the manhole cover shall be replaced with a grating to allow the water to flow into the manhole. The grating shall be manufactured of cast iron and provided with 25mm square holes on 25mm centres in both directions.

4. Manhole Frame & Covers:

   Manhole Frame & Covers shall be of water tight quality manufactured from good quality cast iron conforming to BS 497, & shall be of types as noted below:

   Grade A - Manhole covers & frames capable of bearing wheel loads upto 11.5 tonnes for use in carriage ways

   Grade B Class 1 - Manhole covers & frames capable of bearing wheel loads upto 5.0 tonnes for use in carriage ways carrying relatively slow moving normal commercial vehicles.

   Grade B Class 2 - Sealed manhole covers and frames capable of bearing wheel loads upto5.0 tonnes for use in areas to which vehicles would have only occasional access.

   Grade C - Sealed inspection covers and frames for use in situation in-accessible to motor vehicles.

5. Gully Trap:

   Gully trap chamber shall be constructed of 100mm thick masonry walls with 15mm thick puddlo plaster. Bottom of gully trap shall be 100mm thick 1:2:4 RCC pad with nominal reinforcement. Trap shall be of cast iron/uPVC 100mm dia with 50mm water seal. Frames and cover shall be of cast iron of water tight quality. Size 300mm x 300mm, weight 10 kg.

6. Grease Trap (Cast Iron):

   Grease Trap shall be of cast iron/steel, suitable for exterior installation, rated at (4) GPM and (4kg) grease capacity with (ø 50) inlet and outlet, internal air relief by-pass, bronze clean-out plug and visible double wall trap seal, with removable pressure equalizing/flow diffusing baffle and sediment container. Gas and watertight gasketed non-skid cover secured with recessed and covered center securing handle, enzyme port opening having bronze plug baffle and basket assembly, complete with flow control fitting. Similar to ZURN model Z-1170.

7. Grease Trap (Concrete):

   Grease Trap shall be constructed in a concrete/masonry chamber below ground as per detail shown on the drawings. It shall be provided with cast-iron manhole fame & cover, baffle plates, 304 stainless steel grease removal trays, etc. all as shown on the drawings complete in all respects.

8. Grease Trap (Stainless Steel):

   Grease trap for below sink installation shall be fabricated of 304 stainless steel, as per detail shown on the drawings. It shall be provided with removable lid,

baffle plates, grease removable tray, etc. all fabricated frame SS 304 complete in all respects.

PLUMBING FIXTURES, FITTINGS AND ACCESSORIES

1. General:

All fixtures shall be free from imperfections, true as to line, angles, curves and colors, smooth, water tight and complete in every respect.

All fixtures specified to be of vitreous ware, shall be fired vitreous china ware of the best quality, non-absorbent and burned so that the whole mass is thoroughly fused and vitrified producing a material white or colored, which when manufactured will show a homogeneous mass, close grained and free from pores. The glazing and vitreous china fixtures shall be of a color approved by the Consultant, thoroughly fused, and united to the body, without discoloration, chips, or flaws and shall be free from craze. Warped or other imperfect fixtures will not be accepted.

All plumbing fixtures supplied shall be as specified & from source indicated.

All fixtures shall be furnished from one manufacturer unless otherwise specified in Equipment and Material selection data (Section-2).

All fittings, cast brass set screws, escutcheons faucets, traps, exposed piping, etc., shall be of brass, chrome plated over nickel plate with polished finished. Any supports nuts etc., visible shall likewise be chrome plate over nickel plate.

After installation of plumbing accessories, the Contractor shall ensure their protection against damage, misuse and general deterioration. Fixture outlets shall be plugged with suitable material to prevent entry of external debris. All chrome plated and other metallic fittings shall be provided with a coat of grease to prevent their deterioration. All items prior to handing over must be in perfect condition in the visual and operational sense.

All fixtures and accessories shall be first quality, imported, unless otherwise indicated.

All cracks between fixtures and walls shall be filled using approved silicone sealant.

2. Fixtures & Fittings:

Shall be best quality Imported or locally manufactured from approved sources as shown make and models in Equipment and Material selection data (Section-2).

3. Installation:

a) All screws, bolts and other anchoring devices shall be of stainless steel or chrome plated brass.

b) Install toilet fixtures, fittings and accessory units in accordance with manufacturer's instructions, using fasteners which are appropriate to

substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored with brass screws and nylon anchors at locations and at heights indicated in drawings.

c) Set accessories plumb, level, and square at locations approved, in accordance with manufacturers instruction for type of substrata involved.

d) Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

e) Remove and replace accessories which are broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

f) Clean and polish all exposed surfaces after removing temporary labels and protective coatings.

DISINFECTION OF WATER DISTRIBUTION SYSTEM

1. Pipeline Disinfection:

a) General: The Contractor shall furnish all equipment, labour and material for the proper disinfection of the pipeline. Disinfection shall be accomplished by chlorination after the lines have been tested for leakage but before they have been connected to the main system. Disinfection of the pipelines shall be done in the presence of the Engineer's representative with equipment approved by him.

a) Chlorination: A chlorine and water mixture shall be supplied by means of a solution feed chlorination device. The chlorine solution shall be applied at one end of the pipeline through a trap, in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be at-least (25 ppm) or enough to meet the requirements given hereinafter.

b) Retention Period: Chlorinated water shall be retained in the pipeline for a period of at least 24 hours. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at such other representative points shall be at least 10 parts per million. The procedure shall be repeated until the required residual chlorine concentration is obtained.

c) Chlorination of Valve: During the process of chlorination of the pipe lines, all valves or other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

d) Final Flushing: Following complete disinfection of the pipeline, all treated water shall be thoroughly flushed from the pipeline at its extremities. Treated water and water used for flushing the pipelines shall be disposed of in a manner instructed by the Engineer. Fresh treated water shall be filled in the line and water tested for presence of coliform. The test result should indicate negative coliform presence. If the test indicates any positive coliform, the entire process of disinfection shall be repeated or improved upon until coliform free samples are obtained.

e) Sampling and Testing: Disinfection of the pipeline and appurtenances shall be the responsibility of the Contractor. The first set of samples will be collected for analysis by the Engineer. Should the sample reveal presence of coliform the Contractor shall again disinfect the pipeline and appurtenance and shall pay the Employer for

sampling and testing for subsequent retest until coliform free samples are obtained.

f) Clean-Up: Upon completion of the installation of the water supply lines, distribution system and appurtenances, all debris and surplus materials resulting from the work will be removed and disposed off in a manner satisfactory to the Engineer.

g) Measurement and Payment: Payment of this work will be made at the lump sum cost quoted in the BOQ, after satisfactory completion of this work as certified by the Consultant.

FIRE PUMP, DIESEL ENGINE OPERATED (HYDERANT APPLICATION)

1. General:

Scope: The contractor shall supply & install a packaged fire pump set consisting of electric motor driven fire pump(s), A fire pump control panel along with controls, instrumentation, piping, valves all factory installed on a suitable steel skid. The entire packaged set shall be hydraulically tested at 150 % of the operating pressure at the factory. All steel surfaces shall be sand blasted and painted with two coats of primer and finish paint of fire red colour.

Service Condition & Design Standard: Fire Pump Set shall be designed and constructed to operate satisfactorily in a typical fire protection application. Pumps, motors & controllers shall be the product of a manufacturer regularly engaged in the production and marketing. Fire pump set shall conform to the requirements of the latest edition of NFPA-20 (Standard for the Fire Pumps).

As indicated in the EQUIPMENT & MATERIAL TECHNICAL DATA (Section-2), the Fire Pump Set shall be listed for fire protection service and as per NFPA-20, so certified by Factory Mutual &, Under-writers Laboratories Listed.

2. Fire Pump:

Operating Conditions: The pump(s) shall be sized to provide a flow rate and total head as scheduled under Section 2, EQUIPMENT & MATERIAL TECHNICAL DATA. At 150% of the rated capacity the fire pump shall develop at-least 65% of its rated head and shall not exceed 140% of its rated head at zero capacity. Each pump shall be furnished with a certified performance curve indicating pressure, capacity & horsepower requirements.

Casing shall be vertical or horizontally split case / end section centrifugal pumps with centreline discharge, foot-supported and made of cast iron. Casing shall be provided with tapped and plugged holes for priming vent an drain.

Impeller: shall be the single section enclosed type of bronze. Impeller shall be statically and hydraulically balanced. Drilled holes shall be provided through the impeller hub to balance axial thrust loads and keep positive pressure on the stuffing box. Impeller shall be keyed & locked to the shaft with a hexagonal head impeller nut, and shall be easily removable without the use of special tools.

Shaft: Pump shaft shall be high strength stainless steel sized to provide a minimum amount of deflection. Shaft shall be protected in the stuffing box area by a replaceable shaft sleeve.

Stuffing: Pumps shall be provided with stuffing box with gland packed seat.

Bearing Frame. shall be rigid, one-piece cast iron construction. Frame shall be provided with catch basin reservoir with tapped drain hole to collect and pipe away drip.

Bearings: shall be ball type on both ends of the frame. Both bearings shall be locked in place and be sized to provide long life under thrust loads encountered. Both the bearings shall be enclosed by replaceable box.

Bearing Lubrication: Ball bearing shall be grease lubricated with provisions for the addition and relief of grease.

Baseplate: shall be fabricated steel centre drain or cast iron drip lip sufficiently rigid to support the pump and the driving motor with tap hole to pipe away leakage and condensation.

Coupling: shall be flexible type.

Coupling-Guard: shall be all metal and fastened to the base plate.

3. Diesel Engine:

The compression-ignition diesel engine shall be approved / listed for fire pump operation. The mark of the listing laboratory (FM, UL) shall be displayed on the engine name plate showing compliance with the performance ratings and functional requirements.

The engine shall be rated at standard SAE conditions at 752.1mmHg barometer and 25°c (77°F) inlet air temperature. (SAE=Society of Automotive Engineers) engine shall have an additional 10% power reserve of the pump's maximum requirement.

Instrumentation and Control Devices: The following instrumentation shall be mounted on front of panel.

1- Techo meter (rpm) with hour meter (run time).
2- Mode selector switch.
3- Warning lights
4- Over speed re-set switch
5- Manual start contactor 1
6- Manual start contactor 2
7- Over speed verification indicator
8- Engine oil pressure gauge.
9- Volt meter for battery set-1
10- Volt meter for battery set-2
11- Coolant temperature gauge
12- Manual operating instructions plate.

The engine shall have:

- A governor cable for regulating the engine speed with a range of 10% between shut-off and maximum load.

- An over speed shut-down device arranged to shut down the engine at a speed approximately 20% above the rated engine speed.

Starting System: The engine shall be provided with 2-strorage battery units. At 4.5°c (40°F) each battery shall be twice the capacity sufficient to maintain a 3-minute attempt to start cycle (6 consecutive cycles of 15 seconds cranking and 15 seconds rest).

Two system for recharging the batteries shall be provided.

- An engine –driven generator / alternator recharging the batteries when the diesel engine is running. This system shall be completely independent of external resources.

- Automatically controlled charger power supplied from the building and fitted in the control panel.

Both chargers shall be listed for fine pumps.

Engine Cooling: The engine cooling system shall be closed-circuit heat exchanger type.

Cooling water shall be supplied through a threaded rigid pipe from the pump discharge to the inlet of the heat exchanger. The waste water shall be discharged into a visible, open waste come or go back to a suction reservoir.

The heat exchanger shall be efficient at 60PSI.

Engine Exhaust: Engine shall have an independent exhaust system. A flexible connection shall be used between engine and the exhaust pipe to provide thermal expansion and to isolate engine vibration to the rest of the exhaust run.

The flexible connection shall not be used for misalignment.

The exhaust system shall be building supported and not engine supported.

Fuel Arrangement: The fuel tank outlet shall be placed above the engine fuel inlet.

The size of fuel tank shall be for 5.1 L/KW (1 gallon / hp) plus 10% (5% for expansion and 5% for sump) or equivalently proposed of appropriate sizing by the Diesel Engine Manufacturers as Per Their Manufacturing standards. Fuel supply and return lines shall be flame resistant, reinforced flexible hose.

Coupling: The engine shall be connected to the pump by means of a PTO (Power take off) shaft.

The diesel engine shall include all necessary equipment as listed below:

- Air cleaner
- Alternator
- Exhaust protection

- Coupling
- Exhaust connection
- Fly wheel housing
- Fly wheel power take off
- Fuel connections
- Fuel injection system
- Fuel system
- Engine heater
- Governor speed
- Droop
- Heat exchanger
- Instrument panel
- Junction box
- Lubricating oil cooler
- Lubricating oil filter
- Manual start control
- Over speed control
- Raw water solenoid operation
- Run solenoid
- Run stop control
- Starters
- Throttle control
- Water pump.

4. Fire pump Controller:

The Fire Pump Controller shall be as per NFPA standard & must be listed by Underwriters Laboratories or approved by Factory Mutual.

Operational System: The Fire Pump Controller shall be designed to operate the Electric Operated jockey pump automatically through a pressure switch control to maintain constant pre-set pressures in the fire mains. The main electric operated pump shall be started automatically when the pressure in the fire mains drops to preset low level, and shall continue to run the electric fire pump until at shutdown manually. Whenever the main fire-pump operates, an audible signal shall be activated. In case electric driven jockey and main fire pump failed to start due to any reasons, Diesel engine driven fire pump shall come on duty automatically. All the fire pump shall also start thru panel mounted push-buttons, remote break-glass switch, flow-switch or deluge valve switch. An override emergency manual start facility shall also be provided for all pumps.

Enclosure: The enclosure shall be constructed of 14 gauge steel, provided with baked enamel paint, with fully gasketed lockable hinged door and removable un-drilled gland plate located in the base. Degree of protection shall be IP-54.+

5. Testing at Manufacturers Works

The fire pumps & controller shall be subjected to complete testing at the manufacturers works. To determine conformance to the specifications.

6. Foundation:

Foundation shall be 1:2:4 concrete sized to provide an inertia block having a mass equal to 3 times the weight of the pump and Diesel Engine. The foundation shall be isolated from the structure and plant room floor by using 50mm thick high-density cork. Edges of the foundation shall be provided with a 25-25-3mm angle-iron frame and the same shall be provided with two coats of oil paint.

7. Installation:

During installation pump shall be properly levelled, grouted in and realigned before operation in accordance with the manufacturer's recommendations. Suction and discharge connections shall be installed through flexible connectors, and electrical wiring shall be done.

For pumps taking suction from a stored water tank, an anti-vortex suction plate shall be installed at the entrance to the suction pipe.

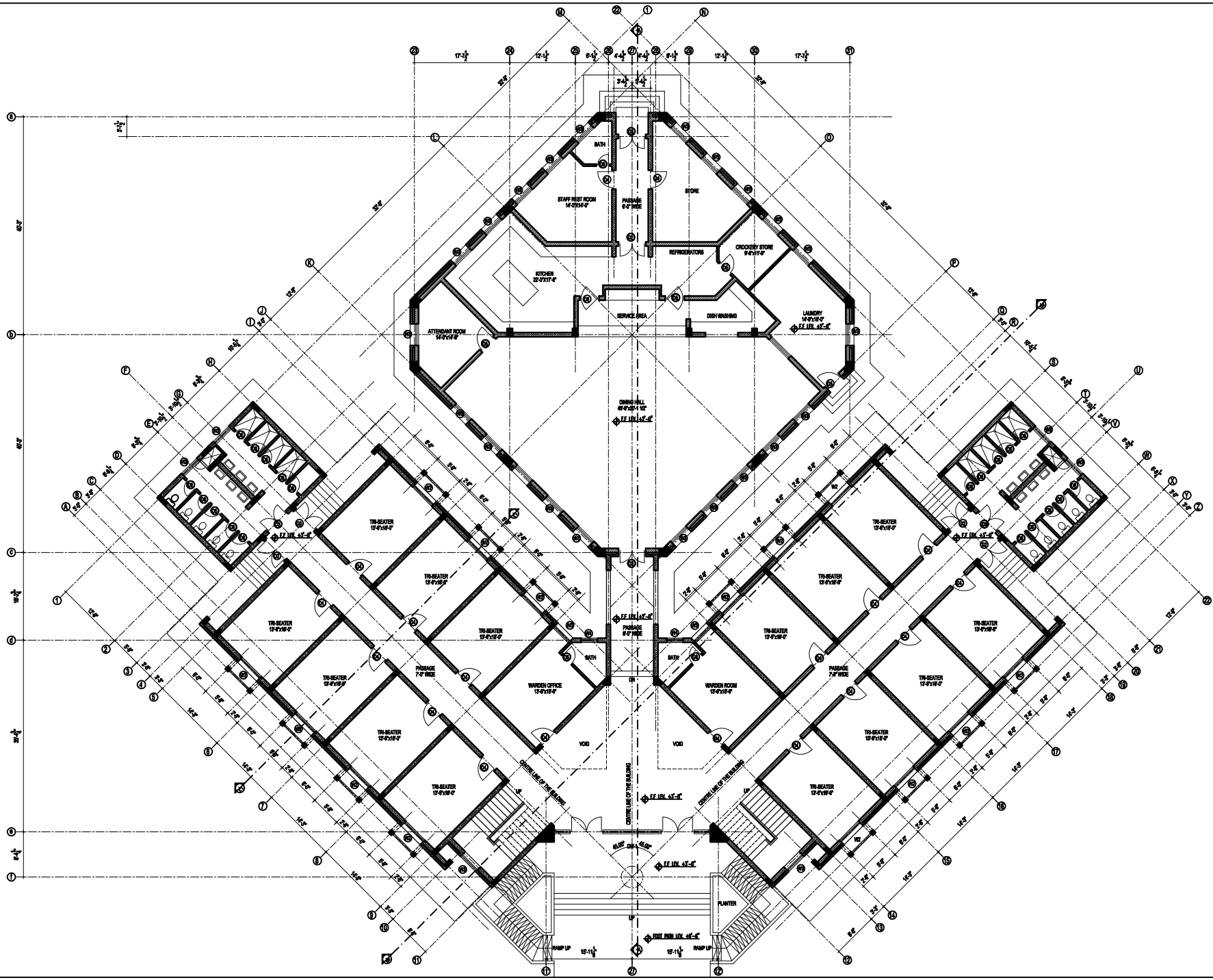
8. Commissioning and Testing:

The pump shall be commissioned and tested by the Contractor, in accordance with the manufacturer's recommendations. The pump operational curve shall be identified by taking no-flow reading and shall be charted on the pump curve. Operational point at full flow shall be identified and submitted to the Consultant. Tests shall be conducted in pressure of consultant and test reports submitted to the Consultant and approval obtained.

