OFFICE OF THE
MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLAGE HOSPITAL
LARKANO

NO. CMCHL/ACCTS:/ 700/04- **Dated:-** 14-01- **2026**

To,

The Director Advertising
Information Department,
Government of Sindh,
Karachi

SUBJECT: **PUBLICATION OF NOTICE INVITING TENDER FOR HIRING OF CONTRACTOR FOR RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, (PHASE-I)**

I am directed to refer to the subject noted above and to enclose herewith 07 copies of Notice Inviting Tender for Hiring of Contractors Firm for **RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHING BLOCK) LARKANO. (PHASE-I),** Health Department, Government of Sindh, Karachi is to be published in daily leading newspapers i.e. English, Urdu & Sindhi.

MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE HOSPITAL
LARKANO

C.C. to

1. The Secretary Information Department, Government of Sindh, Karachi
2. The Manager (Assessment), Sindh Public Procurement Regulatory Authority, Sindh Karachi
3. The Additional Secretary (Development), Health Department, Government of Sindh, Karachi
4. The P.S. to Secretary, Health Department, Govt. of Sindh, Karachi
4. Office File.

MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE HOSPITAL
LARKANO

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OFFICE OF THE MEDICAL SUPERITENDENTCHANDKA MEDICAL COLLEGE LARKANA

(TENDER # CMC/Works/M&R/ /2026-2027/001)

NOTICE INVITING TENDER

Medical Superintendent Chandka Medical College Hospital, Larkana invites E-Bids through E-Pak Acquisition and Disposal System (EPADS) from PEC Registered Constructors/ Contractors in the Category of C-4 and above, and with Active Taxpayers List of the FBR/SRB (whichever is applicable) for the**RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, (PHASE-I)**for the Financial year 2025-26 & 2026-27 under M&R Budget.

Name of Work	Estimated Cost (PKR)	Tender Fee (Rs.)	Bid Security	Completion Time
RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO,**(PHASE-I)**	Rs 138.892 Mn	Rs. 3000/=	2% of the bid cost	18 Months

1. The Eligibility Criteria in details is mentioned in the bidding documents, refer **clause IB.2** for meeting the requirements of this tender.
2. A complete set of bidding documents may be purchased from date of publicationup to***February 05, 2026*****before 2:00 PM** upon payment of tender fee (non- *refundable)* against tender packagein the form of pay order in favor of **MS-CMC LARKANA** withwritten application along with a copy of letter of invitation.
3. The method of procurement would be***Single Stage One Envelope***
4. Tender Fees Receipt should be uploaded with the Technical Proposal on EPADS. Electronic Bids should be submitted through EPADS only. Manual bid shall not be received. Interested Bidders are required to register themselves on EPAD System at the link: https://sindh.eprocure.gov.pk/#/supplier/registration for submission of electronic-bids.
5. The bids would be rejected and considered non-responsive under following conditions;
   - (i) Conditional and telegraphic bids/tenders;
   - (ii) Bids not accompanied by bid security of required amount and form (Soft should be uploaded on EPADS while Hardcopy to be submitted in person with Bids Hardcopy);
   - (iii) Bids received / uploaded onEPADS after specified date and time.
   - (iv) Non-Submission of Original set of Documents in Hard Copy to the Designated office.
   - (v) Non-compliance with the requisite PEC specialized codes for Operation Theater renovation works.
6. Bid validity Period is (90) days
7. (i) **Submission:** The bids prepared in accordance with the instructions in the bidding documents, must be submitted on EPADS by***February 05, 2026.up to 2:00 PM on EPADS***and the original instrument of tender fee Rs. 3,000/- and the bid security @ 2% of the bid price must reach the following procurement agency before the deadline for submission of e-bids, which will be opened on the same day i.e
   - (ii) **Opening:** Tenders will be opened on ***February 05, 2026@ 3:00 PM***at the below mentioned address in the presence of Procurement Committee and representative of bidders.
   - (iii) **Place** of issuance, inquiries and opening will be below mention postal Address.
   - (iv) In case of Govt. announces any Public Holiday or any unfavorable circumstances, the tender /bids original set of documents will be opened on next working day, with same Venue and Time.
8. CMC reserves the right to reject all or any bids subject to the relevant provisions of Sindh Public Procurement Rules, 2010, amended 2023.

MEDICAL SUPERINTENDENT

CHANDKA MEDICAL COLLEGE LARKANA
Shah Nawaz Bhutto Rd, Larkana, 77280, Phone: +92-74-9410715
PABX:+92-74-9410750.

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OFFICE OF THE
MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE HOSPITAL / SHAIKH ZAID HOSPITAL FOR WOMEN
LARKANO-SINDH

Phone– 074-9410718 , Fax:- 074-9410708
Website: www.cmch.gos.pk E-mail: mscmchlarkana@gmail.comTwitter: @LarkanoCmch

No CMCHL// Dated: 02-02- 2026

To,

The Director Advertising
Information Department,
Government of Sindh

SUBJECT: **PUBLICATION OF CORRIGENDUM FOR HIRING OF CONTRACTOR FOR RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, (PHASE-I)**

I am directed to refer to the subject noted above and to enclose herewith 07 copies of Corrigendum NO.1 for Hiring of Contractors Firm for **RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, (PHASE-I)**,Health Department, Government of Sindh, is to be published in daily leading newspapers i.e. English, Urdu & Sindhi.

MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE HOSPITAL
LARKANO

C.C. to

1. The Secretary Information Department, Government of Sindh, Karachi
2. The Manager (Assessment), Sindh Public Procurement Regulatory Authority, Sindh Karachi
3. The Additional Secretary (Development), Health Department, Government of Sindh, Karachi
4. The P.S. to Secretary, Health Department, Govt. of Sindh, Karachi
4. Office File.

MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE HOSPITAL
LARKANO

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OFFICE OF THE MEDICAL SUPERITENDENTCHANDKA MEDICAL COLLEGE LARKANA

(TENDER # CMC/Works/M&R/ /2026-2027/001)

CORRIGENDUM

Reference is made to the Notice Inviting Tender (NIT) published on 14 January 2026 refer advertisement reference INF-KRY/0178/2026 for the work titled "Renovation / Repair / Augmentation / Strengthening of Operation Theater Blocks along with Allied Facilities at Chandka Medical College Hospital (Teacher Block), Larkana (Phase-I)".

It is hereby notified for the information of all prospective bidders that the submission deadline for electronic bids through EPADS has been extended as under:

Previous Submission Deadline 05 February 2026 at 02:00 PM
Revised Submission Deadline 23 February 2026 at 02:00 PM

The bid opening shall accordingly take place on **23 February 2026 at 03:00 PM** at the same venue as mentioned in the original NIT.

All other terms, conditions, eligibility criteria, and provisions of the original Notice Inviting Tender shall remain unchanged.

Prospective bidders are advised to take note of the above extension and submit their bids accordingly.

MEDICAL SUPERINTENDENT

CHANDKA MEDICAL COLLEGE LARKANA
Shah Nawaz Bhutto Rd, Larkana, 77280, Phone: +92-74-9410715
PABX:+92-74-9410750.

Medical Superintendent
CMC Hospital / SZW Hospital
LARKANO

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GOVERNMENT OF SINDH
HEALTH DEPARTMENT
(PROCUREMENT MONITORING & INSPECTION CELL)

NOTIFICATION

No. SO(PM&I)/2025-26/E.36/(CMCHL): A Procurement Committee under Rule-7 of Sindh Public Procurement Rules 2010 (Amended up-to-date) is hereby constituted for maintenance and repair requirements of the infrastructure and allied services for Chandka Medical College Hospital, Larkano for the financial year 2025-26 & 2026-27.

01	Medical Superintendent, CMCH, Larkano	Chairman
02	Director Finance, Sindh Govt. CMC Hospital Larkana	Member/Secretary
03	Executive Engineer, Provincial Building Division, Health Works (Upper Sindh) Larkano.	Member

TORs:

- The TORs/ Functions / Responsibilities of the Procurement Committee in accordance with Rule-8 of SPP Rules 2010 shall be as under:

1) Preparing and /or Reviewing bidding documents.
2) Carrying out technical as well as financial evaluation of the bids;
3) Preparing evaluation report as provided in Rule-45;
4) Making recommendations for the award of contract to the competent authority; and
5) Perform any other function ancillary and incidental to the above.

SECRETARY HEALTH
GOVERNMENT OF SINDH

No. SO(PM&I)/2025-26/E.36/(CMCHL): Karachi dated, the 29th October 2025

Copy forwarded for information and necessary action to:-

1. The Managing Director, Sindh Public Procurement Regulatory Authority, Karachi.
2. The District Accounts Officer, Larkano.
3. The Chairman & all members of the Committee
4. PS to Minister, Health & Population Welfare Department, Govt. of Sindh, Karachi.
5. PS to Secretary Health, Govt. of Sindh, Karachi.

29/X/2025

(ZULFIQAR ALI DARS)
DEPUTY SECRETARY (PM&I)

Not - 2910202500002

GOVERNMENT OF SINDH
HEALTH DEPARTMENT
(PROCUREMENT MONITORING & INSPECTION CELL)

NOTIFICATION

No. SO(PM&I)/2025-26/E.36/(CMCHL): A Complaint Redressal Committee under Rule-31 of Sindh Public Procurement Rules 2010 (Amended up-to-date) comprising the following officers for scrutinizing the complaints of aggrieved bidders against Tender for maintenance and repair requirements of the infrastructure and allied services invited by the Chandka Medical College Hospital, Larkano for the financial year 2025-26 & 2026-27.

01	Secretary Health, Govt. of Sindh	Chairman
02	Technical Person (Nominated by Department)	Member/Secretary
03	Member from Accountant General Sindh, Karachi.	Member

TORs:

- To scrutinize the complaints received from the aggrieved bidders and decide the same in accordance with SPP Rules-2010.

SECRETARY HEALTH
GOVERNMENT OF SINDH

No. SO(PM&I)/2025-26/E.36/(CMCHL): Karachi dated, the 29th October 2025

Copy forwarded for information and necessary action to:-

1. The Managing Director, Sindh Public Procurement Regulatory Authority, Karachi.
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3. The Chairman & all members of the Committee
4. PS to Minister, Health & Population Welfare Department, Govt. of Sindh, Karachi.
5. PS to Secretary Health, Govt. of Sindh, Karachi.

Not - 2910202500003

(ZULFIQAR ALI DARS)
DEPUTY SECRETARY (PM&I)

CHANDKA MEDICAL COLLEGE

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL LARKANO PHASE-I

VOLUME-I

CONDITIONS OF CONTRACT

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OFFICE OF THE MEDICAL SUPERITENDENT CHANDKA MEDICAL COLLEGE LARKANA

(TENDER # CMC/Works/M&R/ /2026-2027/001)

NOTICE INVITING TENDER

Medical Superintendent Chandka Medical College Hospital, Larkana invites E-Bids through E-Pak Acquisition and Disposal System (EPADS) from PEC Registered Constructors/ Contractors in the Category of C-4 and above, and with Active Taxpayers List of the FBR/SRB (whichever is applicable) for the **RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, (PHASE-I)** for the Financial year 2025-26 & 2026-27 under M&R Budget.

Name of Work	Estimated Cost (PKR)	Tender Fee (Rs.)	Bid Security	Completion Time
RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, **(PHASE-I)**	Rs 138.892 Mn	Rs. 3000/=	2% of the bid cost	18 Months

1. The Eligibility Criteria in details is mentioned in the bidding documents, refer **clause IB.2** for meeting the requirements of this tender.
2. A complete set of bidding documents may be purchased from date of publication up to ***February 05, 2026*** **before 2:00 PM** upon payment of tender fee (non- *refundable)* against tender package in the form of pay order in favor of **MS-CMC LARKANA** with written application along with a copy of letter of invitation.
3. The method of procurement would be ***Single Stage One Envelope***
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   (iv) Non-Submission of Original set of Documents in Hard Copy to the Designated office.
   (v) Non-compliance with the requisite PEC specialized codes for Operation Theater renovation works.
6. Bid validity Period is (90) days
7. (i) **Submission:** The bids prepared in accordance with the instructions in the bidding documents, must be submitted on EPADS by ***February 05, 2026, up to 2:00 PM on EPADS*** and the original instrument of tender fee Rs. 3,000/- and the bid security @ 2% of the bid price must reach the following procurement agency before the deadline for submission of e-bids, which will be opened on the same day i.e
   (ii) **Opening:** Tenders will be opened on ***February 05, 2026 @ 3:00 PM*** at the below mentioned address in the presence of Procurement Committee and representative of bidders.
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   (iv) In case of Govt, announces any Public Holiday or any unfavorable circumstances, the tender /bids original set of documents will be opened on next working day, with same Venue and Time.
8. CMC reserves the right to reject all or any bids subject to the relevant provisions of Sindh Public Procurement Rules, 2010, amended 2023.

MEDICAL SUPERINTENDENT

CHANDKA MEDICAL COLLEGE LARKANA

Shah Nawaz Bhutto Rd, Larkana, 77280, Phone: +92-74-9410715

PABX:+92-74-9410750.

INSTRUCTIONS
TO
BIDDERS

A. GENERAL

IB.1 Scope of Bid

1.1 The Employer as defined below hereinafter called "the Employer" wishes to receive bids for the construction and completion works as described below and summarized referred to as the "Works".

Name and Address of the Employer:
The Employer is "Chandka Medical College, Larkana - 77170"
Phone: (9274) 9410715, PABX. (9274) 9410750
Name of the Project & Summary of the Works:

"RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL LARKANO PHASE-I"

The work involves Renovation/Repair/Augmentation/Strengthening of Operation Theater Blocks Along with Allied Facilities at Chandka Medical College Hospital Larkano Phase-I includes the following;

Tender No.	Description
Tender # CMC/Works/M&R/ /2026-2027/001	**"Renovation/Repair/Augmentation/Strengthening of Operation Theater Blocks Along with Allied Facilities at Chandka Medical College Hospital Larkano Phase-I"**

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

IB.2 Source of Fund

2.1 The Employer has arranged funds from Chandka Medical College – Maintenance & Repair (M&R) Budget for eligible payments under the Contract for which these Bidding Documents are issued.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all firms and persons meeting the following requirements:

The bidders must submit the following documents/information to Chandka Medical College along with his bid in separate and sealed envelope.

Bids will not be entertained and declared non-responsive if bidder does not submit the following details:

i. Company profile

ii. Minimum three works of similar nature and size each performed in last 5 years. (Cost not less than Rs. 100 Million).

iii. Qualification and experience of technical personnel shall meet the evaluation criteria given in the bidding documents.

iv. The participating firm(s) must have at least in hand (01) similar nature of building repair

& renovation work worth Rs.40M or above in any Government Hospital. (Work order to be attached for verification).

v. The participating firm(s) must have average annual turnover of Rs.300M or above during last 03-years and must be reflected in FBR/Audit report

vi. Attach details of litigation/black listing of the company. Attach all certificates of litigation/backlisting or in case there is no such case, attach affidavit that the company is not involved in litigation or has been blacklisted by any government, semi-government or private entity on a Non-Judicial stamp paper of Rs. 500/- only (Not doing so will result in rejection of tender).

vii. Active Registration with Income Tax & Sindh Revenue Board (SRB). Must attach last 03-year FBR tax return & last 03-month SRB return

viii. Valid Registration with Pakistan Engineering Council PEC in category C4 or above with Specialization Code CE-09, CE-10, BC02, ME-01, ME-02, ME-06, EE-10, EE-09 & EE-11. (Valid till 2026)

ix. **Must fulfill the evaluation criteria as given in this bidding document.**

IB.4 One Bid per Bidder

4.1 Each bidder shall submit only one bid either by himself, or through its authorized representative. A bidder who submits or 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
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
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 (07) seven 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 Sub-Clause 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 (English) 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 Accompanying the Bid

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 continue to meet the minimum criteria set out in the Evaluation Criteria which as a minimum, would include the following:

(i) Evidence of access to financial resources along with average annual construction turnover;
(ii) Financial predictions for the current year and the two following years including the effect of known commitments;
(iii) Work commitments since prequalification;
(iv) Current litigation information; and
(v) Availability of critical equipment.

(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 programme etc.