9. Spares:

Spares shall be supplied as shown in (Section-2) Equipment & Technical Data and as per manufacturer recommendations for one year operation.

An "Operation and Maintenance" manual shall be supplied with the fire pump set.



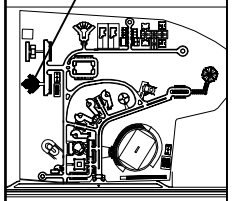
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEER
BLOCK NO.09 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 92760760-92760868

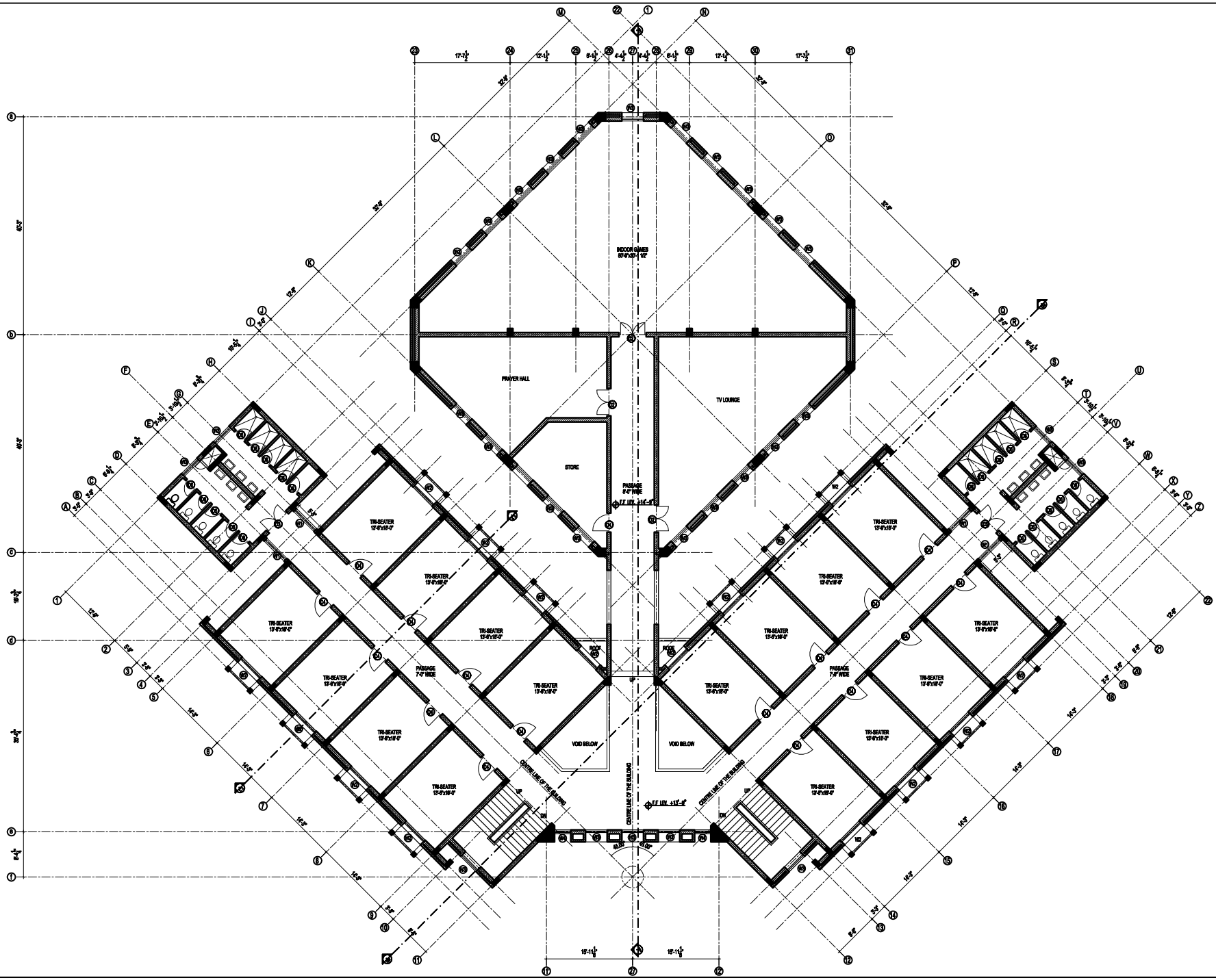
RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.NAQVI	M.A.MOKTADIR

STRUCTURAL ENGINEERS: GLOBAL ENG. SERVICES Tel: 021-35344336 KARACHI-PAKISTAN	GES
ELECTRICAL ENGINEERS: ASSOCIATED TECHNICAL CONSULTANTS 509 , ASKARI TOWER , SHAHRAH-E-FAISAL Karachi , Pakistan Ph: (92-21) 4540509-10	ATCONS
PLUMBING ENGINEERS: DESIGN DEVELOPERS 448-H.M.R SQUARE,COMMUL/1,BLOCK-10 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4130405,FAX:021-4130384	DD

DRAWING TITLE:

GROUND FLOOR PLAN

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-02
	CHECKED BY:	



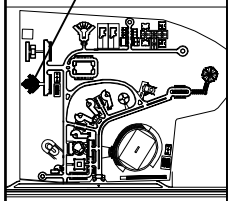
GENERAL NOTES & CONSENTS

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.09 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 92760760-92760868

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.NAQVI	M.A.MUKTADIR

STRUCTURAL ENGINEER
GLOBAL ENG. SERVICES GES
Tel: 021-35344328 KARACHI-PAKISTAN

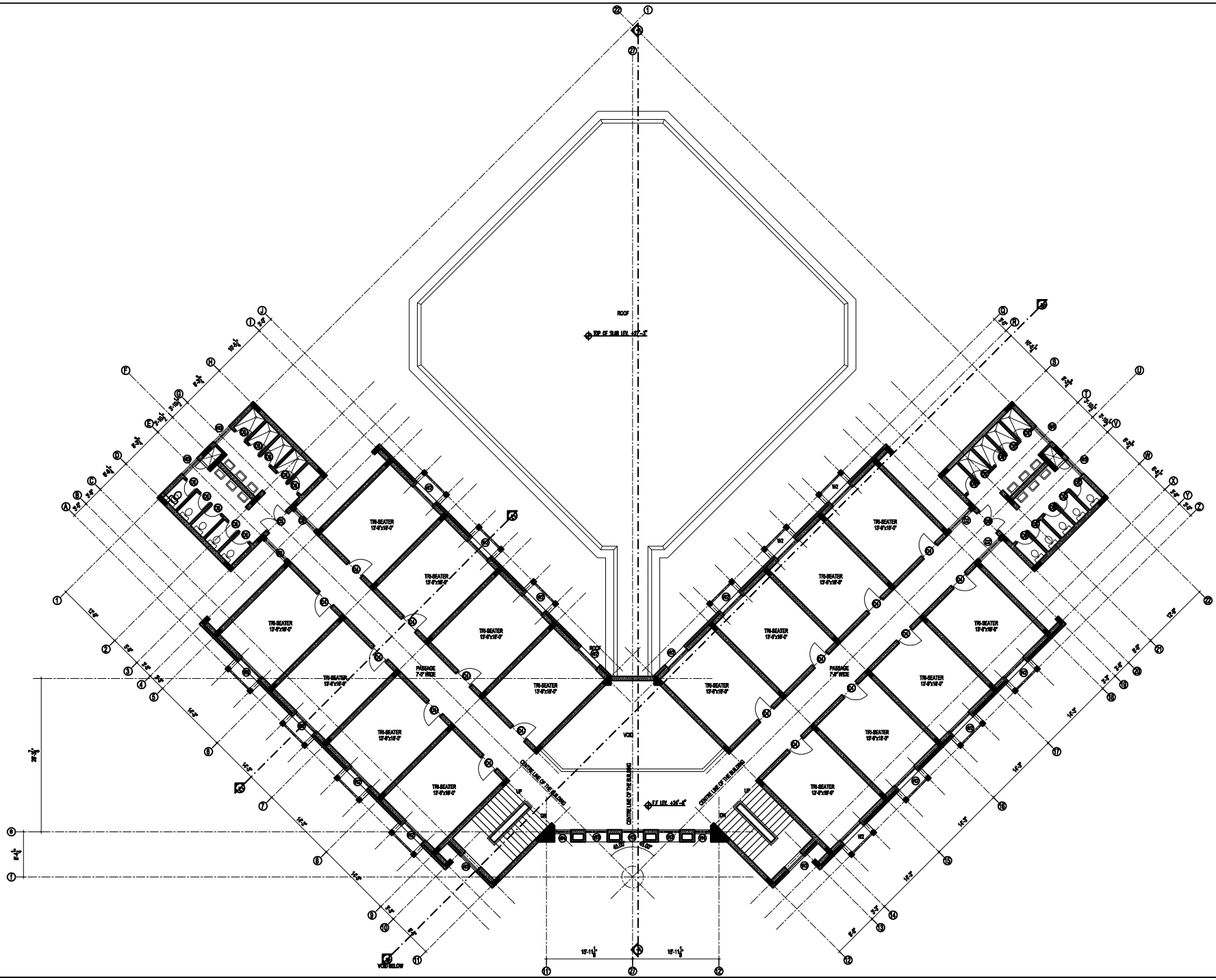
ELECTRICAL ENGINEER
ASSOCIATED TECHNICAL CONSULTANTS ATCONS
Karachi - Pakistan
Ph: (92-21) 4540260-61

PLUMBING ENGINEER
DESIGN DEVELOPERS DD
TEL NO: 021-4120405,FAX:021-4120284

DRAWING TITLE:

FIRST FLOOR PLAN

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-03
	CHECKED BY:	



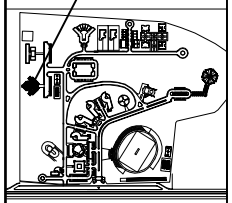
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEERS
BLOCK NO.19 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 92(51)5-4572068

RESIDENT ENGINEER: Q.A.NAQVI

RESIDENT ARCHITECT: M.A.MUKTADIR

STRUCTURE: GLOBAL ENG. SERVICES — GES
Tel: 021-5354328 KARACHI-PAKISTAN

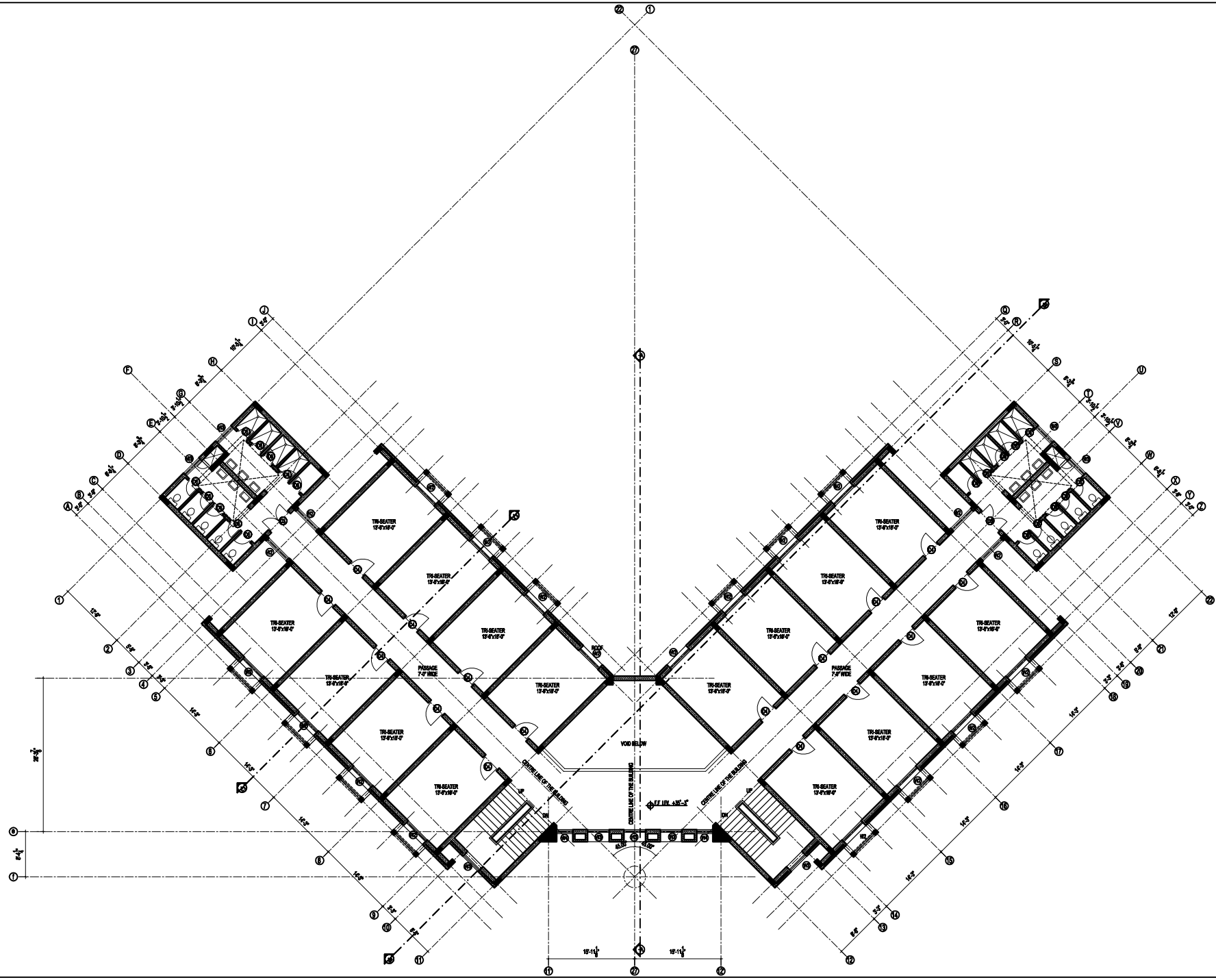
ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
Karachi - Pakistan
Ph: (92-21) 4540260-61

PLUMBING ENGINEER: DESIGN DEVELOPERS
TEL NO: 021-4120405,FAX:021-4120284

DRAWING TITLE:

SECOND FLOOR PLAN

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-04
	CHECKED BY:	

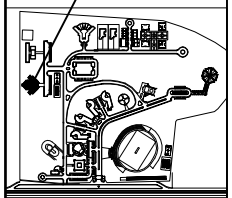


GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.98 FIRST FLOOR
SECTOR F-8
ISLAMABAD
TEL. 92(051)-2270088

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIR

STRUCTURES: GLOBAL ENG. SERVICES — GES
Tel: 021-3530-4209 RAWALPINDI

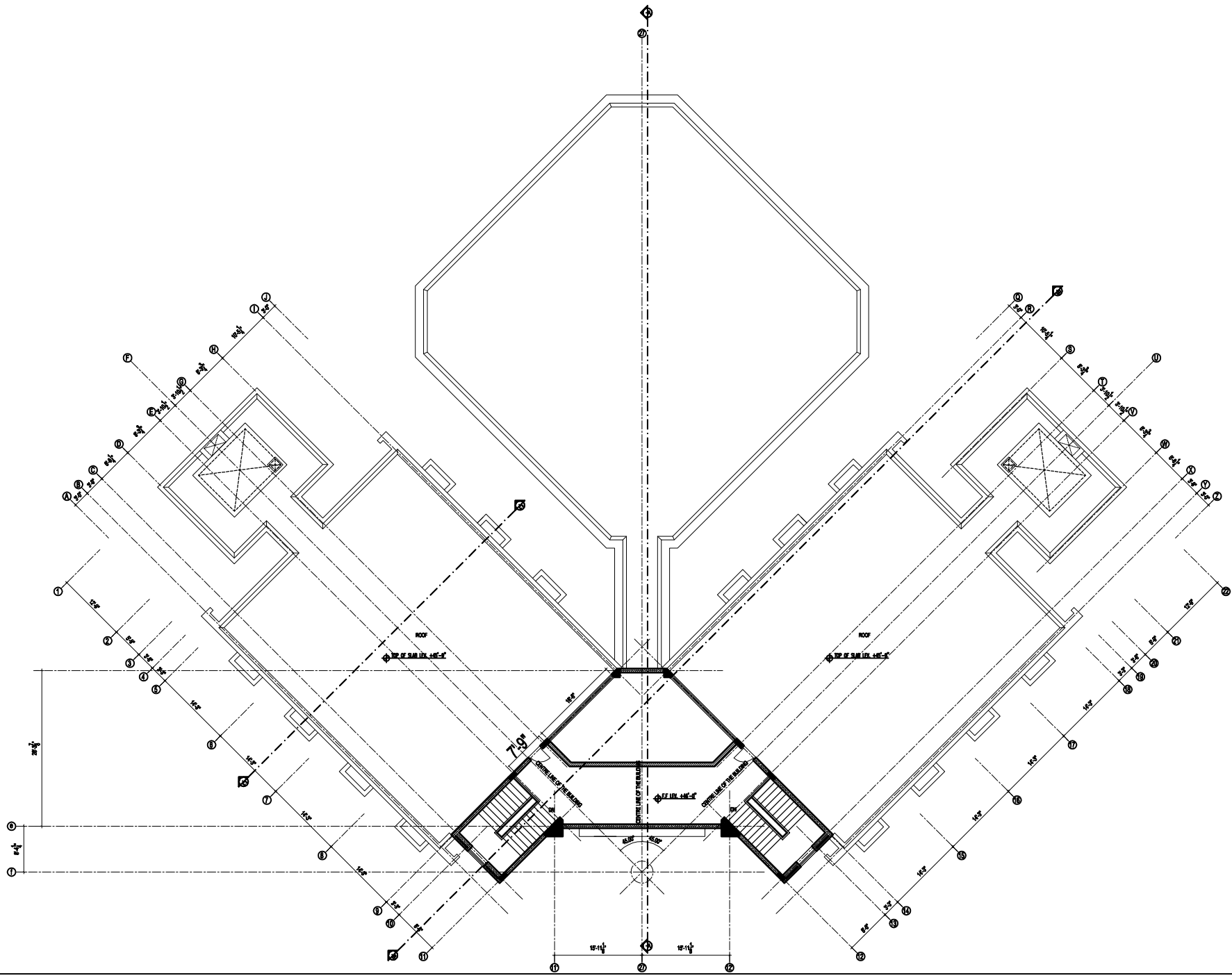
ELECTRICAL ENGINEERS: ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
505 , AMBER ESTATE , SHAHRAH-E-FAISAL
Karachi , Pakistan
Ph: (92-21) 4560360-61