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

(a) the bid and in case of a successful bid, the Form of Contract Agreement shall be signed so as to be legally binding on all partners;
(b) one of the joint venture partners shall be nominated as being in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the joint venture partners;
(c) the partner-in-charge shall always be duly authorized to deal with the Employer regarding all matters related with and/or incidental to the execution of Works as per the terms and Conditions of Contract and in this regard to incur any and all liabilities, receive instructions, give binding undertakings and receive payments on behalf of the joint venture;
(d) all partners of the joint venture shall at all times and under all circumstances be liable jointly and severally for the execution of the Contract in accordance with the Contract terms and a statement to this effect shall be included in the authorization mentioned under Sub-Para(b) above as well as in the Form of Bid and in the Form of Contract Agreement (in case of a successful bid); and
(e) a copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the Contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partner without prior written consent of the Employer.

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

IB.12 Bid Prices

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

12.2 The bidders shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by a

bidder will not be paid for by the Employer when executed and shall be deemed covered by rates and prices for other items in the Bill of Quantities. In case of Composite Schedule of Rates, if the bidder fails to mention the percentage above or below, it shall be deemed to be at par with the rates of Composite Schedule of Rates.

12.3 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.

12.4 The rates and prices quoted by the bidders are subject to adjustment during the performance of the Contract in accordance with the provisions of Clause 70 of the Conditions of Contract. The bidders shall furnish the prescribed information for the price adjustment formulae in Appendix-C to Bid, and shall submit with their bids such other supporting information as required under the said Clause.

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. The Employer shall make payment only in Pak Rupees and no foreign currency payments are admissible. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country shall bear all the costs and risks for arranging the requirements of such currencies through his own resources.

IB.14 Bid Validity

14.1 Bids shall remain valid for the **90 Days** 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 in Pak Rupees (2% of Bid Price in the form of Pay Order/ Bank Draft).

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

15.3 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.

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

15.5 The Bid Security may be forfeited:

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

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

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

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

IB.16 Alternate Proposals by Bidder

16.1 Alternate Proposals by bidder are not invited. Bidder will only quote for the drawings and Design as provided in the Bidding Documents

IB.17 ERRORS, OMISSIONS & QUERIES:

17.2 (a) The bidder shall notify "the Employer" of any inconsistencies, errors and omissions found in the Bid Documents, prior to the Bid Opening Date. Withholding of any such information which will later materially affect the contract price during construction may be considered as sufficient grounds for rejection of the Bid. All queries shall be addressed to the Medical Superintendent (MS), Chandka Medical College, regarding the Renovation, Repair, Augmentation, and Strengthening of Operation Theater Blocks along with Allied Facilities at Chandka Medical College Hospital, Larkana (Phase-I).

17.2 (b) The Chandka Medical College is not responsible for any verbal communications or instructions to the bidders or Acceptable of the Bid Documents.

IB.18 Format and Signing of Bid

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

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

18.3 No alteration is to be made in the Form of Bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.

18.4 Each bidder shall prepare by filling out the forms completely and without alterations one (1) original and two copies, specified in the Bidding Data, of the documents comprising the bid as described in Clause IB.7 and clearly mark them "ORIGINAL" and 'COPY" as appropriate. In the event of discrepancy between them, the original shall prevail.

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

18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Employer, or as are necessary to correct errors made by the bidder, in which case such corrections shall be initialed by the person or persons signing the bid.

18.7 Bidders shall indicate in the space provided in the Form of Bid their full and proper addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the Contract is to be sent. Bids shall be prepared and submitted on the form of "the Bid "provided. All blank spaces must be filled in and completed form must be without interlineations or literation of the original wording. Bids with incomplete and /or unsigned Form of Bid may be rejected/ considered Non-Responsive. The bidder shall stamp and sign each page of Bid Documents for the purpose of identification and acknowledgement of acceptance thereof.
The bids must conform in all respects to the Bid Documents.

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

D. SUBMISSION OF BIDS

IB.19 Sealing and Marking of Bids

19.1 Each bidder shall submit his bid as under:

(a) ORIGINAL and each copy of the Bid shall be separately sealed and put in separate envelopes and marked as such.

(b) The envelopes containing the ORIGINAL and copies will be put in one sealed envelope and addressed / identified as given in Sub- Clause 19.2 hereof.

19.2 The inner and outer envelopes shall:

(a) be addressed to the

Medical Superintendent
Chandka Medical College, Larkana
Tel. +9274-9410715, PABX: +9274-9410750

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

19.3 Provide a warning not to open before the time and date for bid opening, as specified in the Bidding Data.

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

19.5 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the Bid.

IB.20 Deadline for Submission of Bids

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

(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

21.1 (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 Sub-Clauses 22.1 and 27.2.

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

E. BID OPENING AND EVALUATION

F. 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 bidders' 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 The Consultant on behalf of 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 (10) 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.

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.

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; and (iv) 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 bidder's obligations under the Contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

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

IB.27 Correction of Errors

27.1 Bids determined to be substantially responsive will be checked by the 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 Form of 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 Sub- Clause 15.6(b) hereof.

IB.28 Evaluation and Comparison of Bids

28.1 The Consultant on behalf of Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause

IB.26.

28.2 In evaluating the Bids, the 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.

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

28.4 If the Bid of the successful bidder is seriously unbalanced in relation to the 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.

28.5 A bid with highly inflated or unworkable rates of any BOQ items may be considered non-conforming and rejected. The Employer may also disqualify such bidder from participating in the subsequent bids who submits such unbalanced and/or unworkable rates of major items of work.

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

G. 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 Sub-Clause IB 29.2.

29.2 The Employer, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any defect in supplier's or contractor's capacities, may require the suppliers or contractors to provide information concerning their professional, technical, financial, legal or managerial competence

whether already pre-qualified or not:

Provided that such qualification shall only be laid down after recording reasons therefor 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, however, Employer may have clarification meetings to get clarify any item in the bid evaluation report.

31.3 The notification of award and its acceptance by the bidder will constitute the formation of the Contract, binding the 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 performance security shall be equal to an amount of 10% of the contract Price stated in the Letter of Acceptance. Such Security shall be in the Form of unconditional, irrevocable Bank Guarantee from any scheduled Bank of Pakistan acceptable t o the Employer in favor of MS Chandka Medical College. The performance security will be valid for a period (up to the completion of the Project) after the date of issue of Defect Liability Certificate.

32.2 F a i l u r e of the successful bidder to comply with the requirements of Sub-Clause IB.32.1 or Clauses IB.33 or IB.35 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

IB.33 Signing of Contract Agreement

33.1 Within 14 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.

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, interiliac, reject his bid and/or refer the case to the Pakistan Engineering Council (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

NOTES ON BIDDING DATA

This Section is intended to assist the Employer in providing the specific information in relation to corresponding clauses in Instructions to Bidders and should be prepared to suit each individual contract.

The Employer should provide in the Bidding Data information and requirements specific to the circumstances of the Employer, the processing of the Bid, the applicable rules regarding Bid Price and currency, and the Bid evaluation criteria that will apply to the Bids. In preparing this section, the following aspects should be checked:

(a) Information that specifies and complements the provisions of section; Instruction to Bidders must be incorporated.

(b) Amendments and/or supplements, if any, to the provisions of Instructions to Bidders, necessitated by the circumstances of each individual contract, can be introduced only in this section since Instructions to Bidders will remain unchanged.

Bidding Data

1.1 Name and address of the Employer:

The Employer is Chandka Medical College - 77280
Phone: (9274) 9410715, PABX: +9274-9410750

Name of the Project & Summary of the Works:

Renovation/Repair/Augmentation/Strengthening of Operation Theater Blocks Along with Allied Facilities at Chandka Medical College Hospital Larkano Phase-I at Chandka Medical College:

Tender No.	Description
Tender # CMC/Works/M&R/ /2026-2027/001	**"Renovation/Repair/Augmentation/Strengthening of Operation Theater Blocks Along with Allied Facilities at Chandka Medical College Hospital Larkano Phase-I"**

IB.2 Source of Funds:

The Employer has arranged funds from Chandka Medical College – Maintenance & Repair (M&R) Budget and it is intended that part of the proceeds of this will be applied to eligible payments under the Contract for which these Bidding Documents are issued.

IB.3 Eligible Bidders

As notified in NIT

IB.8.1 Time limit for clarification:

The Employer will respond to any request for clarification which he receives earlier than (07) Seven Days prior to the deadline for submission of bids

IB.10 Bid language:

The bid and all correspondence and documents related to the bid exchanged by a bidder and the Employer shall be in the English Language.

IB.11.1(c) Furnish Technical Proposal:

The bidder to submit a technical proposal and sufficient detail to demonstrate the adequacy of the bid in meeting requirements for timely completion of the Works and taking into account the various appendices to Bid specified into instructions to Bidder.

IB.13.1 Currencies of Bid and Payment

The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. The Employer shall make payment only in Pak Rupees and no foreign currency payments are admissible. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Employer's country shall bear all the costs and risks for arranging the requirements of such currencies through his own resources.

IB.14.1 Period of Bid Validity:

Bids shall remain valid for the 90 Days after the date of bid opening.

IB.15.1 Amount of Bid Security:

Minimum 2% of Bid Price in the form of Pay Order/ Bank Draft

IB.18.4 Number of copies of the Bid to be completed and submitted:

One (1) original and One copy.

IB.19 Sealing and Marking of Bids

19.2(a) Employer's address for the purpose of Bid Submission
Medical Superintendent,
Chandka Medical College.
Tel. +9274-9410715, PABX: +9274-9410750
19.2 (a) (b) Name and number of the Contract

Tender No.	Description
Tender # CMC/Works/M&R/ /2026-2027/001	**"Renovation/Repair/Augmentation/Strengthening of Operation Theater Blocks Along with Allied Facilities at Chandka Medical College Hospital Larkano PHASE I"**

IB. 20.1(a) Deadline for submission of bids:

As notified in "NIT"

IB. 23.1 Venue, Time and Date of Bid opening:

As notified in "NIT"

I.B.32.1 Standard form and amount of Performance Security acceptable to the Employer:

The performance security shall be equal to an amount of 10% of the contract Price stated in the Letter of Acceptance. Such Security shall be in the Form of unconditional, irrevocable Bank Guarantee from any scheduled Bank of Pakistan acceptable to the Employer in favor of M S - Chandka Medical College. The performance security will be valid for a period (up to the completion of the Project) after the date of issue of Defect Liability Certificate.

EVALUATION / QUALIFICATION CRITERIA

Evaluation criteria are being given for the benefit of the procuring agency and bidder. Evaluation based on **Single Stage – Two Envelope** procedure is adopted as per SPPRA Rules 2010 (amended 2021). Evaluation criteria as set forth in this proposal are based on mandatory requirements and marks / score and both are adopted as the selection method while evaluating the constructors / firms. Information will be given in forms and marks will be given as per the information given in the submitted technical bid by the bidder.

MANDATORY PROVISIONS/ ELIGIBILITY:

a) Undertaking on Stamp Paper of Rs.500/- containing that: -

- Affidavit to the effect that firm has not been black listed previously by any executing agency (Government/Semi-Government/Public or Private Sector).
- The firm must not involve in any sort of litigation/court case in any Govt Department
- Affidavits to the effect that all documents / particulars / information furnished are true and correct.

b) Minimum Three works of similar Nature and size of each performed in last 5 years. (Cost not less than Rs. 100 million)

c) The participating firm(s) must have average annual turnover of Rs.300M or above during last 03-years and must be reflected in FBR/Audit report.

d) Active Registration with Income Tax & Sindh Revenue Board (SRB). Must attach last 03-year FBR tax return & last 03-month SRB return

e) Valid Registration with Pakistan Engineering Council PEC in category C4 or above with Specialization Code CE-09, CE-10, BC02, ME-01, ME-02, ME-06, EE-10, EE-09 & EE-11. (Valid till 2026)

f) Valid Electrical License issued from Inspectorate of Electrical License Sindh of the similar region with respect to works shown above.

g) The participating firm(s) must have at least in hand (01) similar nature of building repair & renovation work worth Rs.40M or above in any Government Hospital. (Work order to be attached for verification)

h) The participating firm must attach tender purchased receipt along with the technical bid else bid shall be rejected.

i) The participating firm must be ISO Certified at least for last 03years.

j) Method of PROCUREMENT PROCESS: E-Procurement (Single Stage – Two Envelope) (Must Contain Separate Sealed Envelopes for "TECHNICAL PROPOSAL" & "FINANCIAL Proposal" otherwise such tenders will not be entertained).

k) FINANCIAL PROPOSALS will be opened for those firms only who qualify the mandatory & evaluation criteria requirements.
l) Conditional or incomplete tenders shall be rejected.
m) Each page of the Bid Document & Profile of firm must be paginated, signed & stamped by Bidder.
n) Any information regarding the project can be obtained from the office of the undersigned during office hours.
o) In case Government announce any public holiday on scheduled dates, the tender will be submitted/ opened on the next working day, as per usual scheduled in accordance with Rule 41 (3) of SPPRA Rule 2010 (Amended up to date).
p) Bid Security 2% of bid amount in shape of Call Deposit / Pay Order/ Demand Draft from any scheduled Bank of Pakistan in favor of the Employer

In case of failure in above requirements, the proposal of the participating firm(s) shall not be considered for further evaluation and shall be disqualified.

EVALUATION CRITERIA BASED ON MARKS / SCORE

Aggregate Qualifying Score is **70%** but it is mandatory to obtain at least **60%** in each of the following sections: -

A. COMPANY PROFILE - 10 Marks

i. Period since Firm/ Constructor is in Construction Business **5 Marks**

Between 6-10 years 2.5 Marks
Above 10 years 5.0 Marks
Attach your first/old PEC license for reference, as well as your most recent valid PEC license.

ii. Office Facilities **5 Marks**

If office in Karachi & Larkana 5.0 Marks
If outside Karachi 2.5 Marks

B. EXPERIENCE OF THE FIRM/ COMPANY - 40 Marks

Joint Venture participation/past experience, private or subcontract indirect form Procuring agency shall not consider in below criteria.

i. Similar Nature of Building Work of Rs.120 Million or above (each) completed in any Government Hospital all over in Pakistan during last 05-years.

10-Marks will be given for each Project. **20 Marks**

ii. Similar nature of Building repair & renovation Project of Rs.40 Million or above (each)

in hand in any above Government Hospital all over in Pakistan.

10-Marks will be given for each Project. **20 Marks**

C. PERSONNEL CAPABILITIES REQUIRED FOR THIS PEOJECT - 10 Marks

Employed Engineers must register with Pakistan Engineering Council (PEC) and also reflected in firms PEC license.

The key technical personnel required at site and factors for marking are as follows:

S.No	Description/Position with Minimum Qualification & Experience	Marks Assigned	REMARKS
1.	**Project Manager (01 No.)** B.E. (Civil) registered with Pakistan Engineering Council (PEC) having experience of 10 years or above.	4	01 Marks for minimum experience between 10-15 years. 02 Additional Marks for experience above 15 years. 01 Marks for completion of similar nature 02 projects.
2.	**Site Engineer (01 No.)** B.E. (Civil) registered with Pakistan Engineering Council (PEC) having experience of 5 years or above.	3	01 Marks for minimum experience between 05-7 years. 01 Additional Marks for experience above 07 years. 01 Marks for completion of similar nature 02 projects.
3.	**Site Supervisor - B. Tech (honors) in Civil (01 No)** **B. Tech (honors)** in Civil having minimum 10 years of relevant experience **or DAE in Civil** having minimum 15 years of relevant experience.	3	**In case of B. Tech** 01 Marks for minimum experience between 10 -15 years. 01 Additional Marks for experience above 15 years. 01 Marks for completion of similar nature 02 projects. **In case of D.A.E**. 01 Marks for minimum experience between 15 -20 years. 01 Additional Marks for experience above 10 years. 01 Marks for completion of similar nature 02 projects.

D. EQUIPMENT CAPABILITY - 10 Marks

i. Critical equipment and number required for the Project shall be specified by the Procuring Agency.

ii. High value equipment should be an option to own, lease or hire.

iii. Total equipment available with the applicant is to be listed along with its current mobilization and on- going projects.