PLUMBING ENGINEERS: DESIGN DEVELOPERS — DD
402- H.M.H SQUARE,COMM.S/1,BLOCK-10
GULSHAN-E-IQBAL,KARACHI
TEL NO. 021-4125345,FAX 021-4125334

DRAWING TITLE:

THIRD FLOOR PLAN

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-05
	CHECKED BY:	



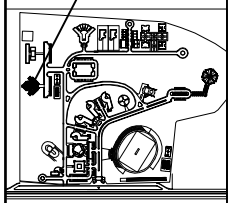
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.09 FIRST FLOOR
SAREEA 7-8
ISLAMABAD TEL. 92760760-92760868

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.NAQVI	M.A.MONTAZIER

STRUCTURE:
GLOBAL ENG. SERVICES
Tel: 021-35341836 KARACHI-PAKISTAN — GES

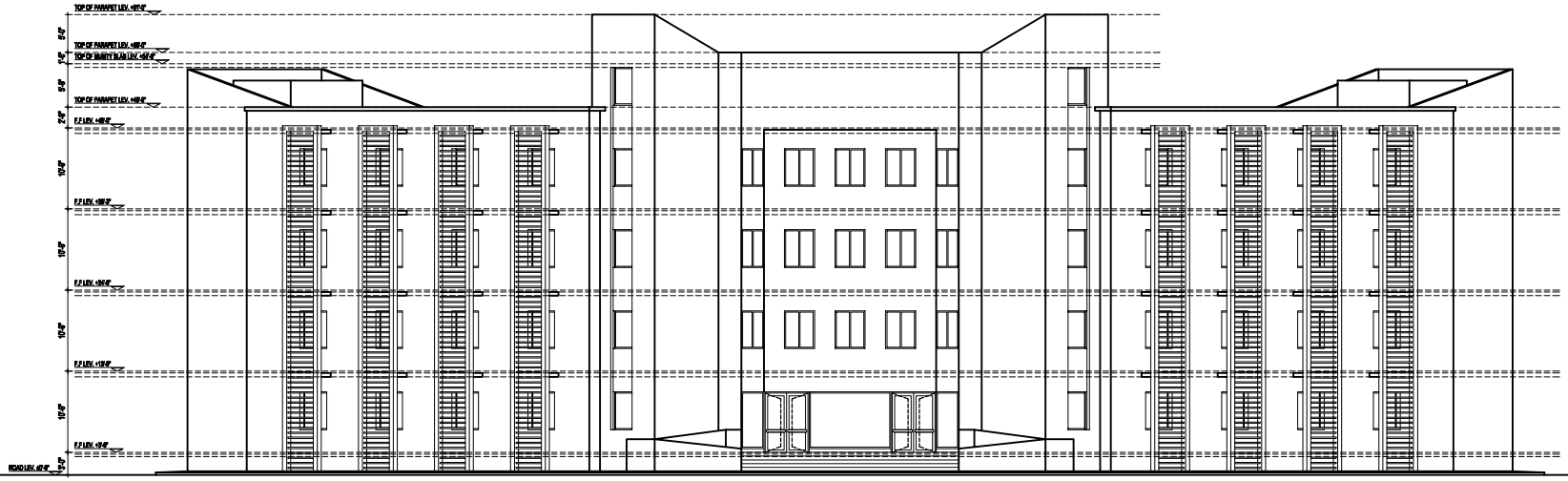
ELECTRICAL ENGINEER:
ASSOCIATED TECHNICAL CONSULTANTS
ATCONS

PLUMBING ENGINEER:
DESIGN DEVELOPERS
DD

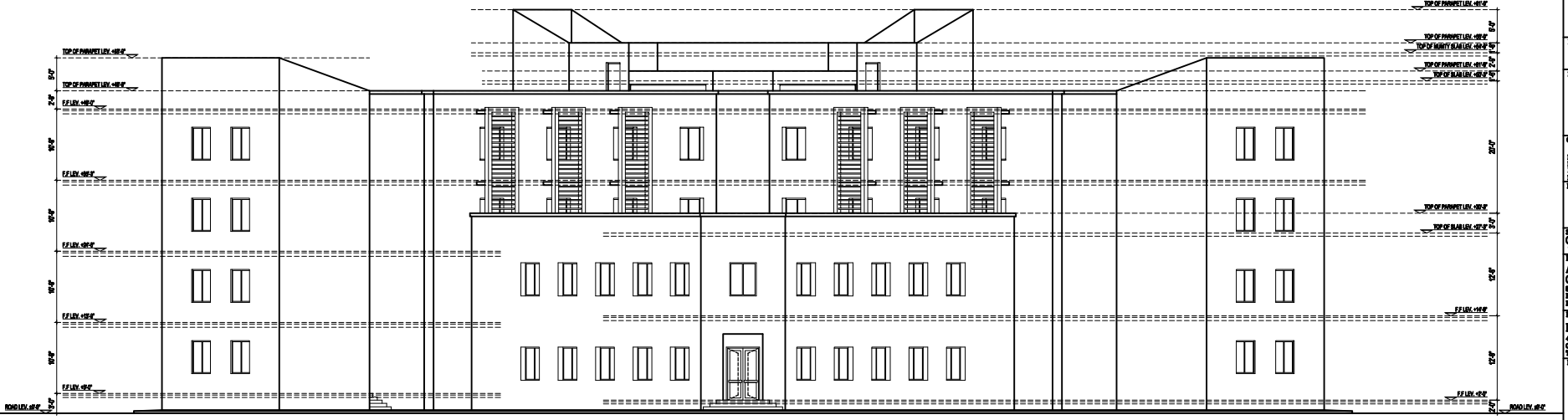
DRAWING TITLE:

ROOF PLAN

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-06
	CHECKED BY:	



FRONT ELEVATION



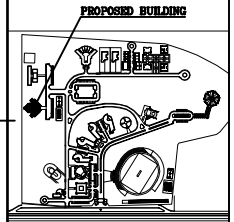
REAR ELEVATION

GENERAL NOTES & CONDITIONS

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEERS
BLOCK NO.19 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 92(051)-4870068

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A. ALAVI	M.A. MORTADER

STRUCTURAL
GLOBAL ENG. SERVICES
Tel: 021-35344336 KARACHI-PAKISTAN — GES

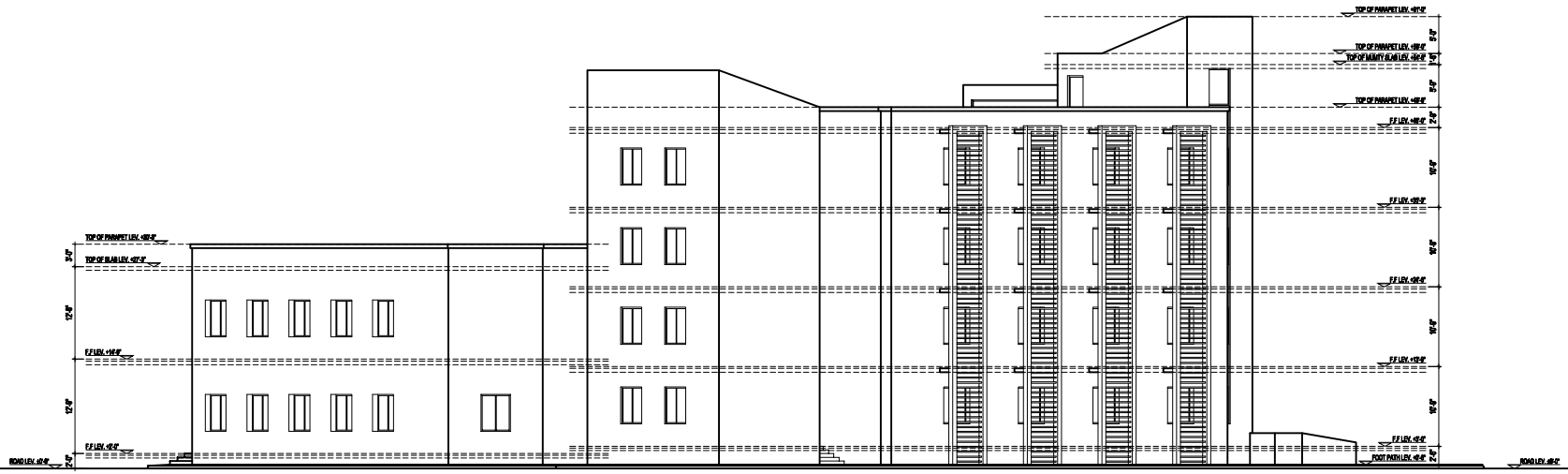
ELECTRICAL ENGINEERS
ASSOCIATED TECHNICAL CONSULTANTS
B28 , ASKARI APTMNT , SHAHRAH-E-FAISAL
Karachi - Pakistan
Ph: (92-21) 4540260-61 — ATCONS

PLUMBING ENGINEERS
DESIGN DEVELOPERS
448-H.M.M.SQUARE,COMM.S/1,BLOCK-13
GULSHAN-E-IQBAL,KARACHI
TEL NO: 021-4130445,FAX:021-4130284 — DD

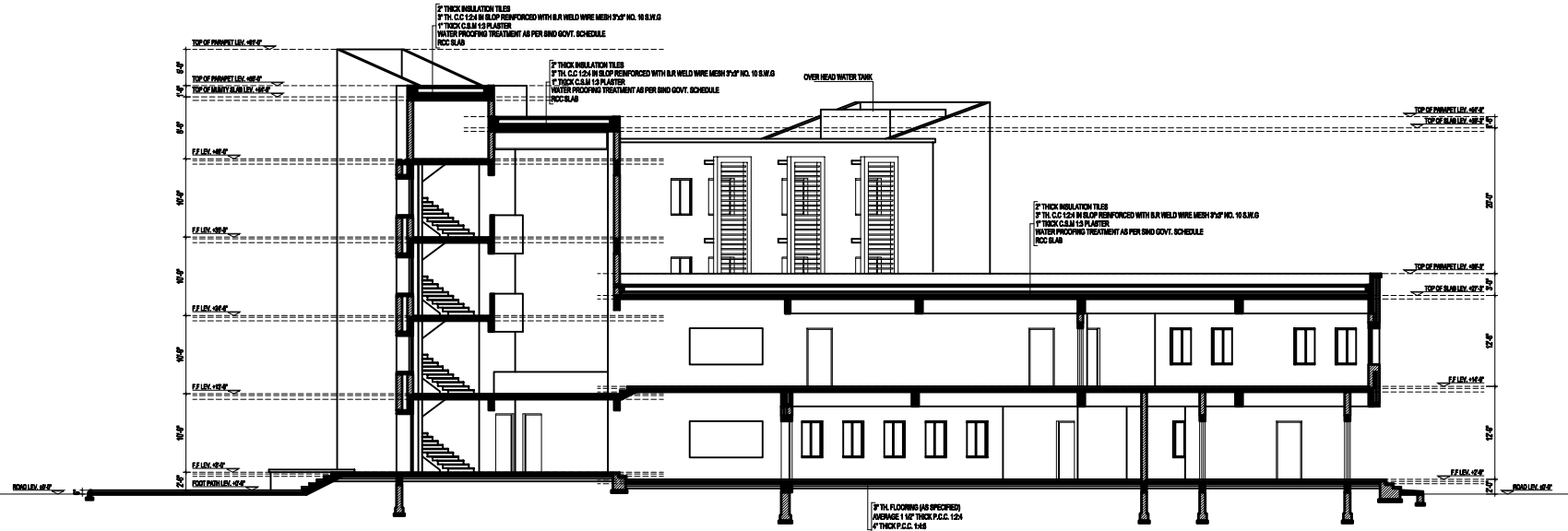
DRAWING TITLE:

FRONT ELEVATION
&
REAR ELEVATION

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-07
	CHECKED BY:	



TYPICAL SIDE ELEVATION



SECTION A-A

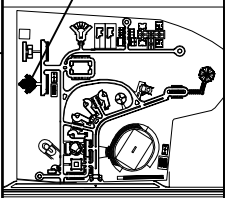
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN:

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
SR. ARCHITECT & ENGINEER
BLOCK NO. 09 FIRST FLOOR
KARACHI 74-C
ISLAMABAD TEL. 92760760-92760668

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.ALAVI	M.A.MOKTADER

STRUCTURE:
GLOBAL ENG. SERVICES — GES
Tel: 021-35044326 KARACHI-PAKISTAN

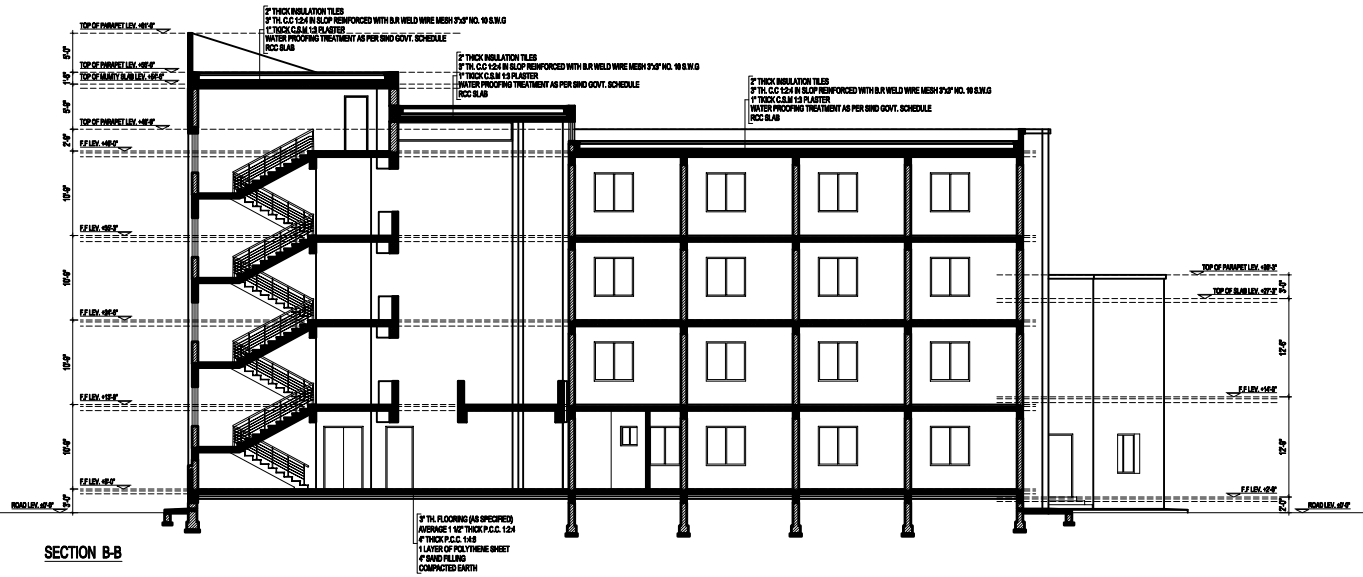
ELECTRICAL ENGINEER:
ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
Karachi - Pakistan
Ph: (92-21) 4540260-61