Details are to be provided as per the below form with documentary proof of ownership / rental / Leased failure to do so can result in rejection of tender).

Sr. No.	Description	Qty.	Unit	Marks
1.	Vibrator (Large Shaft / Small Shaft)	1	No.	01
2.	Air Compressor (15 HP Cap.)	1	No.	0.5
3.	Generator 100KVA	1	No.	01
4.	Concrete Mixer Machine	1	Nos.	0.5
5.	Stucco Machine	1	Nos.	1
6.	Shuttering (Marine Plywood Formwork) 10000 Sft	1	No.	0.5
7.	Scaffolding Pipe 3000 Rft	1	No.	0.5
8.	Level Machine with Staff etc.	2	Nos.	01
9.	Water Pumps	2	Nos.	01
10.	Allied Construction Tools & Plants	4	Nos.	01
11.	Air Compressor (15 HP Cap.)	1	No.	01
12.	Steel Cutting Machine	1	No.	01
	TOTAL MARKS			**10**

E. FINANCIAL SOUNDNESS - 30 Marks

For Financial Status assessment, the Applicants have to submit Income tax returns for the last three years and SRB monthly return. Further, the bidder will provide evidence from bank as well as audited statement for verifying financial soundness of the bidder.

(a) Average Credit Limit 15 Marks

Bank Letter showing credit limit/worth of the firm

i.	upto 75 Million	10 Marks
ii.	upto 100 Million or above	15 Marks

(b) Turnover for last 03 Years 15 Marks

Average Turnover of last 3 financial years (Income Tax return &Audited Financial report)

i.	300 or above Million	10 Marks
ii.	400 or above Million	15 Marks

FORM OF BID
AND
APPENDICES TO BID

FORM OF BID

Bid Reference No. _
(Name of Contract/Works)

To:

_____
_____
_____

Gentleman,

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

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

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

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

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

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

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

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

Dated this _ day of_ _20_

Signature: _

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

_ (Name of Bidder in Block Capitals) (Seal)

Address: _

_____

_____

Witness:

Signature: _
Name: _

Address. _

_____

Occupation _____

SPECIAL STIPULATIONS
Clause
Conditions of Contract

1.	Engineer's Authority to issue Variation in emergency	2.1	15% of the Contract Price stated in the Letter of Acceptance & as per SPPRA Rule 16.
2.	Amount of Performance Security	10.1	10% of Contract Price stated in the Letter of Acceptance in the form of bank guarantee issued by a Scheduled Bank of Pakistan
3.	Time for Furnishing Programme	14.1	Within 7 days from the date of receipt of Letter of Acceptance.
4.	Minimum amount of Third Party Insurance	23.2	Rs. 500,000 per occurrence with number of occurrences unlimited.
5.	Time for Commencement	41.1	Within 14 days from the date of receipt of Engineer's Notice to Commence.
6.	Time for Completion	43.1, 48.2	18 months from the date of receipt of Engineer's Notice to Commence.
7.	Amount of Liquidated Damages	47.1	One tenth of one percent (0.10%) for each day of delay in completion of the Works subject to a maximum of 10% of Contract Price stated in the Letter of Acceptance.
8.	Defects Liability Period	49.1	180 days from the effective date of Taking Over Certificate.
9.	Percentage of Retention Money	60.2	10 % of the amount of Interim Payment Certificate.
10.	Limit of Retention Money	60.2	10 % of Contract Price stated in the Letter of Acceptance.
11.	Minimum amount of Interim Payment Certificates (Running Bills)	60.2	Rs. (05) Five Million
12	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Employer.	60.10	(28) Twenty-Eight days (No interest shall be paid in case of any delay in payment).
13	Mobilization Advance * (Interest Free)	60.12	10 % of Contract Price stated in the Letter of Acceptance against unconditional and irrevocable bank guarantee from a scheduled bank of Pakistan

PRICE ADJUSTMENT UNDER CLAUSE 70 OF CONDITIONS OF CONTRACT

The source of indices and the weightages or coefficients for use in the adjustment formula under Clause 70 shall be as follows:

(To be filled by the Employer)

Cost Element	Description	Weightages	Applicable index
1	2	3	4
(i)	Fixed Portion		
(ii)	Local Labour		Government of Pakistan (GP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin.
(iii)	Cement – in bags		" " "
(iv)	Reinforcing Steel		" " "
(v)	High Speed Diesel (HSD)		" " "
(vi)	Bricks		" " "
(vii)	Bitumen		" " "
(viii)			
	Total	1.000	

Notes:

1) Indices for "(ii)" to "(vii)" are taken from the Government of Pakistan Federal Bureau of Statistics, Monthly Statistical Bulletin. The base cost indices or prices shall be those applying 28 days prior to the latest day for submission of bids. Current indices or prices shall be those applying 28 days prior to the last day of the billing period.

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

3) Employer to determine the weightage of Fixed Portion considering only those cost elements having cost impact of seven (7) percent or more on his specific project as per PEC Price Adjustment Formula -2022 (Amended 2023).

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 as per 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, labor , 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. The Bill of Quantities contains the following Bills and Schedule:
(by way of example)

Bill No. 1	-
Bill No. 2	-
Bill No. 3	-
Bill No. 4	-
Bill No. 5	-
Day work Schedule	
Summary Bill of Quantities	

2. Bidders shall price the Bill of Quantities in Pakistani Rupees only.

BILL OF QUANTITIES

Bill No.1 _

	Description	Unit	Quantity	Rate		Amount
				Rupees in figures	**Rupees in Word**	
1	**2**	**3**	**4**	**5**		**6**
101						
102						
103						
104						
105						
106						
Total for Bill No.1 (Carried Forward to Summary Page) .						

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 complete each 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 for the specified form of Construction Schedule):

	Description	**Time for Completion**
a)	Whole Works	_ days
b)	Part-A (Structural Work Civil)	_ days
c)	Part-B (Electrical Work & ACMV)	_days
d)	Part-C (Plumbing Work)	_days
e)	Part-D (Finishing Work Civil, Electrical & Plumbing Works	_days

METHOD OF PERFORMING THE WORK

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

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

2. Mobilization 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.

LIST OF MAJOR EQUIPMENT – RELATED ITEMS
(NOT APLLICABLE)

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

LIST OF MAJOR EQUIPMENT
(NOT APLLICABLE)

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						

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.).
   d) Provide travelling & lodging arrangement to Consultant & Client concerned staffs for official inspections and testing of material

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

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

6. The Contractor's responsibility to arrange the water for construction work the client will not provide the water and contractor arrange outside from the CMC premises on his own expense. The water Karauses for construction purpose having satisfied test report from PCSIR laboratory.
7. Contractor will arrange electricity source on its own expense or use an alternate of source of electricity (like Generator) or contractor can take temporary connection from Chandka Medical College through sub-meter. Contractor will liable to pay bill to CMC for the temporary connection if allowed.
8. Contractor makes arrangement for effective communication through modern communication tools, using Computer & internet facility available at site office for official correspondence.

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 (1000 Rs.)
1	2
1st Quarter	
2nd Quarter	
3rd Quarter	
4th Quarter	
5th Quarter	
6th Quarter	
Bid Price	

ORGANIZATION CHART FOR THE SUPERVISORY STAFF

(INTEGRITY PACT)
DECLARATION OF FEES, COMISSION AND BROKERAGE ETC. PAYABLE BY CONTRACTORS

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE)

Contract No. _ Dated _

Contract Value: _

Contract Title: _

_ (Name of Contractor) hereby declares that it has not obtained or induce 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 any other entity owned or controlled by it (GoP) through any corrupt business practice.

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

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

(Name of Contractor) accepts full responsibilities and strict liability for making any false declaration, not making full disclosure, misrepresenting facts or taking any action likely to defeat the purpose of 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 rights and remedies available to PA under any law, contract or other instrument, be voidable at the option of PA.

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

_____ _____

(PROCURING AGENCY) **(CONTRACTOR)**

FORMS

PERFORMANCE SECURITY
CONTRACT AGREEMENT
MOBILIZATION ADVANCE GUARANTEE/BOND

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.

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)

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 other part.