PLUMBING ENGINEER:
DESIGN DEVELOPERS — DD
TEL NO: 021-4120405,FAX:021-4120884

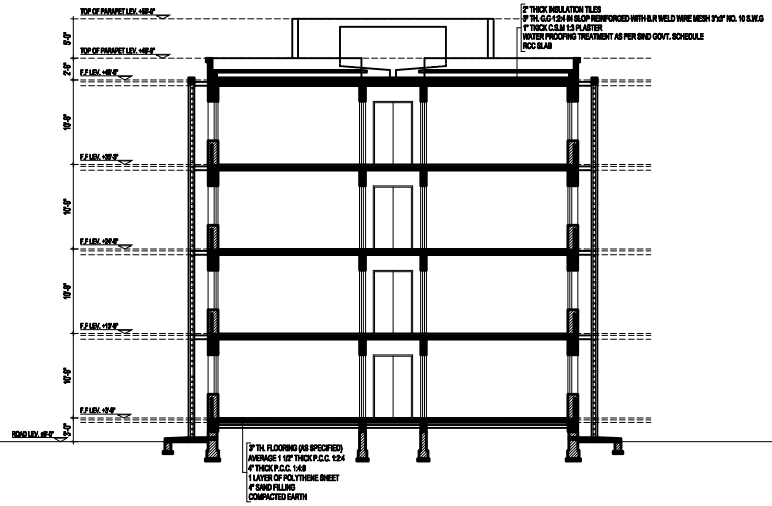
DRAWING TITLE:

TYPICAL SIDE ELEVATION & SECTION A-A

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-08
	CHECKED BY:	



SECTION B-B



SECTION C-C

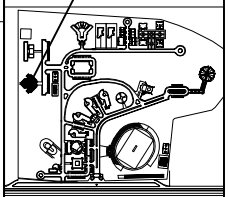
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN:

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.19 FIRST FLOOR
KARACHI P-3
ISLAMABAD TEL. 3076762-3570350

RESIDENT ENGINEER: Q.A. ALAVI

RESIDENT ARCHITECT: M.A. MOKTADIR

STRUCTURE: GLOBAL ENG. SERVICES Tel: 021-5504308 RAWALPINDI — GES

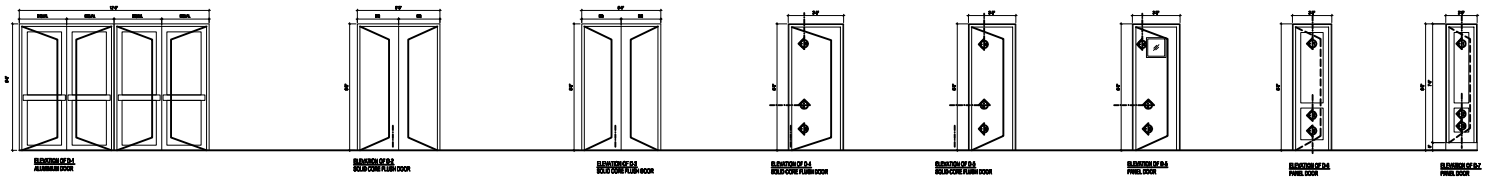
MECHANICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS 020 , AMBER ESTATE , SHAHRAH-E-FAISAL Karachi , Pakistan Ph: (92-21) 4548920-24 — ATCONS

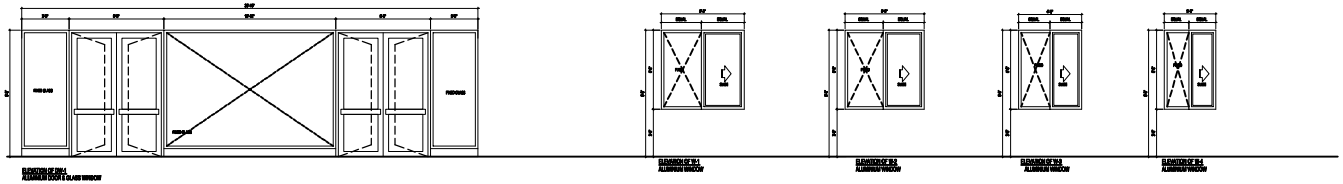
PLUMBING ENGINEER: DESIGN DEVELOPERS 418-19 M.M.ALAM HOUSE,FLOOR 6,7,BLOCK-16 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4389495,FAX:021-4389894 — DD

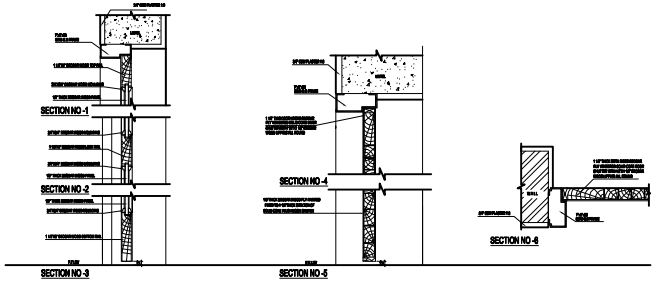
DRAWING TITLE:

SECTION B–B
&
SECTION C–C

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-09
	CHECKED BY:	







SCHEDULE OF DOORS AND WINDOWS				
S.NO	TYPE	WIDTH / HEIGHT	SILL LEV.	TYPE
1	DW-1	28'-10"x8'-0"	—	ALUMINIUM DOOR
2	D-2	3'-3"x8'-0"	—	SOLID CORE FLUSH DOOR
3	D-3	3'-0"x8'-0"	—	SOLID CORE FLUSH DOOR
4	D-4	3'-6"x8'-0"	—	SOLID CORE FLUSH DOOR
5	D-5	3'-0"x8'-0"	—	SOLID CORE FLUSH DOOR
6	D-6	2'-6"x7'-6"	0'-6"	PANEL DOOR
7	D-6	2'-0"x7'-6"	0'-6"	PANEL DOOR
8	DW-1	28'-10"x8'-0"	3'-0"	ALUMINIUM WINDOW
9	W-1	3'-3"x3'-0"	3'-0"	ALUMINIUM WINDOW
10	W-2	3'-0"x3'-0"	3'-0"	ALUMINIUM WINDOW
11	W-3	4'-0"x3'-0"	3'-0"	ALUMINIUM WINDOW
12	W-4	3'-x3'-0"	3'-0"	ALUMINIUM WINDOW

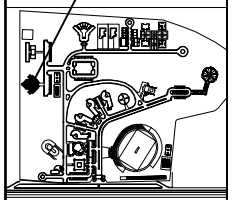
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION:	S.NO.	DATE:

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.19 FIRST FLOOR
MARGLA T-4
ISLAMABAD
TEL. 2070702-2070703

RESIDENT ENGINEER: Q. A. ALAVI

RESIDENT ARCHITECT: M. A MOKTADER

STRUCTURE: GLOBAL ENG. SERVICES — GES
Tel: 021-35824826 RAWALPINDI

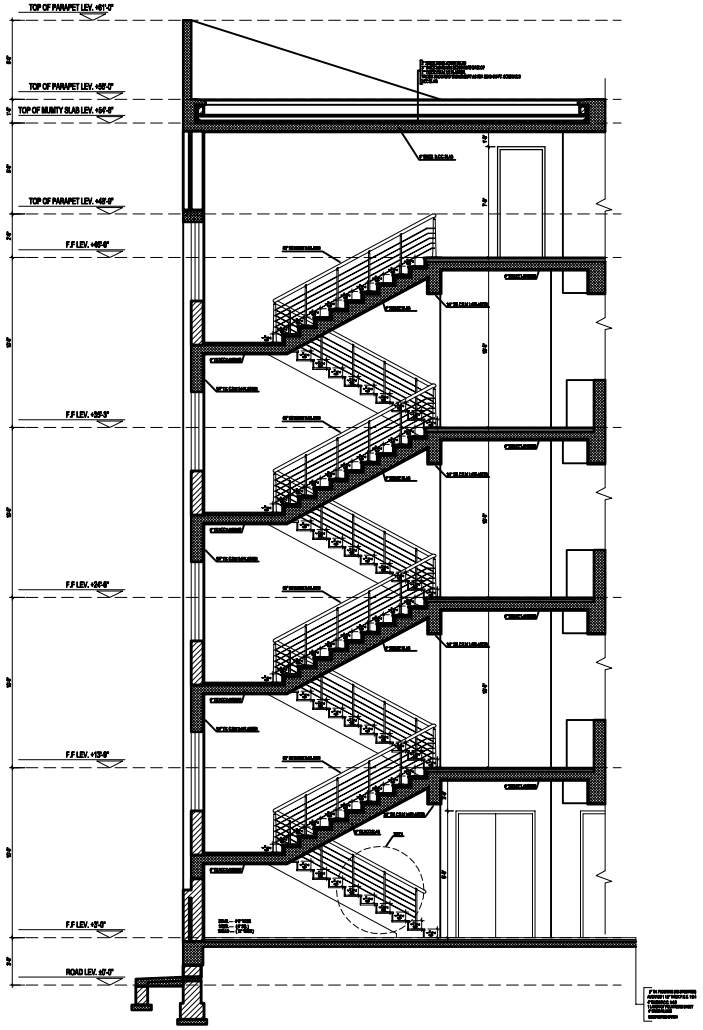
ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
505, AMBER ESTATE, SHAHRAH-E-FAISAL, Karachi Pakistan
Ph: (92-21) 4548960-61

PLUMBING ENGINEER: DESIGN DEVELOPERS — DD
402-H.M.S(SAHIL COMPLX),BLOCK-13 GULSHAN-E-IQBAL KARACHI
TEL. NO. 021-4120345,FAX 021-4120334

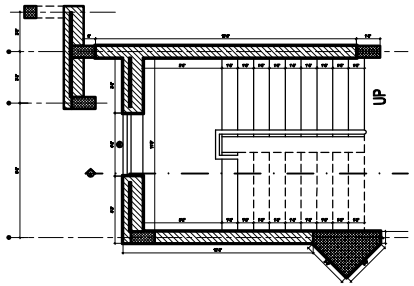
DRAWING TITLE:

DOORS & WINDOWS DETAILS

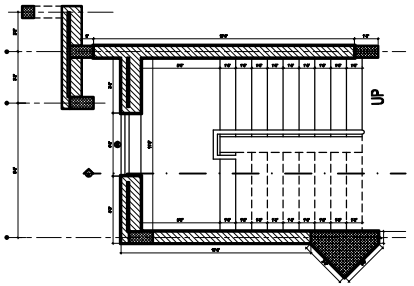
PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-10
	CHECKED BY:	



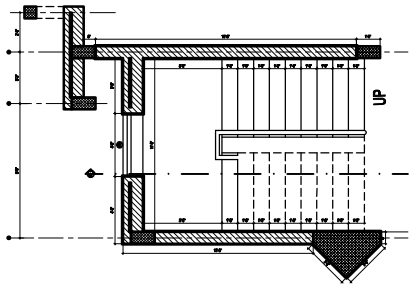
SECTION B-B



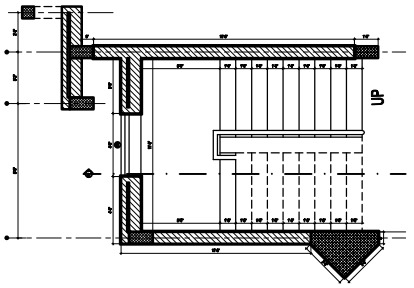
GROUND FLOOR PLAN STAIR DETAIL



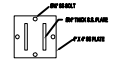
2ND FLOOR PLAN STAIR DETAIL



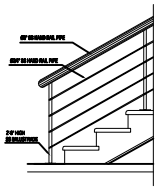
1ST FLOOR PLAN STAIR DETAIL



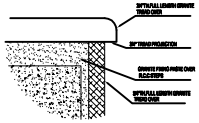
3RD FLOOR PLAN STAIR DETAIL



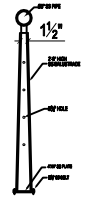
BALUSTER PLAN



RAILING ELEVATION
DETAIL-1



ENLARGED DETAIL OF
MARBLE TREAD & RISER
DETAIL-2



BALUSTER ELEVATION
DETAIL-3

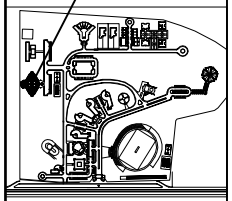
GENERAL NOTES & CONDITIONS

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEERS
BLOCK NO.19 FIRST FLOOR
KARACHI 7-4
ISLAMABAD TEL. 92760760-92760668

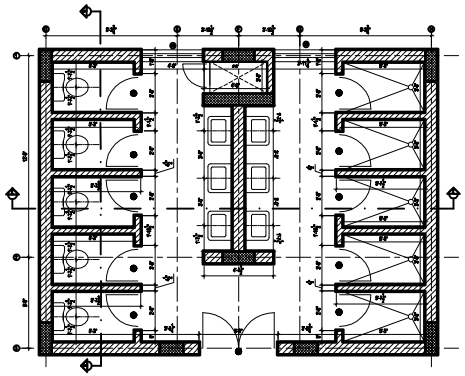
RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.ALAVI	M.A.MOKTADIR

STRUCTURE GLOBAL ENG. SERVICES Tel: 021-35041026 KARACHI-PAKISTAN	GES
ELECTRICAL ENGINEERS ASSOCIATED TECHNICAL CONSULTANTS 909 , AMBER TOWER , SHAHRAH-E-FAISAL, Karachi - Pakistan. Ph: (92-21) 4540909-11	ATCONS
PLUMBING ENGINEERS DESIGN DEVELOPERS 408-H.M.M SQUARE,COMMLS/1,BLOCK-13 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4130405,FAX:021-4130884	DD

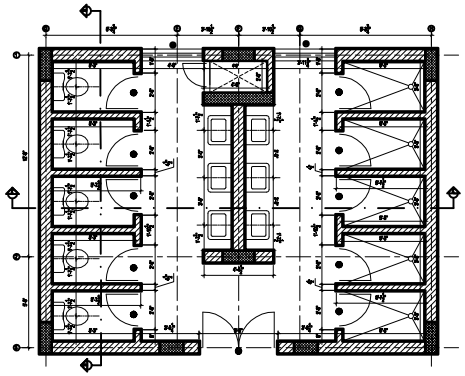
DRAWING TITLE:

DETAILS OF STAIRS

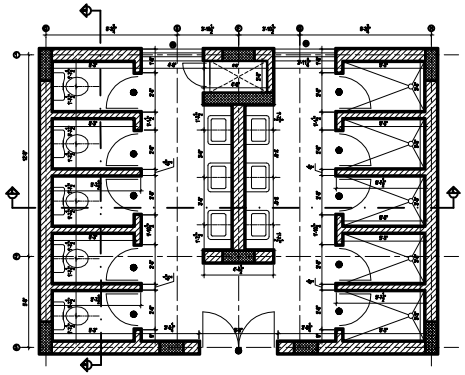
PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-11
	CHECKED BY:	



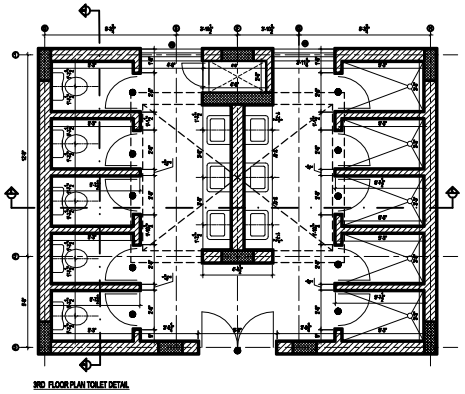
GROUND FLOOR PLAN TOILET DETAIL



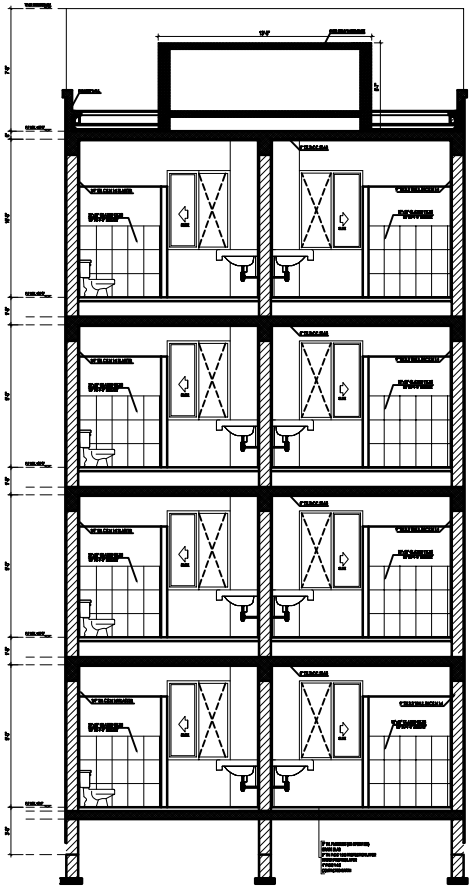
1ST FLOOR PLAN TOILET DETAIL



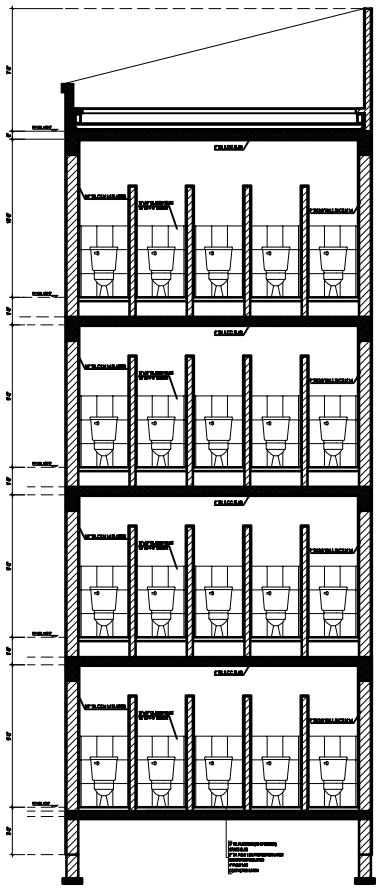
2ND FLOOR PLAN TOILET DETAIL



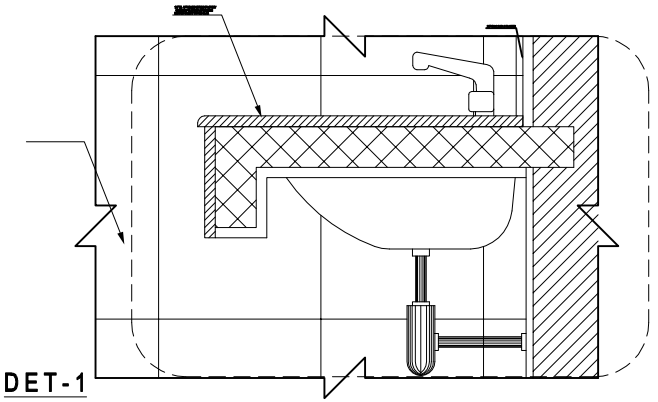
3RD FLOOR PLAN TOILET DETAIL



SECTION A-A



SECTION B-B



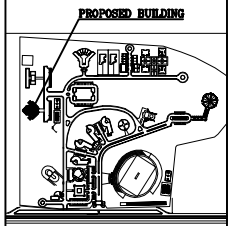
DET-1

GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION:	S.NO.	DATE

KEY PLAN



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
INC. ARCHITECT & ENGINEER
BLOCK NO.19 FIRST FLOOR
MARGLA P.O
ISLAMABAD TEL. 92(051)-5870008