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 witnessed as follows:

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

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

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

3. In consideration of the payments to be made by the 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)

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 fulfilment 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)

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 Internationale 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 Conditions of Contract can be referred to in the bidding documents, and the bidders are advised to obtain copies directly from FIDIC. *

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* Add the following text if the bidding documents, as issued, do not include a copy: "Copies of the FIDIC Conditions of Contract can be obtained from:
FIDIC Secretariat
P.O. Box 86
1000 Lausanne 12
Switzerland
e-mail: fidic.pub@fidic.org – FIDIC.org/bookshop]

FEDERATION INTERNATIONALE DES INGENIEURS-CONSEILS

CONDITIONS OF CONTRACT FOR WORKS OF CIVIL ENGINEERING CONSTRUCTION

PART I GENERAL CONDITIONS

WITH FORMS OF TENDER AND AGREEMENT

FOURTH EDITION 1987
Reprinted 1988 with editorial amendments
Reprinted 1992 with further amendments

PART1: GENERAL CONDITIONS OF CONTRACT

General

Conditions of Contract

Definitions and Interpretation

1.1 Definitions
1.2 Headings and Marginal Notes
1.3 Interpretation
1.4 Singular and Plural
1.5 Notices, Consents, Approvals, Certificates & Determinations

Representatives

2.1 Appointment of Engineer's Representative
2.2 Duties and Authority of Engineer's Representative
2.3 Instructions in Writing
2.4 Contractor's Representative
2.5 Instructions in Writing
2.6 Engineer to Act Impartially

Sub-Contracting

3.1 Assignment of Contract
4.1 Sub-Contracting
4.2 Assignment of Sub Contractor's Obligations

Contract Documents

5.1 Language and Law
5.2 Priority of Contract Documents
6.1 Custody and supply of Drawings
6.2 One Copy of Drawings to be kept on Site
6.3 Disruption of Progress
6.4 Delays and cost of Delay of drawings
6.5 Failure by Contractor to Submit drawings
7.1 Supplementary Drawings and Instructions
7.2 Permanent Works designated by the Contractor
7.3 Responsibility unaffected by Approval

General Obligations

8.1 Contractor's General Responsibilities
8.2 Site Operations and Method of Construction
9.1 Contract Agreement
10.1 Performance Security

10.2	Period of Validity of Performance Bond
10.3	Claims Under Performance Security
11.1	Inspection of Site
12.1	Sufficiency of Tender
12.2	Not Foreseeable Physical Obstructions or Conditions
13.1	Work to be in Accordance with Contract
14.1	Program to be Submitted
14.2	Revised Program
14.3	Cash Flow Estimate to be Submitted
14.4	Contractor not relieved of duties and responsibilities
15.1	Contractor's Superintendence
16.1	Contractor's Employees
16.2	Employer at Liberty to Object
17.1	Setting Out
18.1	Bore-holes and Exploratory Excavation
19.1	Safety, Security and Protection of Environment
19.2	Employer's Responsibility
20.1	Care of Works
20.2	Responsibility to Rectify Loss or Damage
20.3	Loss or Damage due to Employer's Risk
20.4	Employer's Risk
21.1	Insurance of Works and Contractor's Equipment
21.2	Scope of Cover
21.3	Responsibility for Amounts not Recovered
21.4	Exclusions
22.1	Damage to Persons and Property
22.2	Exceptions
22.3	Indemnity by Employer
23.1	Third Party Insurances (including Employer's Property)
23.2	Minimum Amount of Insurance
23.3	Cross Liabilities
24.1	Accident or Injury to Workmen
24.2	Insurance against Accident to Workmen
25.1	Evidence and Terms of Insurance
25.2	Adequacy of Insurance
25.3	Remedy on Contractor's Failure to Insure
25.4	Compliance with Policy Conditions
26.1	Compliance with Statutes, Regulations
27.1	Fossils
28.1	Patent Rights
28.2	Royalties
29.1	Interference with Traffic and adjoining Properties
30.1	Avoidance of Damage to Roads

30.2 Transportation of Contractor's Equipment & Temporary Works
30.3 Compliance with Traffic Laws
31.1 Opportunities for other Contractors
31.2 Facilities for other Contractors
32.1 Contractor to keep Site Clear
33.1 Clearance of Site on Completion

Labour

34.1 Engagement of Staff and Labour
35.1 Returns of Labour and Contractor's Equipment

Materials, Plant and Workmanship

36.1 Quality of Materials, Plant and Workmanship
36.2 Cost of Samples
36.3 Cost of Tests
36.4 Cost of Tests not Provided for
36.5 Employer's Determination where Tests not Provided For
37.1 Inspection of Operations
37.2 Inspection and Testing
37.3 Dates for Inspection and Testing
37.4 Rejection
37.5 Independent Inspection
38.1 Examination of Works before Covering Up
38.2 Uncovering and Making Openings
39.1 Removal of Improper Work, Material or Plant
39.2 Default of Contractor in Compliance

Suspension

40.1 Suspension of Work
40.2 Employer's Determination following Suspension
40.3 Suspension lasting more than 84 days

Commencement and Delays

41.1 Commencement of Works
42.1 Possession of Site and Access Thereto
42.2 Failure to give Possession
42.3 Rights of Way and Facilities
43.1 Time for Completion
44.1 Extension of Time for Completion
44.2 Contractor to provide Notification and detailed Particulars
44.3 Interim Determination of Extension
45.1 Restriction on Working Hours
46.1 Rate of Progress
47.1 Liquidated Damages for Delay
47.2 Reduction of Liquidated Damages
48.1 Taking Over Certificate

48.2 Taking Over of Sections or Parts

48.3 Substantial Completion of Parts

48.4 Surfaces Requiring Reinstatement

Defects Liability

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Definitions and Interpretation

Definitions

1.1 In the Contract (as hereinafter defined) the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

(a) (i) "Employer" means the person named as such in Part II of these Conditions and the legal successors in title to such person, but not (except with the consent of the Contractor) any assignee of such person.

(ii) "Contractor" means the person whose tender has been accepted by the Employer and the legal successors in title to such person, but not (except with the consent of Employer) any assignee of such person.

(iii) "Subcontractor" means any person named in the Contract as a Subcontractor for a part of the Works or any person to whom a part of the Works has been subcontracted with the consent of the Engineer and the legal successors in title to such person, but not any assignee of any such person.

(iv) "Engineer" means the person appointed by the Employer to act as Engineer for the purposes of the Contract and named as such in Part II of these Conditions.

(v) "Engineer's Representative" means a person appointed from time to time by the Engineer under Sub-Clause 2.2.

(b) (i) "Contract" means these Conditions (Parts I and II), the Specification, the Drawings, the Bill of Quantities, the Tender, the Letter of Acceptance, the Contract Agreement (if completed) and such further documents as may be expressly incorporated in the Letter of Acceptance or Contract Agreement (if completed).

(ii) "Specification" means the specification of the Works included in the Contract and any modification thereof or addition thereto made under Clause 51 or submitted by the Contractor and approved by the Engineer.

(iii) "Drawings" means all drawings, calculations and technical information of a like nature provided by the Engineer to the Contractor under the Contract and all

drawings, calculations, samples, patterns, models, operation and maintenance manuals and other technical information of a like nature submitted by the Contractor and approved by the Engineer.

(iv) "Bill of Quantities" means the priced and completed bill of quantities forming part of the Tender.

(v) "Tender" means the Contractor's priced offer to the Employer for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract, as accepted by the Letter of Acceptance.

(vi) "Letter of Acceptance" means the formal acceptance by the Employer of the Tender.

(vii) "Contract Agreement" means the contract agreement (if any) referred to in Sub-Clause 9. 1.

(viii) "Appendix to Tender" means the appendix comprised in the form of Tender annexed to these Conditions.

(c) (i) "Commencement Date" means the date upon which the Contractor receives the notice to commence issued by the Engineer pursuant to Clause 41.

(ii) "Time for Completion" means the time for completing the execution of and passing the Tests on Completion of the Works or any Section or part thereof as stated in the Contract (or as extended under Clause 44) calculated from the Commencement Date.

(d) (i) "Tests on Completion" means the tests specified in the Contract or otherwise agreed by the Engineer and the Contractor which are to be made by the Contractor before the Works or any Section or part thereof are taken over by the Employer.