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.ALAVI	M.A.MONTAZIR

STRUCTURE:
GLOBAL ENG. SERVICES
Tel: 021-5862609 KARACHI — GES

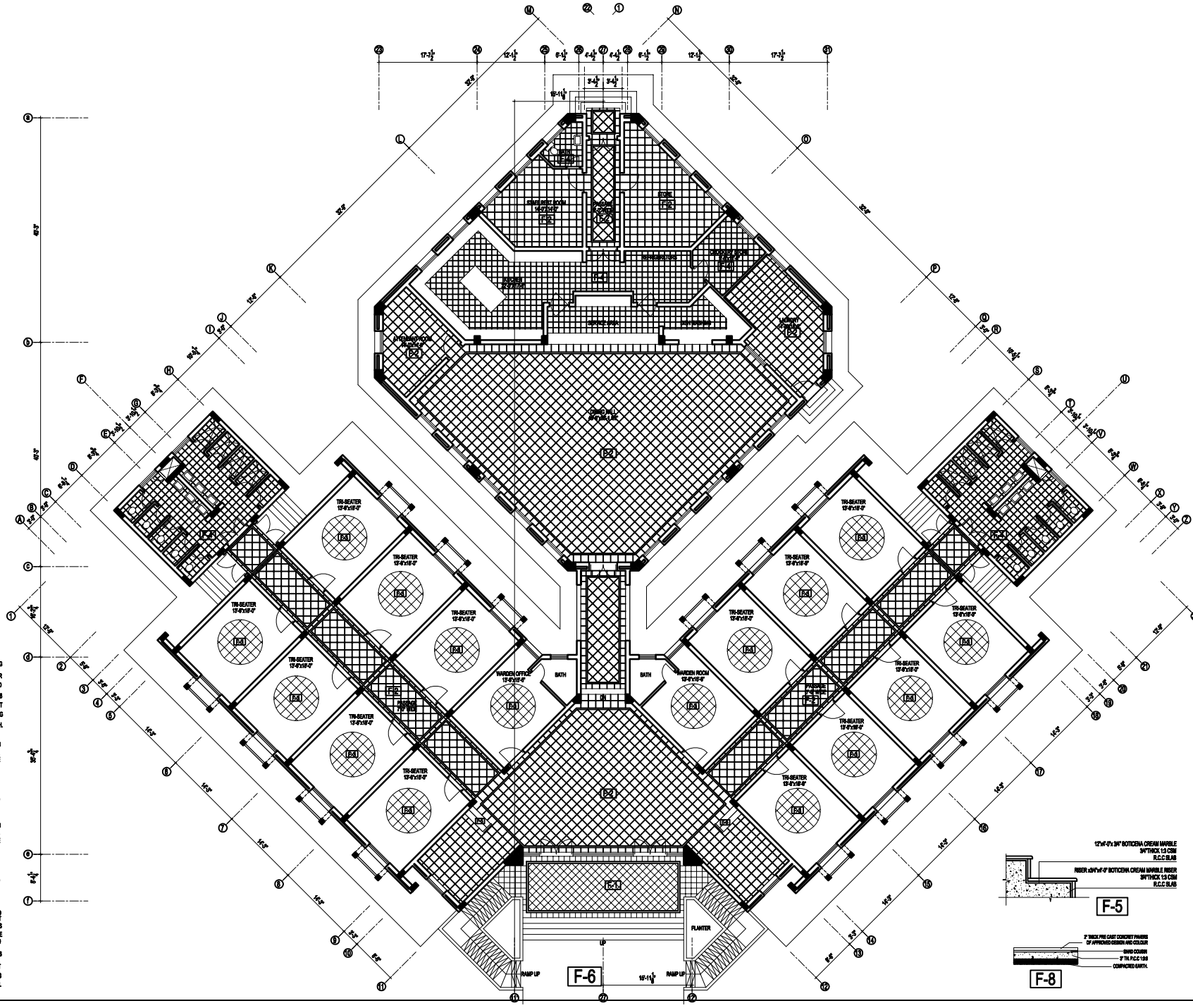
ELECTRICAL ENGINEER:
ASSOCIATED TECHNICAL CONSULTANTS
305, AMBER ESTATE, SHAHRAH-E-FAISAL
Karachi Pakistan
Ph: (92-21) 4548909-91 — ATCONS

PLUMBING ENGINEER:
DESIGN DEVELOPERS
402-H.M.S.SQUARE,COMPLEX/1,BLOCK-12
GULSHAN-E-IQBAL KARACHI
TEL NO: 021-4120345,FAX:021-4120334 — DD

DRAWING TITLE:

DETAILS OF TOILETS

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-12
	CHECKED BY:	



GENERAL NOTES & CONSENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING

PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEER
BLOCK NO. 19 FIRST FLOOR
MARGLA T-I
ISLAMABAD TEL. 2276760-2270068

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADER

STRUCTURE: GLOBAL ENG. SERVICES Tel: 021-5804826 KARACHI — GES

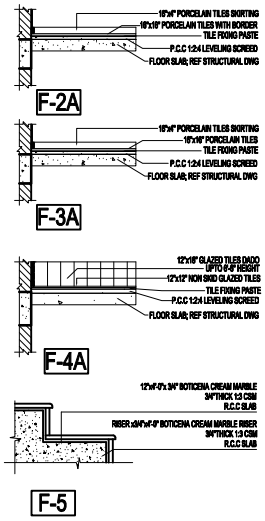
ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS 509, ANSAR ESTATE, SHAHRAH-E-FAISAL, Karachi, Pakistan. Ph: (92-21) 4540509-10 — ATCONS

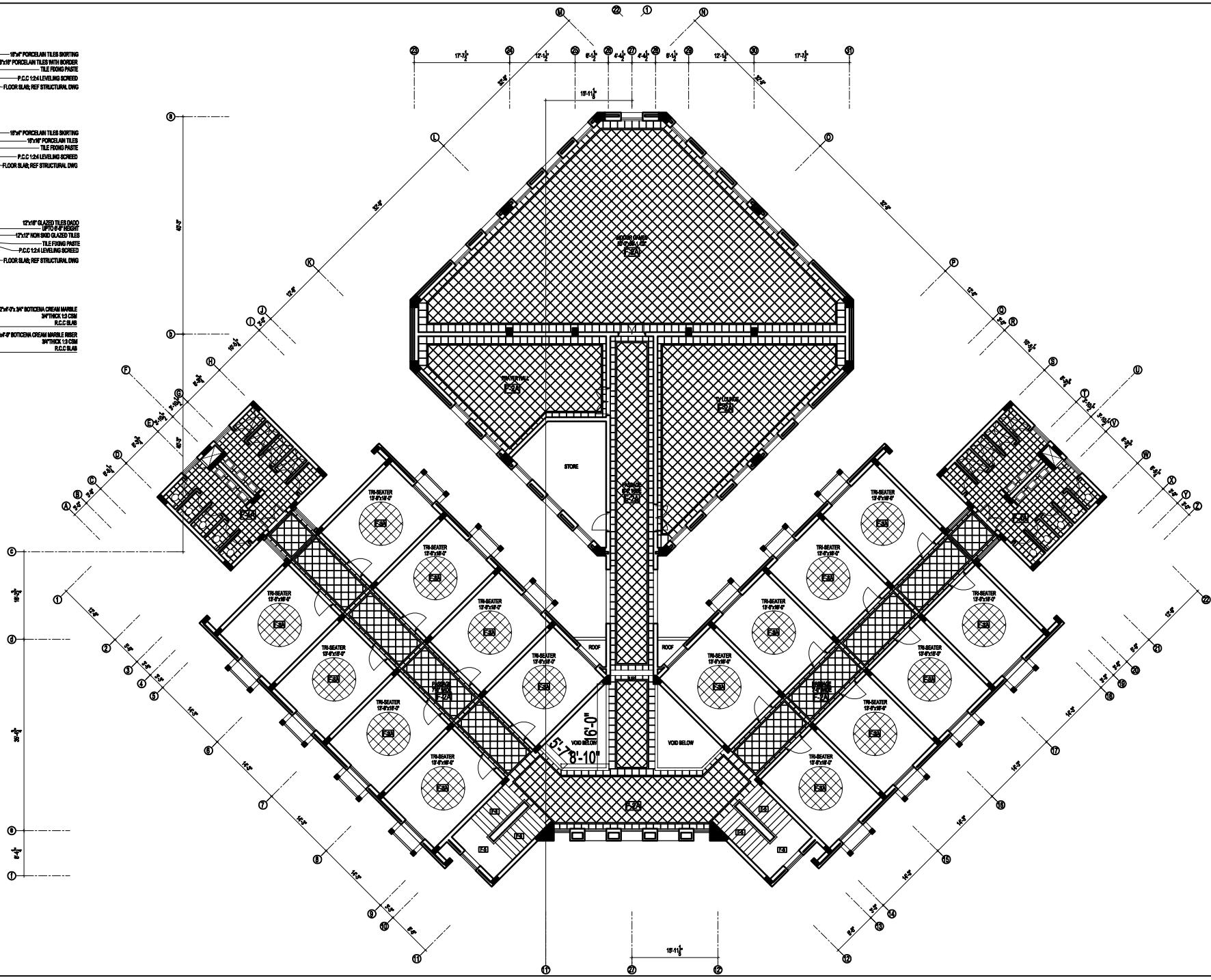
PLUMBING ENGINEER: DESIGN DEVELOPERS 405-H.M.M. SQUARE,COMMERCIAL-1,BLOCK-13A GULISTAN-E-JOHAR,KARACHI TEL NO: 021-4100405,FAX:021-4100384 — DD

DRAWING TITLE

GROUND FLOOR PLAN
FLOOR FINSHES

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1"=6"=1/8"	SCAD/B.H
	DRAWN BY:	A-13
	CHECKED BY:	





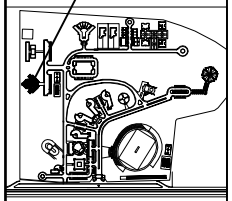
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	R.NO.	DATE

KEY PLAN:

PROPOSED BUILDING



PROJECT CLIENT:

ARORR UNIVERSITY OF ART, ARCHITECTURE , DESIGN AND HERITAGES SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEERS
BLOCK NO.19 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL: 92(51)5-4572068

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADER

STRUCTURE:
GLOBAL ENG. SERVICES
Tel: 021-5354328 KARACHI-PAKISTAN
GES

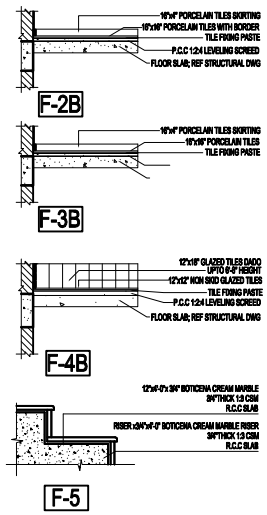
ELECTRICAL ENGINEER:
ASSOCIATED TECHNICAL CONSULTANTS
ATCONS

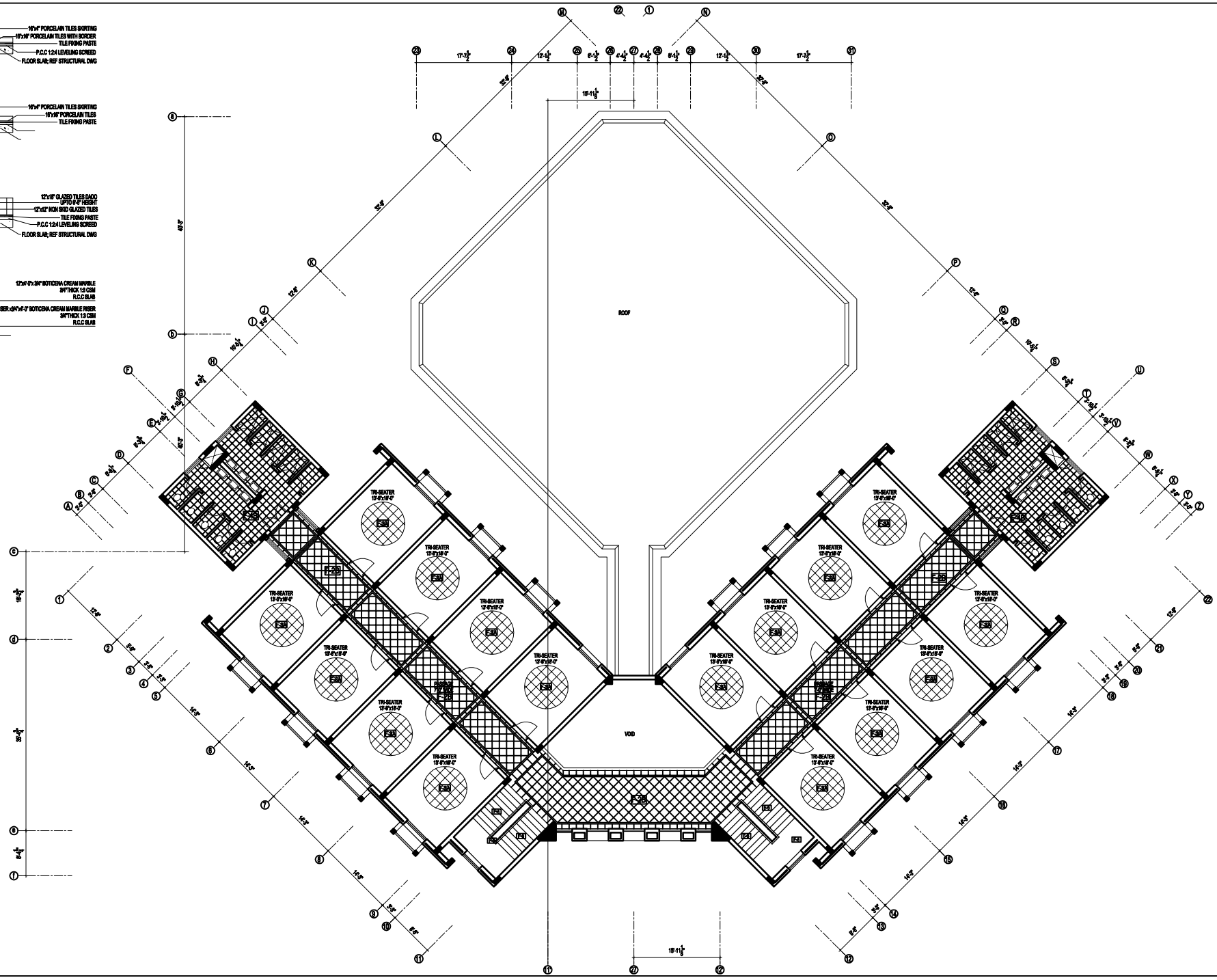
PLUMBING ENGINEER:
DESIGN DEVELOPERS
DD

DRAWING TITLE:

FIRST FLOOR PLAN
FLOOR FINSHES

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-14
	CHECKED BY:	





N

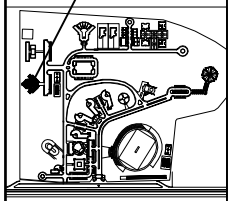
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN:

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEER
BLOCK NO.19 FIRST FLOOR
MARGLA 7-4
ISLAMABAD TEL. 92760760-62760668

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIR

STRUCTURAL: GLOBAL ENG. SERVICES — GES
Tel: 021-5354328 KARACHI-PAKISTAN

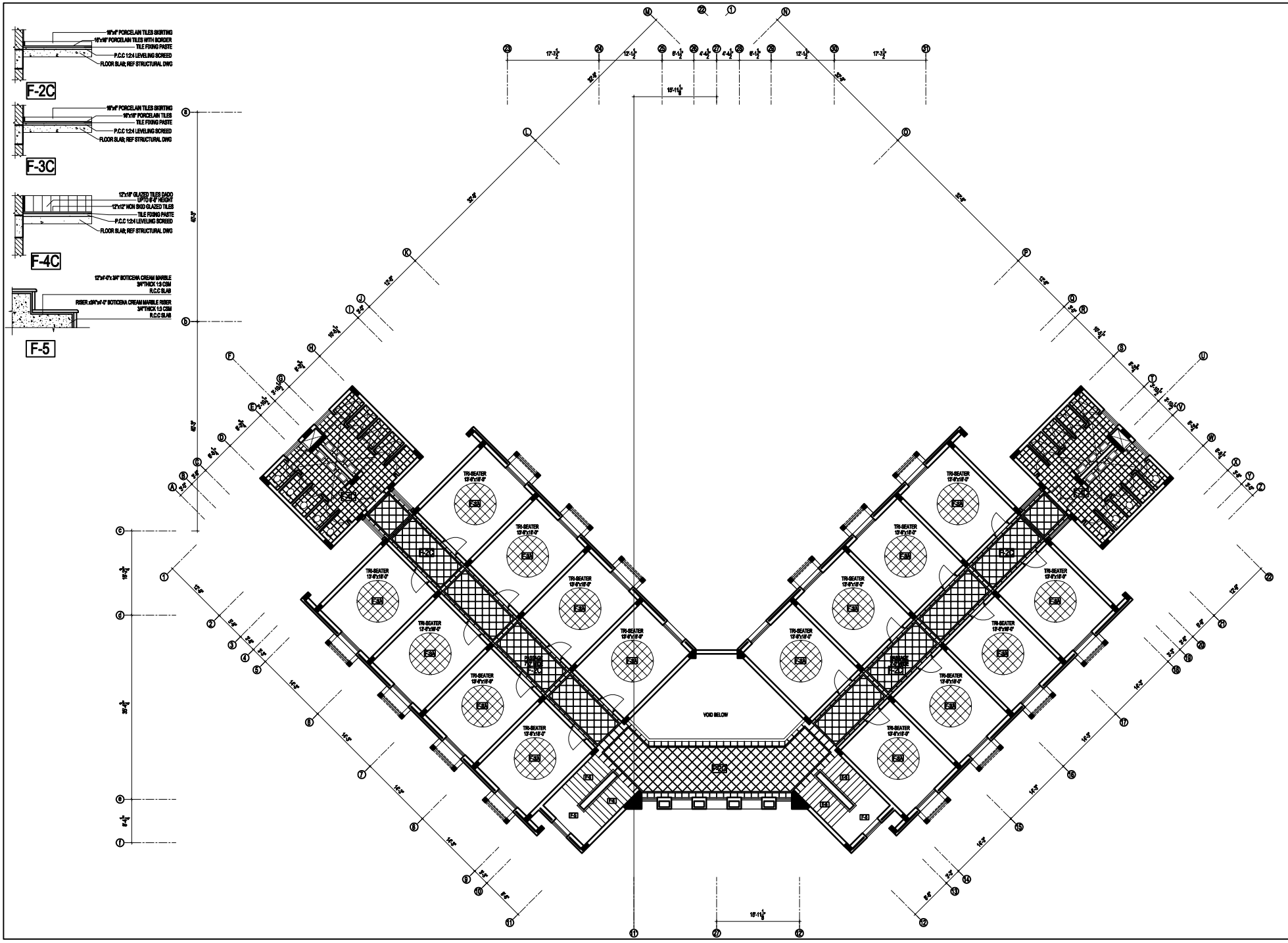
ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
Karachi - Pakistan
Ph: (92-21) 4540260-61

PLUMBING ENGINEER: DESIGN DEVELOPERS — DD
TEL NO: 021-4120405,FAX:021-4120284

DRAWING TITLE:

SECOND FLOOR PLAN
FLOOR FINSHES

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-15
	CHECKED BY:	



GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	R.NO.	DATE

KEY PLAN

PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEERS
BLOCK NO. 19 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 5170760-5170068

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIR

STRUCTURAL ENGINEERS
GLOBAL ENG. SERVICES
Tel: 021-5804826 KARACHI-PAKISTAN
GES

ELECTRICAL ENGINEERS
ASSOCIATED TECHNICAL CONSULTANTS
ATCONS

PLUMBING ENGINEERS
DESIGN DEVELOPERS
DD

DRAWING TITLE:

THIRD FLOOR PLAN
FLOOR FINSHES

PROJECT ARCHITECT:

DATE:

SCALE: 1'-0"=1/8"

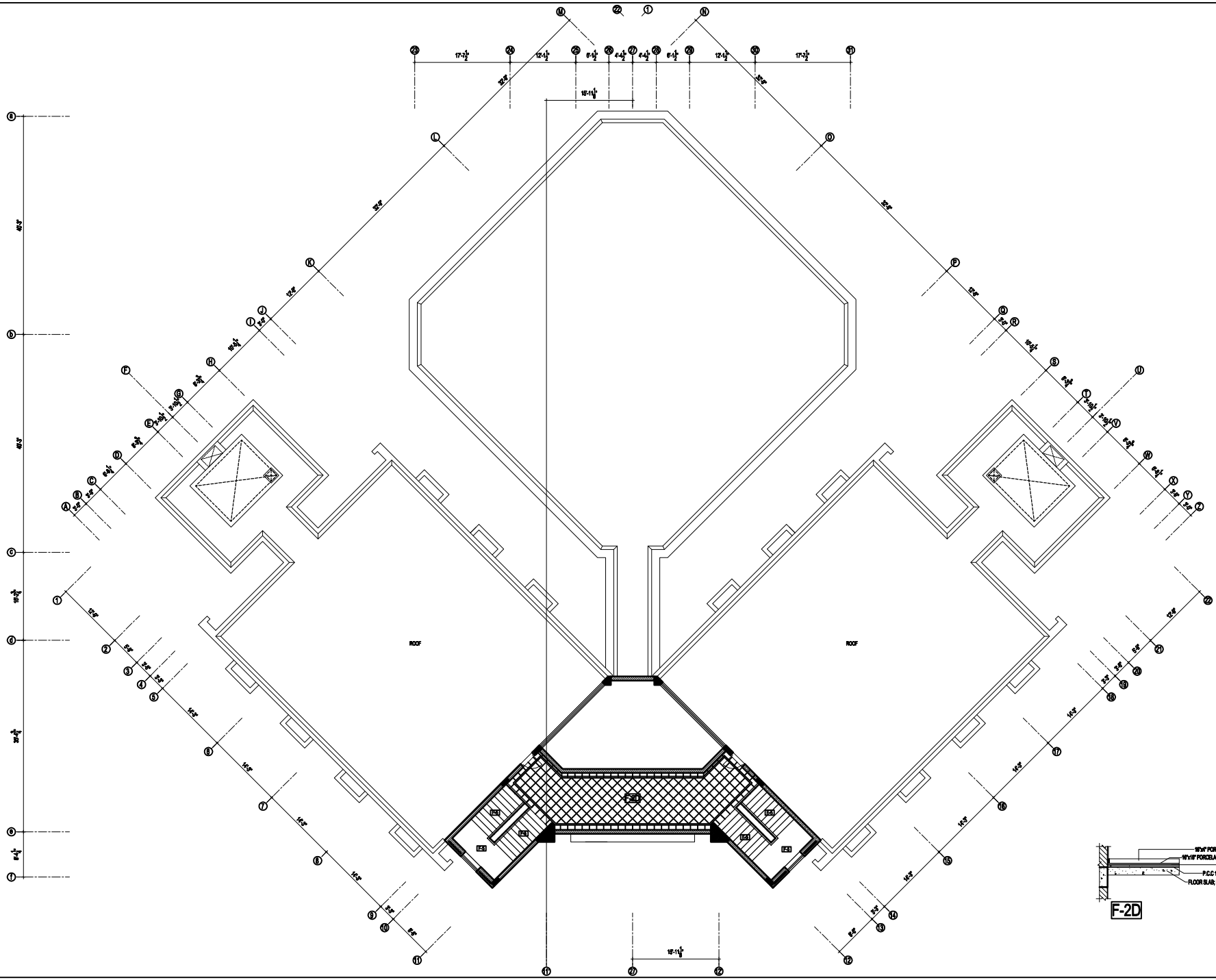
DRAWN BY:

CHECKED BY:

DRAWING NO:

SCAD/B.H

A-16



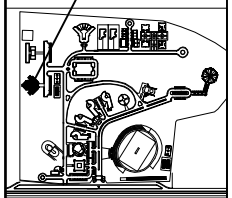
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.09 FIRST FLOOR
SAMAN-F-7-3
ISLAMABAD TEL. 9870707-9870908

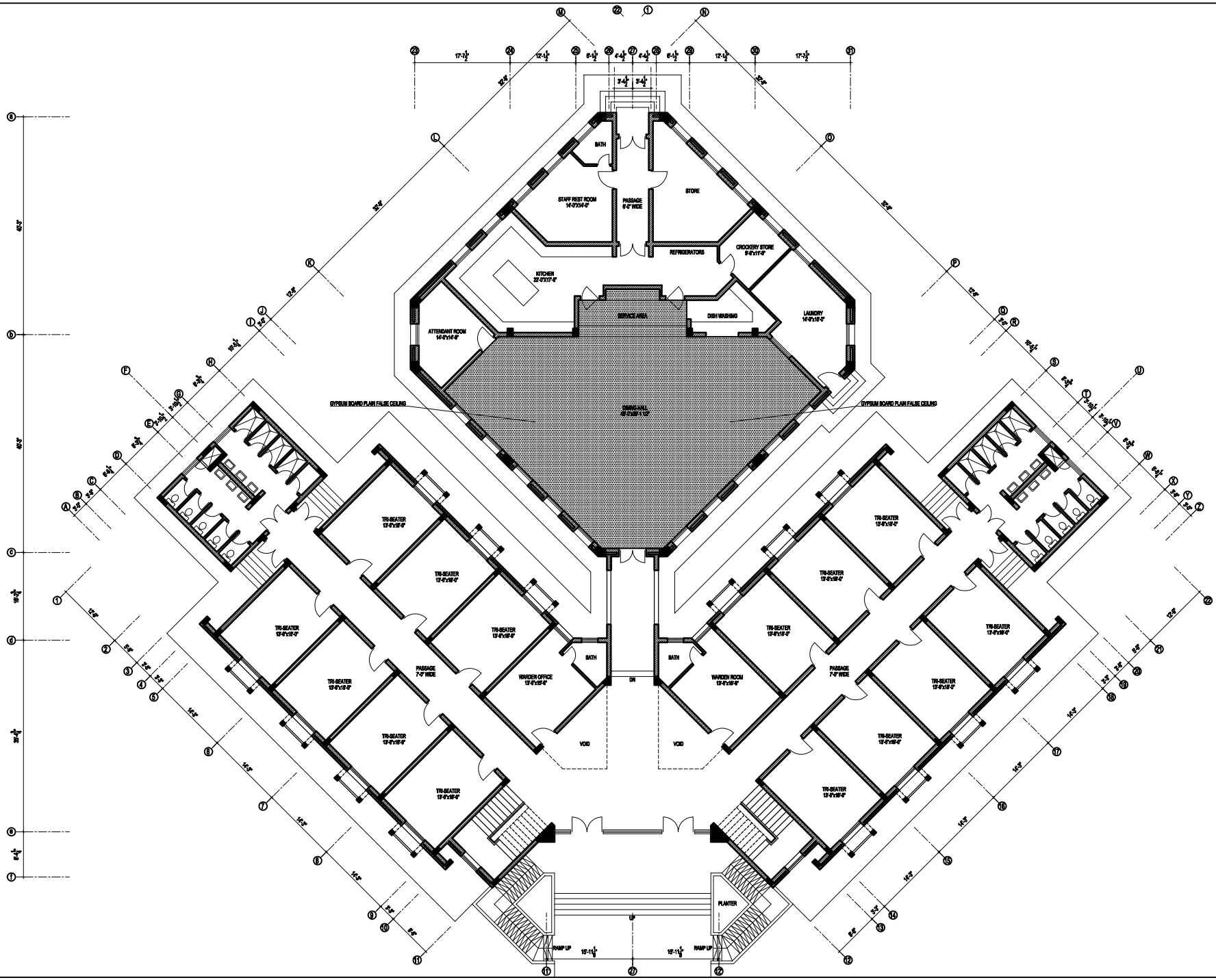
RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.ALAVI	M.A.MOKTADIR

STRUCTURE GLOBAL ENG. SERVICES Tel: 021-3530-4939 RAWALPINDI	GES
ELECTRICAL ENGINEERS ASSOCIATED TECHNICAL CONSULTANTS 505, AMBER ESTATE, SHAHRAH-E-FAISAL, Karachi, Pakistan Ph: (92-21) 4548300-01	ATCONS
PLUMBING ENGINEERS DESIGN DEVELOPERS 448-H.M.R SQUARE,COMMLS/1,BLOCK-12 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4120408,FAX:021-4120384	DD

DRAWING TITLE:

ROOF PLAN
FLOOR FINSHES

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-17
	CHECKED BY:	



N

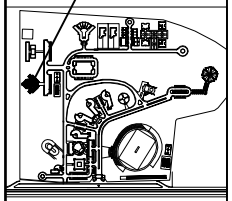
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEER
BLOCK NO.19 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 92(051)- 4870068

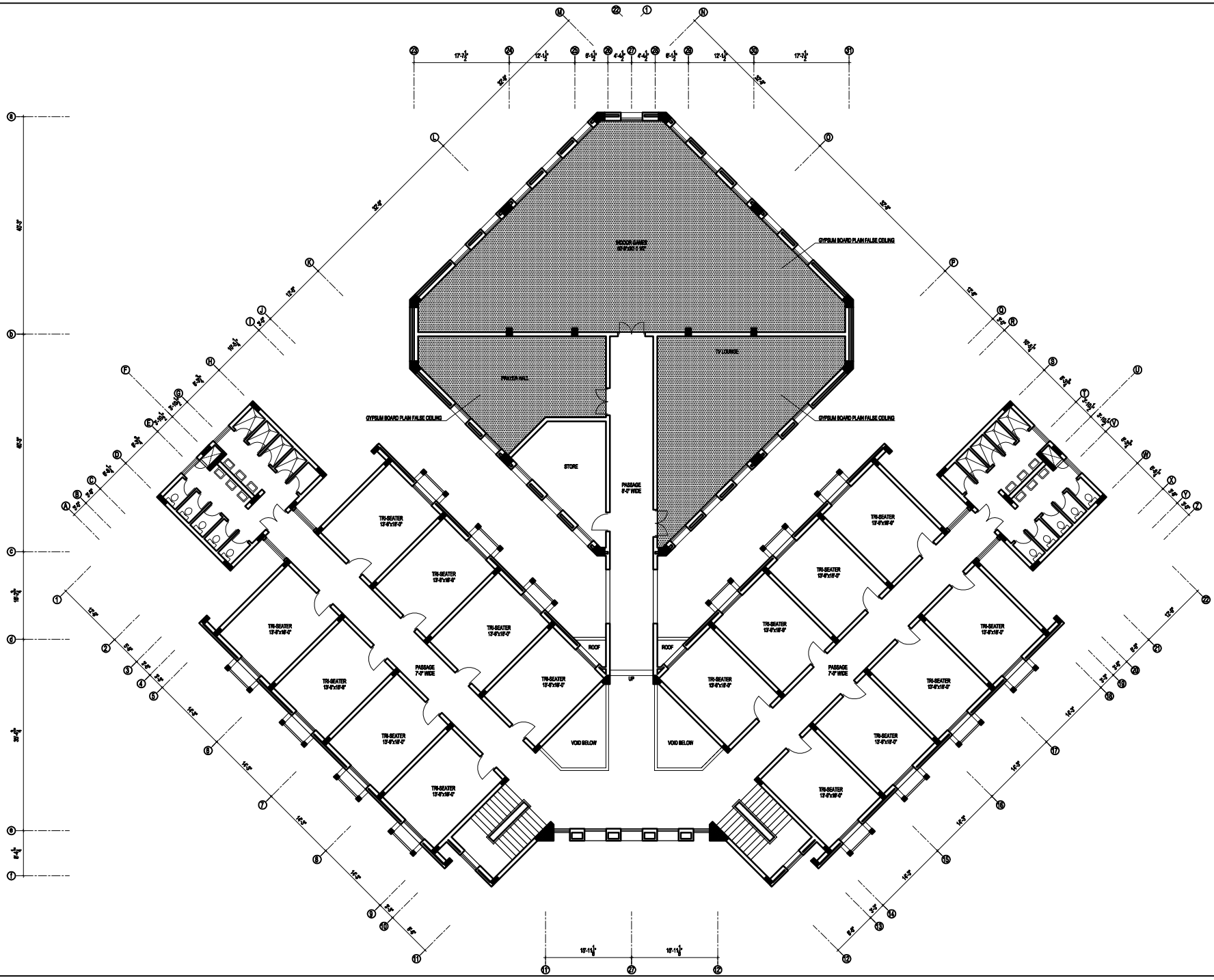
RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.ALAVI	M.A.MUKTADIR

STRUCTURAL ENGINEERS: GLOBAL ENG. SERVICES Tel: 021-35344326 KARACHI-PAKISTAN	GES
ELECTRICAL ENGINEERS: ASSOCIATED TECHNICAL CONSULTANTS 509 , AMEER ESTATE , SHAHRAH-E-FAISAL, Karachi , Pakistan. Ph: (92-21) 4540509-10	ATCONS
PLUMBING ENGINEERS: DESIGN DEVELOPERS 402-H.M.H.SQUARE,COMMLS/1,BLOCK-13 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4130405,FAX:021-4130384	DD

DRAWING TITLE:

REFLECTED CEILING PLAN OF GROUND FLOOR

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-18
	CHECKED BY:	



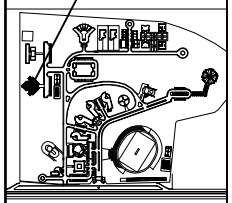
GENERAL NOTES & CONDITIONS

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEERS
BLOCK NO.19 FIRST FLOOR
SARENA 7-8
ISLAMABAD TEL. 2270760-2270868