(ii) "Taking-Over Certificate" means a certificate issued pursuant to Clause 48.

(e) (i) "Contract Price" means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract.

(ii) "Retention Money" means the aggregate of all monies

retained by the Employer pursuant to Sub-Clause 60.2(a).

(iii) "Interim Payment Certificate" means any certificate of payment issued by the Engineer other than the Final Payment Certificate.

(iv) "Final Payment Certificate" means the certificate of payment issued by the Engineer pursuant to Sub-Clause 60.8.

(f) (i) "Works" means the Permanent Works and the Temporary Works or either of them as appropriate.

(ii) "Permanent Works" means the permanent works to be executed (including Plant) in accordance with the Contract.

(iii) "Temporary Works" means all temporary works of every kind (other than Contractor's Equipment) required in or about the execution and completion of the Works and the remedying of any defects therein.

(iv) "Plant" means machinery, apparatus and the like intended to form or forming part of the Permanent Works.

(v) "Contractor's Equipment" means all appliances and things of whatsoever nature (other than Temporary Works) required for the execution and completion of the Works and the remedying of any defects therein, but does not include Plant, materials or other things intended to form or forming part of the Permanent Works.

(vi) "Section" means a part of the Works specifically identified in the Contract as a Section.

(vii) "Site" means the places provided by the Employer where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of the Site.

(g) (i) "cost" means all expenditure properly incurred or to be incurred, whether on or off the Site, including overhead and other charges properly allocable thereto but does not include any allowance for profit.

(ii) "day" means calendar day.

(iii) "foreign currency" means a currency of a country other than that in which the Works are to be located.

(iv) "writing" means any hand-written, type-written, or printed communication including telex, cable and facsimile transmission.

Headings and Marginal Notes

1.2 The headings and marginal notes in these Conditions shall not be deemed part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.

Interpretation

1.3 Words importing persons or parties shall include firms and corporations and any organization having legal capacity.

Singular and Plural

1.4 Words importing the singular only also include the plural and vice versa where the context requires.

Notices, Consents, Approvals, Certificates and Determinations

1.5 Wherever in the Contract provision is made for the giving or issue of any notice, consent, approval, certificate or determination by any person, unless otherwise specified such notice, consent, approval, certificate or determination shall be in writing and the words "notify", "certify" or "determine" shall be construed accordingly. Any such consent, approval, certificate or determination shall not unreasonably be withheld or delayed.

Engineer and Engineer's Representative

Engineer's Duties and Authority

2.1 (a) The Engineer shall carry out the duties specified in the Contract.

(b) The Engineer may exercise the authority specified in or necessarily to be implied from the Contract, provided, however, that if the Engineer is required, under the terms of his appointment by the Employer, to obtain the specific approval of the Employer before exercising any such authority, particulars of such requirements shall be set out in Part II of these Conditions. Provided further that any requisite approval shall be deemed to have been given by the Employer for any such authority exercised by the Engineer.

(c) Except as expressly stated in the Contract, the Engineer shall have no authority to relieve the Contractor of any of his obligations under the Contract.

Engineer's Representative

2.2 The Engineer's Representative shall be appointed by and be responsible to the Engineer and shall carry out such duties and exercise such authority as may he delegated to him by the Engineer under Sub-Clause 2.3.

Engineer's Authority to Delegate

2.3 The Engineer may from time to time delegate to the Engineer's Representative any of the duties and authorities vested in the Engineer and he may at any time revoke such delegation. Any such delegation or revocation shall be in writing and shall not take effect until a copy thereof has been delivered to the Employer and the Contractor.
Any communication given by the Engineer's Representative to

the Contractor in accordance with such delegation shall have the same effect as though it had been given by the Engineer. Provided that:

(a) any failure of the Engineer's Representative to disapprove any work, materials or Plant shall not prejudice the authority of the Engineer to disapprove such work, materials or Plant and to give instructions for the rectification thereof; and

(b) if the Contractor questions any communication of the Engineer's Representative he may refer the matter to the Engineer who shall confirm, reverse or vary the contents of such communication.

Appointment of Assistants

2.4 The Engineer or the Engineer's Representative may appoint any number of persons to assist the Engineer's Representative in the carrying out of his duties under Sub-Clause 2.2. He shall notify to the Contractor the names, duties and scope of authority of such persons. Such assistants shall have no authority to issue any instructions to the Contractor save in so far as such instructions may be necessary to enable them to carry out their duties and to secure their acceptance of materials, Plant or workmanship as being in accordance with the Contract and any instructions given by any of them for those purposes shall be deemed to have been given by the Engineer's Representative.

Instructions in Writing

2.5 Instructions given by the Engineer shall be in writing, provided that if for any reason the Engineer considers it necessary to give any such instruction orally, the Contractor shall comply with such instruction. Confirmation in writing of such oral instruction given by the Engineer, whether before or after the carrying out of the instruction, shall be deemed to be an instruction within the meaning of this Sub-Clause. Provided further that if the Contractor, within 7 days, confirms in writing to the Engineer any oral instruction of the Engineer and such confirmation is not contradicted in writing within 7 days by the Engineer, it shall be deemed to be an instruction of the Engineer.

The provisions of this Sub-Clause shall equally apply to instructions given by the Engineer's Representative and any assistants of the Engineer or the Engineer's Representative appointed pursuant to Sub-Clause 2.4.

Engineer to Act Impartially

2.6 Wherever, under the Contract, the Engineer is required to exercise his discretion by:

(a) giving his decision, opinion or consent,

(b) expressing his satisfaction or approval,

(c) determining value, or

(d) otherwise taking action which may affect the rights and obligations of the Employer or the Contractor he shall exercise such discretion impartially within the terms of the Contract and having regard to all the circumstances. Any such decision, opinion, consent, expression of satisfaction, or approval, determination of value or action may be opened up, reviewed or revised as provided in Clause 67.

Assignment and Subcontracting

Assignment of Contract

3.1 The Contractor shall not, without the prior consent of the Employer (which consent, notwithstanding the provisions of Sub-Clause 1.5, shall be at the sole discretion of the Employer), assign the Contract or any part thereof, or any benefit or interest therein or there under, otherwise than by:

(a) a charge in favor of the Contractor's bankers of any monies due or to become due under the Contract, or

(b) assignment to the Contractor's insurers (in cases where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

Subcontracting

4.1 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 agents, 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, or

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

Assignment of Subcontractors' Obligations

4.2 In the event of a Subcontractor having undertaken towards the Contractor in respect of the work executed, or the goods, materials, Plant or services supplied by such Subcontractor, any continuing obligation extending for a period exceeding that of the Defects Liability Period under the Contract, the Contractor

shall at any time, after the expiration of such Period, assign to the Employer, at the Employer's request and cost, the benefit of such obligation for the unexpired duration thereof.

Contract Documents

Language/s and Law

5.1 There is stated in Part II of these Conditions:

(a) the language or languages in which the Contract documents shall be drawn up, and

(b) the country or state the law of which shall apply to the Contract and according to which the Contract shall be construed. If the said documents are written in more than one language, the language according to which the Contract shall be construed and interpreted is also stated in Part II of these Conditions, being therein designated the "Ruling Language".

Priority of Contract Documents

5.2 The several documents forming the Contract are to be taken as mutually, explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer who shall thereupon issue to the Contractor instructions thereon and in such event, unless otherwise provided in the Contract, the priority of the documents forming. The Contract shall be as follows:

(1) The Contract Agreement (if completed);

(2) The Letter of Acceptance.

(3) The Tender,

(4) Part II of these Conditions;

(5) Part I of these Conditions; and
(6) Any other document forming part of the Contract.

Custody and Supply of Drawings and Documents

6.1 The Drawings shall remain in the sole custody of the Engineer, but two copies thereof shall be provided to the Contractor free of charge. The Contractor shall make at his own cost any further copies required by him. Unless it is strictly necessary for the purposes of the Contract, the Drawings, Specification and other documents provided by the Employer or the Engineer shall not, without the consent of the Engineer, be used or communicated to a third party by the Contractor. Upon issue of the Defects Liability Certificate, the Contractor shall return to the Engineer all Drawings, Specification and other documents provided under the Contract.
The Contractor shall supply to the Engineer four copies of all Drawings, Specification and other documents submitted by the

Contractor and approved by the Engineer in accordance with Clause 7, together with a reproducible copy of any material which cannot be reproduced to an equal standard by photocopying. In addition, the Contractor shall supply such further copies of such Drawings, Specification and other documents as the Engineer may request in writing for the use of the Employer, who shall pay the cost thereof.