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIR

STRUCTURAL ENGINEERS
GLOBAL ENG. SERVICES
Tel: 021-35344326 KARACHI-PAKISTAN
GES

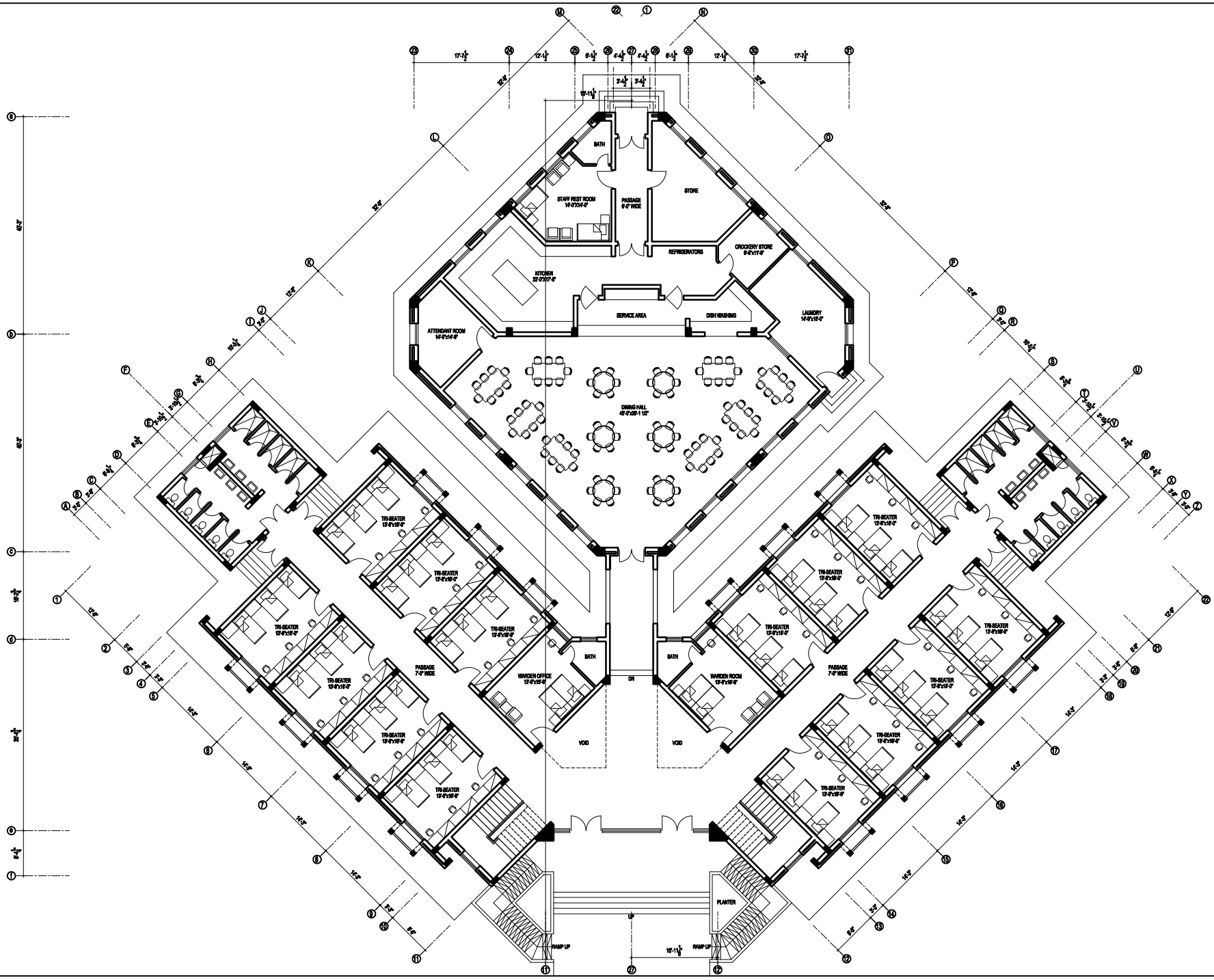
ELECTRICAL ENGINEERS
ASSOCIATED TECHNICAL CONSULTANTS
ATCONS

PLUMBING ENGINEERS
DESIGN DEVELOPERS
DD

DRAWING TITLE

REFLECTED CEILING PLAN OF FIRST FLOOR

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-19
	CHECKED BY:	



N

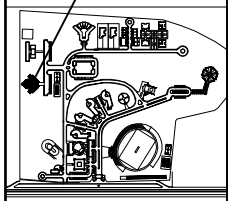
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEER
BLOCK NO.19 FIRST FLOOR
MARKAZ F-6
ISLAMABAD TEL. 2270760-2270068

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIR

STRUCTURE: GLOBAL ENG. SERVICES Tel: 021-35344326 KARACHI — GES

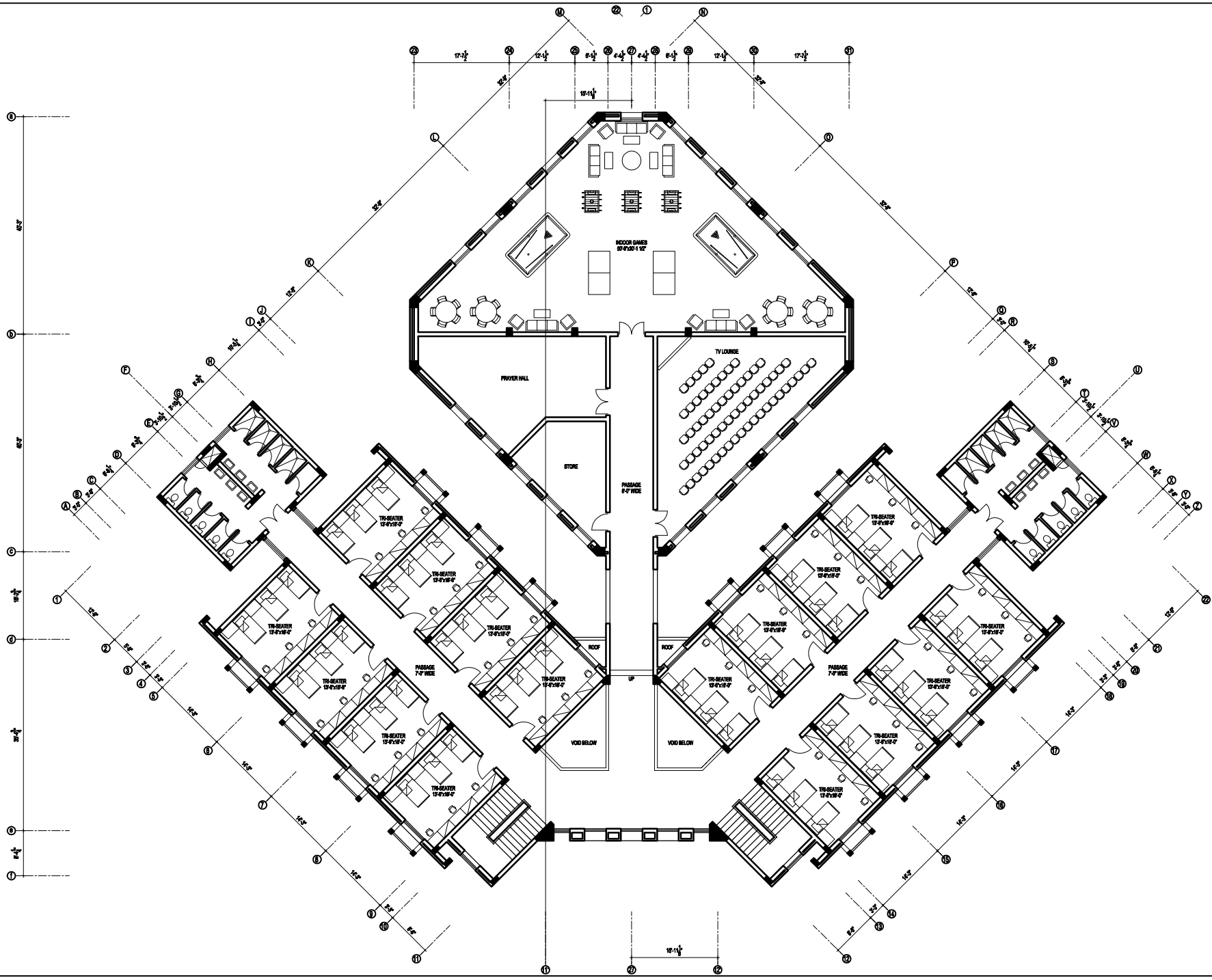
ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS 505, ASKARI TOWER, SHAHRAH-E-FAISAL, Karachi, Pakistan. Ph: (92-21) 4540505-08 — ATCONS

PLUMBING ENGINEER: DESIGN DEVELOPERS 46B-H.M.H.SQUARE,COMMLS/1,BLOCK-13 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4139405,FAX:021-4139384 — DD

DRAWING TITLE:

GROUND FLOOR PLAN FURNITURE LAYOUT

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-20
	CHECKED BY:	



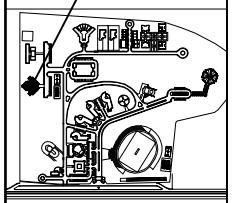
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO. 09 FIRST FLOOR
MARIZ T-4
ISLAMABAD TEL. 92765760-62760268

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIR

STRUCTURAL ENGINEER: GLOBAL ENG. SERVICES Tel: 021-35344326 KARACHI — GES

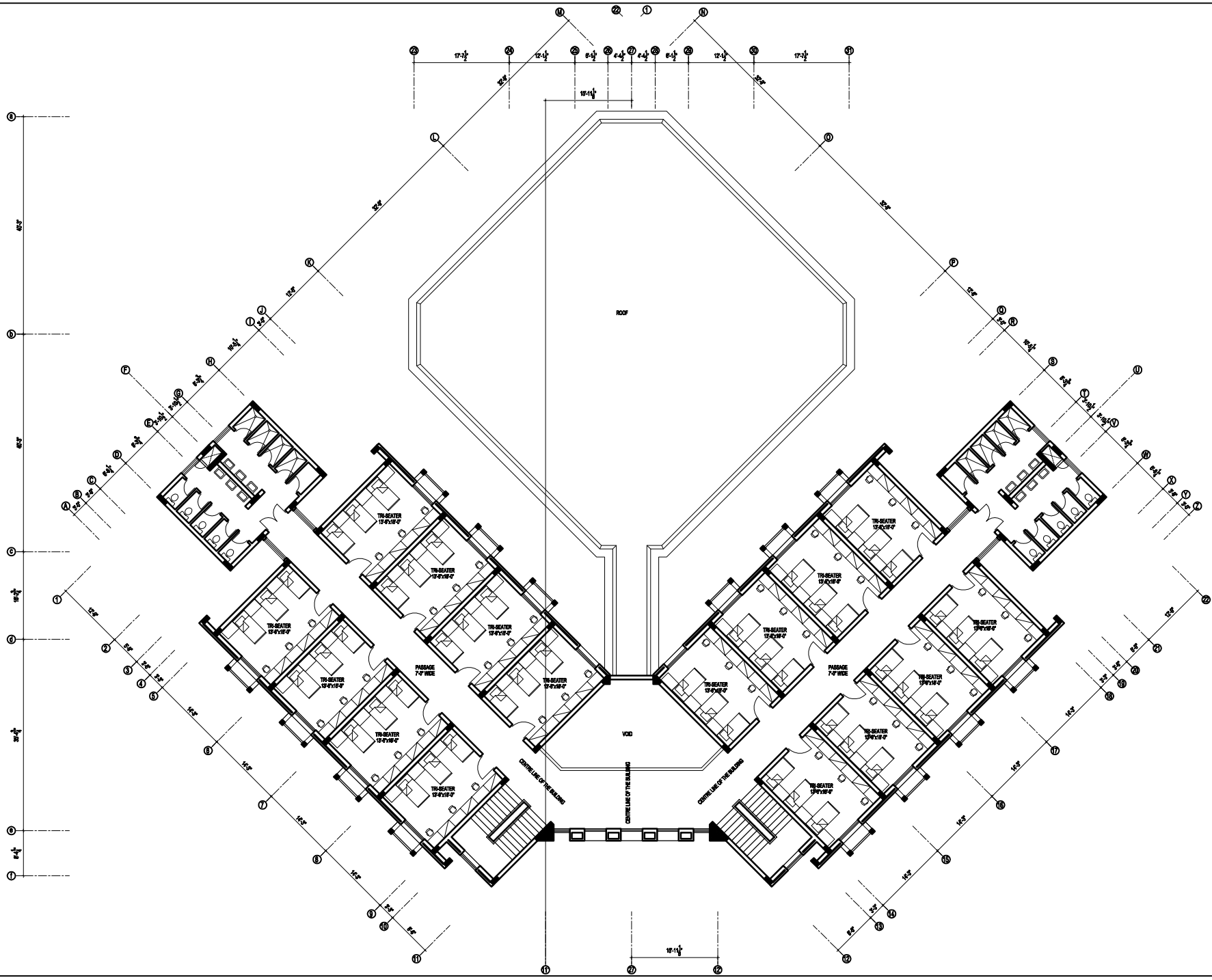
ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS 509, AMBER ESTATE, SHAHRAH-E-FAISAL, Karachi, Pakistan. Ph: (92-21) 4540509-10 — ATCONS

PLUMBING ENGINEER: DESIGN DEVELOPERS 408-H.M.M.SQUARE,COMMUN.2/1,BLOCK-13 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4139405,FAX:021-4139384 — DD

DRAWING TITLE:

FIRST FLOOR PLAN FURNITURE LAYOUT

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-21
	CHECKED BY:	



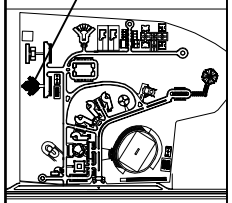
GENERAL NOTES & CONSENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
SST. ARCHITECT & ENGINEER
BLOCK NO. 09 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 92760760-92760868

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.NAVI	M.A.MOKTADIER

STRUCTURAL ENGINEERS:
GLOBAL ENG. SERVICES — GES
Tel: 021-5354326 KARACHI-PAKISTAN

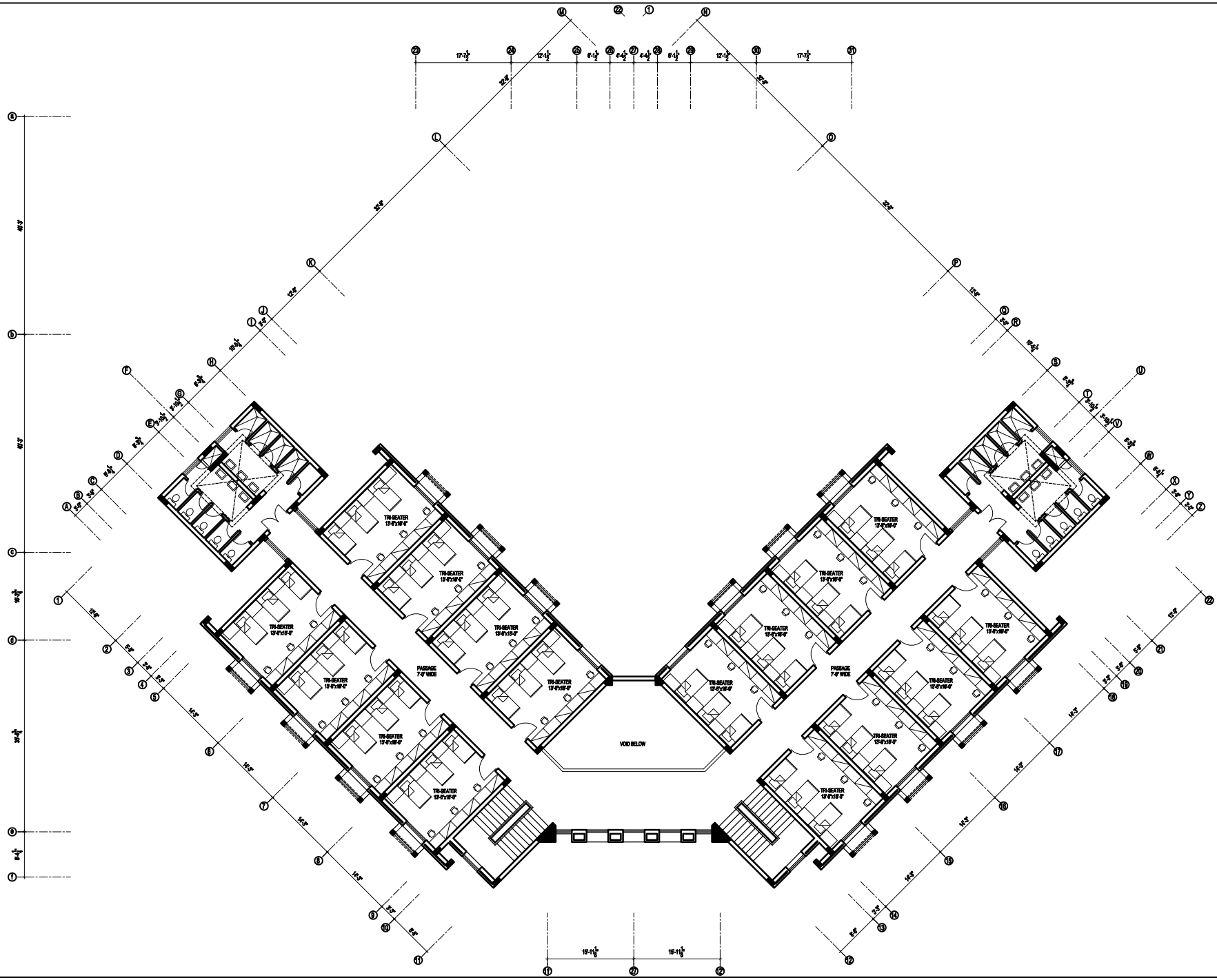
ELECTRICAL ENGINEERS:
ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
Karachi - Pakistan
Ph: (92-21) 4540260-61

PLUMBING ENGINEERS:
DESIGN DEVELOPERS — DD
TEL NO: 021-4120405,FAX:021-4120264

DRAWING TITLE:

SECOND FLOOR PLAN
FURNITURE LAYOUT

PROJECT ARCHITECT	DATE:	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY:	A-22
	CHECKED BY:	

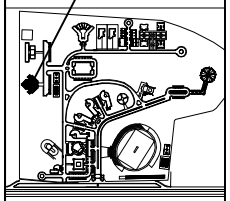


GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	R.NO.	DATE

KEY PLAN:



PROJECT CLIENT:

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS:

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO.10 THIRD FLOOR
KARIAK E-2
ISLAMABAD TEL 2870760-2870880

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIER

STRUCTURE: GLOBAL ENG. SERVICES GES
Tel 021-5804808 KARACHI-PAKISTAN

ELECTRICAL ENGINEERS: ASSOCIATED TECHNICAL CONSULTANTS ATCONS
888 , ANSER HOUSE , SHAHRAH-E-FAISAL
Karachi - Pakistan
Ph (92-21) 454900-01

PLUMBING ENGINEERS: DESIGN DEVELOPERS
418-H.M.H.SQUARE,COMMLS/1,BLOCK-15
GULSHAN-E-IQBAL,KARACHI
TEL NO: 021-4559455,FAX 021-4559554

DRAWING TITLE:

THIRD FLOOR PLAN
FURNITURE LAYOUT

PROJECT ARCHITECT:

DATE:

SCALE: 1'-0"=1/8"

DRAWN BY:

CHECKED BY:

DRAWING NO: SCAD/B.H
A-23

GROUND FLOOR - SCHEDULE OF FINISHES

AREA	FLOOR	SKIRTING	DADO	INTERNAL SURFACES		FALSE CEILING	EXTERNAL FINISHES	
				WALLS	CEILING		AREA	FINISHES
ENTRANCE PODIUM	12"x12" MARBLE TILES WITH BORDER	12"x4" MARBLE TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	——	EXTERNAL WALL	WEATHER SHIELD PAINT OVER PLASTER
PASSAGE	16"x16" PORCELAIN TILES WITH BORDER	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	——	——
TRI-SEATER	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
DINING HALL	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	GYPSUM BOARD PLAIN FALSE CEILING	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
ATTENDANT ROOM	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
LAUNDRY	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
KITCHEN	12"x12" NON SKID GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
SERVICE AREA	12"x12" PORCELAIN TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	——	——
CROCKERY STORE	12"x12" NON SKID GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	MATT ENAMEL PAINT OVER PLASTER	MATT ENAMEL PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
DISH WASHING	12"x12" NON SKID GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	MATT ENAMEL PAINT OVER PLASTER	MATT ENAMEL PAINT OVER PLASTER	——	——	——
STAFF ROOM	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
STORE	16"x16"PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	MATT ENAMEL PAINT OVER PLASTER	MATT ENAMEL PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
TOILET	12"x12" GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
STAIRS	3/4"TH. X FULL LENGTH BOTICENA CREAM MARBLE	12"x4" MARBLE SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER

FIRST FLOOR - SCHEDULE OF FINISHES

AREA	FLOOR	SKIRTING	DADO	INTERNAL SURFACES		FALSE CEILING	EXTERNAL FINISHES	
				WALLS	CEILING		AREA	FINISHES
PASSAGE	16"x16" MARBLE TILES WITH BORDER	16"x4" MARBLE TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	——	——
TRI-SEATER	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
TV.LOUNGE	16"x16" PORCELAIN TILES WITH BORDER	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	GYPSUM BOARD PLAIN FALSE CEILING	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
PRAYER HALL	16"x16" PORCELAIN TILES WITH BORDER	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	GYPSUM BOARD PLAIN FALSE CEILING	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
INDOOR GAMES	16"x16" PORCELAIN TILES WITH BORDER	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	GYPSUM BOARD PLAIN FALSE CEILING	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
TOILET	12"x12" GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
STAIRS	3/4"TH. X FULL LENGTH BOTICENA CREAM MARBLE	12"x4" MARBLE SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER

SECOND FLOOR - SCHEDULE OF FINISHES

AREA	FLOOR	SKIRTING	DADO	INTERNAL SURFACES		FALSE CEILING	EXTERNAL FINISHES	
				WALLS	CEILING		AREA	FINISHES
PASSAGE	16"x16" MARBLE TILES WITH BORDER	16"x4" MARBLE TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	——	——
TRI-SEATER	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
TOILET	12"x12" GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
STAIRS	3/4"TH. X FULL LENGTH BOTICENA CREAM MARBLE	12"x4" MARBLE SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER

THIRD FLOOR - SCHEDULE OF FINISHES

AREA	FLOOR	SKIRTING	DADO	INTERNAL SURFACES		FALSE CEILING	EXTERNAL FINISHES	
				WALLS	CEILING		AREA	FINISHES
PASSAGE	16"x16" MARBLE TILES WITH BORDER	16"x4" MARBLE TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	——	——
TRI-SEATER	16"x16" PORCELAIN TILES	16"x4" PORCELAIN TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
TOILET	12"x12" GLAZED TILES	——	12"x18" GLAZED CERAMIC TILES UPTO 4'-6" HEIGHT	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER
STAIRS	3/4"TH. X FULL LENGTH BOTICENA CREAM MARBLE	12"x4" MARBLE SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	——	——	EXTERNAL WALLS	WEATHER SHIELD PAINT OVER PLASTER

TOP FLOOR - SCHEDULE OF FINISHES

AREA	FLOOR	SKIRTING	DADO	INTERNAL SURFACES		FALSE CEILING	EXTERNAL FINISHES	
				WALLS	CEILING		AREA	FINISHES
PASSAGE	16"x16" MARBLE TILES WITH BORDER	16"x4" MARBLE TILES SKIRTING	——	PLASTIC EMULSION PAINT OVER PLASTER	PLASTIC EMULSION PAINT OVER PLASTER	——	PARAPET	WEATHER SHIELD PAINT OVER PLASTER

SCHEDULE OF FINISHES

SCALE: 1:1-1/4"

DRAWING NO: A-24

DRAWN BY: SCAD/B.H

ASSOCIATED TECHNICAL CONSULTANTS

DESIGN DEVELOPERS

ARCHITECTS

GLOBAL ENG. SERVICES

GES

NAQVI AND SIDDIQUE

Q.A.NAQVI

M.A.SIDDIQUE

BOYS HOSTEL

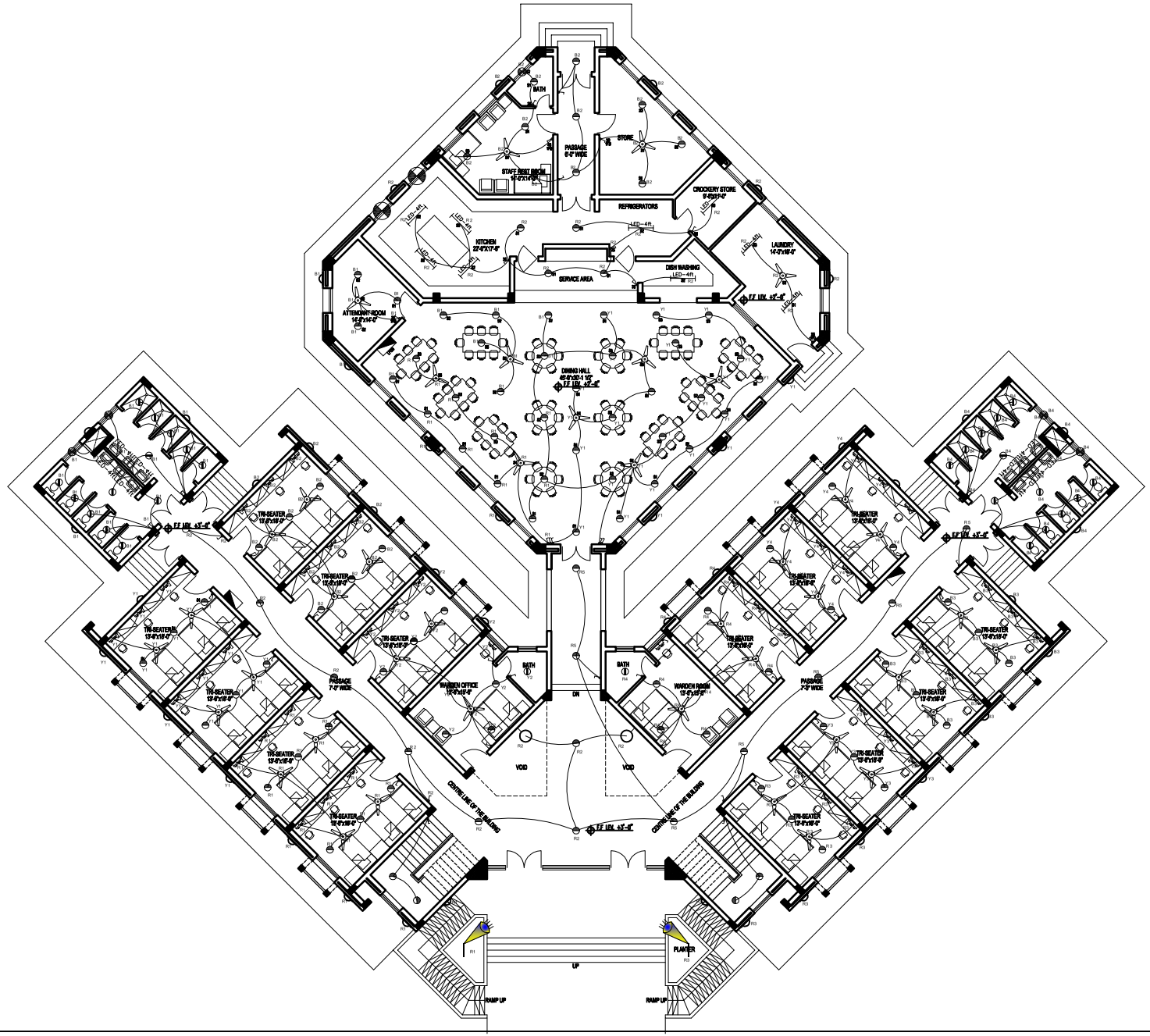
SHABBIR MAMONAI

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROPOSED BUILDING

KEY PLAN

WORKING DRAWING



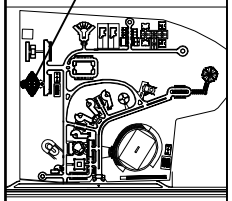
GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN

PROPOSED BUILDING



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARCHITECT & ENGINEER
BLOCK NO. 09 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 051-5170760-5170565

RESIDENT ENGINEER	RESIDENT ARCHITECT
Q.A.NAQVI	M.A.MOKTADIER

STRUCTURAL ENGINEER
GLOBAL ENG. SERVICES — GES
Tel: 021-35344324 KARACHI-PAKISTAN

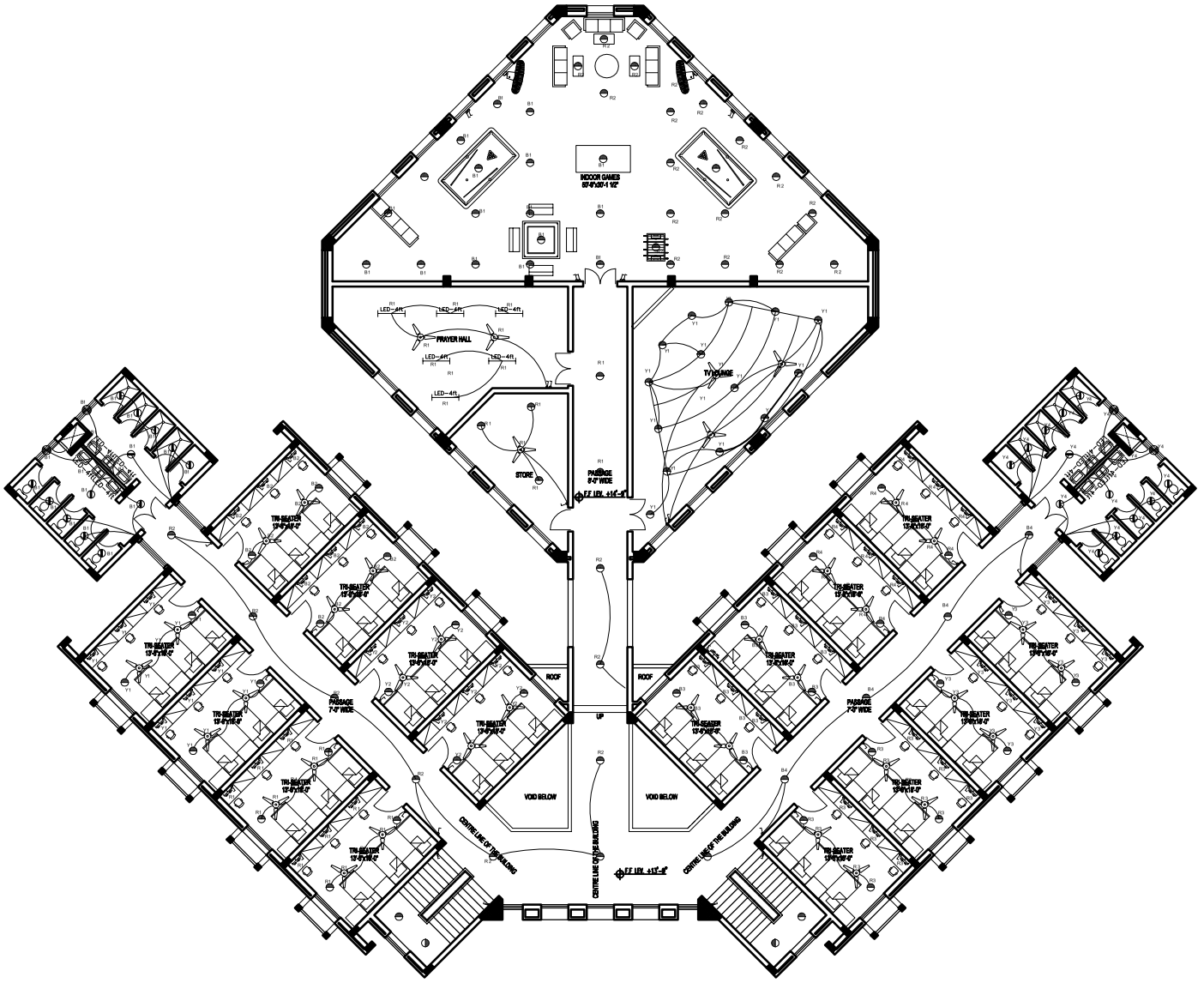
ELECTRICAL ENGINEER
ASSOCIATED TECHNICAL CONSULTANTS — ATCONS
Karachi - Pakistan
Ph: (92-21) 4540260-61

PLUMBING ENGINEER
DESIGN DEVELOPERS
TEL NO: 021-4120405,FAX:021-4120284

DRAWING TITLE:

GROUND FLOOR
LIGHTING LAYOUT

PROJECT ARCHITECT	DATE: 01-09-2018	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY: ENGR.ASRAR BALAI	E-01
	CHECKED BY: PARVEZ BIJRAI	

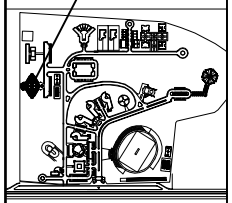


GENERAL NOTES & COMMENTS:

WORKING DRAWING

REVISION	S.NO.	DATE

KEY PLAN



PROJECT CLIENT:

SINDH COLLEGE OF ART AND DESIGN SUKKUR

PROJECT DIRECTOR:

SHABBIR MAMONAI

PROJECT TITLE:

BOYS HOSTEL

CONSULTANTS

NAQVI AND SIDDIQUIE
ARC. ARCHITECT & ENGINEER
BLOCK NO. 09 FIRST FLOOR
MARGLA T-4
ISLAMABAD TEL. 0709700-0870068

RESIDENT ENGINEER: Q.A.ALAVI

RESIDENT ARCHITECT: M.A.MOKTADIER

STRUCTURAL ENGINEER: GLOBAL ENG. SERVICES Tel: 021-5354326 KARACHI — GES

ELECTRICAL ENGINEER: ASSOCIATED TECHNICAL CONSULTANTS 509 , AMBER ESTATE , SHAHRAH-E-FAISAL Karachi , Pakistan Ph: (92-21) 4540509-10 — ATCONS

PLUMBING ENGINEER: DESIGN DEVELOPERS 402-B.M.M.SQUARE,COMM.2/1,BLOCK-13 GULSHAN-E-IQBAL,KARACHI TEL NO: 021-4130405,FAX:021-4130384 — DD

DRAWING TITLE:

FIRST FLOOR
LIGHTING LAYOUT

PROJECT ARCHITECT	DATE: 01-09-2018	DRAWING NO:
	SCALE: 1'-0"=1/8"	SCAD/B.H
	DRAWN BY: ENGR.ASHAR ISLAM	E-02
	CHECKED BY: PARVEZ IQBAL	