One Copy of Drawings to be Kept on site

6.2 One copy of the Drawings, provided to or supplied by the Contractor as aforesaid, shall be kept by the Contractor on the Site and the same shall at all reasonable times be available for inspection and use by the Engineer and by any other person authorized by the Engineer in writing.

Disruption of Progress

6.3 The Contractor shall give notice to the Engineer, with a copy to the Employer, whenever planning or execution of the Works is likely to be delayed or disrupted unless any further drawing or instruction is issued by the Engineer within a reasonable time. The notice shall include details of the drawing or instruction required and of why and by when it is required and of any dela y or disruption likely to be suffered if it is late.

Delays and Cost of delay of Drawings

6.4 If, by reason of any failure or inability of the Engineer to issue, within a time reasonable [maximum 7 days] in all the circumstances, any drawing or instruction for which notice has been given by the Contractor in accordance with Sub-Clause 6.3, the Contractor suffers delay and/or incurs costs then 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 of such costs, which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Employer.

Failure by Contractor to submit Drawings

6.5 If the failure or inability of the Engineer to issue any drawings or instructions is caused in whole or in Part by the failure of the Contractor to submit Drawings, Specification or other documents which he is required to submit under the Contract, the Engineer shall take such failure by the Contractor into account when making his determination pursuant to Sub-Clause 6.4.

Supplementary Drawings and Instructions

7.1 The Engineer shall have authority to issue to the Contractor, from time to time, such supplementary Drawings and instructions as shall be necessary for the purpose of the proper and adequate execution and completion of the Works and the remedying of any defects therein. The Contractor shall carry out

and be bound by the same.

Permanent Works Designed by Contractor

7.2 Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall submit to the Engineer, for approval:

(a) such drawings, specifications, calculations and other information as shall he necessary to satisfy the Engineer as to the suitability and adequacy of that design, and

(b) operation and maintenance manuals together with drawings of the Permanent Works as completed, in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust the Permanent Works incorporating that design. The Works shall not be considered to be completed for the purposes of taking over in accordance with Clause 48 until such operation and maintenance manuals, together with drawing on completion, have been submitted to and approved by the Engineer.

Responsibility Unaffected by Approval

7.3 Approval by the Engineer, in accordance with Sub-Clause 7.2, shall not relieve the Contractor of any of his responsibilities under the Contract.

General Obligations

Contractor's General Responsibilities

8.1 The Contractor shall, with due care and diligence, design (to the extent provided for by the Contract), execute and complete the Works and remedy any defects therein in accordance with the provisions of the Contract. The Contractor shall provide all superintendence, labor, materials, Plant, Contractor's Equipment and all other things, whether of a temporary or permanent nature, required in and for such design, execution, completion and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.
The Contractor shall give prompt notice to the Engineer, with a copy to the Employer, of any error, omission, fault or other defect in the design of or Specification for the Works which he discovers when reviewing the Contract or executing the Works.

Site Operations and Method of Construction

8.2 The Contractor shall take full responsibility for the adequacy, stability and safety of all Site operations and methods of construction. Provided that the Contractor shall not be responsible (except as stated hereunder or as may be otherwise agreed) for the design or specification of Permanent Works, or for the design or specification of any Temporary Works not prepared by the Contractor. Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall be fully responsible for that part of such Works, notwithstanding any approval by the Engineer.

Contract Agreement

9.1 The Contractor shall, if called upon so to do, enter into and execute the Contract Agreement, to be prepared and completed at the cost of' the Employer, in the form annexed to these Conditions with such modification, as may be necessary.

Performance Security

10.1 If the Contract requires the Contractor to obtain security for his proper performance of the Contract, he shall obtain and provide to the Employer such security within 15 days after the receipt of the Letter of Acceptance, in the sum stated in the Appendix to Tender. When providing such security to the Employer, the Contractor shall notify the Engineer of so doing. Such security shall be in the form annexed to these Conditions or in such other form as may be agreed between the Employer and the Contractor. The institution providing such security shall be subject to the approval of the Employer. The cost of complying with the requirements of this Clause shall be borne by the Contractor, unless the Contract otherwise provides.

Period of Validity of Performance Security

10.2 The performance security shall be valid until the Contractor has executed and completed the Works and remedied any defects therein in accordance with the Contract. No claim shall be made against such security after the issue of the Defects Liability Certificate in accordance with Sub-Clause 62.1 and such security shall be returned to the Contractor within 14 days of the issue of the said Defects Liability Certificate.

Claims Under Performance Security

10.3 Prior to making a claim under the performance security the Employer shall, in every case, notify the Contractor stating the nature of the default in respect of which the claim is to be made.

Inspection of Site

11.1 The Employer shall have made available to the Contractor, before the submission by the Contractor of the Tender, such data on hydrological and sub-surface conditions as have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works but the Contractor shall be responsible for his own interpretation thereof.

The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself (so far as is practicable, having regard to considerations of cost and time) before submitting his Tender, as to:

(a) the form and nature thereof, including the sub-surface conditions,

(b) the hydrological and climatic conditions,

(c) the extent and nature of work and materials necessary for the

execution and completion of the Works and the remedying of any defects therein, and

(d) the means of access to the Site and the accommodation he may require, and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

The Contractor shall be deemed to have based his Tender on the data made available by the Employer and on his own inspection and examination, all as aforementioned.

Sufficiency of Tender

12.1 The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and of the rates and prices stated in the Bill of Quantities, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract (including those in respect of the supply of goods, materials, Plant or services or of contingencies for which there is a Provisional Sum) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein.

Not Foreseeable Physical Obstructions or Conditions

12.2 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.

Work to be in Accordance with Contract

13.1 Unless it is legally or physically impossible, the Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract to the satisfaction of the Engineer. The Contractor shall comply with and adhere strictly

to the Engineer's instructions on any matter, whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions only from the Engineer (or his delegate).

Programme to be Submitted

14.1 The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, submit to the Engineer for his consent a programme, in such form and detail as the Engineer shall reasonably prescribe, for the execution of the Works. The Contractor shall, whenever required by the Engineer, also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works.

Revised Programme

14.2 If at any time it should appear to the Engineer that the actual progress of the Works does not conform to the programme to which consent has been given under Sub-Clause 14.1, the Contractor shall produce, at the request of the Engineer, a revised programme showing the modifications to such programme necessary to ensure completion of the Works within the Time for Completion.

Cash Flow Estimate to be Submitted

14.3 The Contractor shall, within the time stated in Part II of these Conditions after the date of the Letter of Acceptance, provide to the Engineer for his information a detailed cash flow estimate, in quarterly periods, of all payments to which the Contractor will be entitled under the Contract and the Contractor shall subsequently supply revised cash flow estimates at quarterly intervals, if required to do so by the Engineer.

Contractor not Relieved of Duties or Responsibilities

14.4 The submission to and consent by the Engineer of such programmes or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

Contractor's Superintendence

15.1 The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorized representative approved of by the Engineer, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorized representative shall receive, on behalf of the Contractor, instructions from the Engineer.

If approval of the representative is withdrawn by the Engineer, the Contractor shall, as soon as is practicable, having regard to the requirement of replacing him as hereinafter mentioned, after receiving notice of such withdrawal, remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another

representative approved by the Engineer.

Contractor's Employees

16.1 The Contractor shall provide on the Site in connection with the execution and completion of the Works and the remedying of any defects therein:

(a) only such technical assistants as are skilled and experienced in their respective calling and such foremen and leading hands as are competent to give proper superintendence of the Works, and

(b) such skilled, semiskilled and unskilled labor as is necessary for the proper and timely fulfilling of the Contractor's obligations under the Contract.

Engineer at Liberty to Object

16.2 The Engineer shall be at liberty to object to and require the Contractor to remove forthwith from the Works any person provided by the Contractor who, in the opinion of the Engineer, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose presence on Site is otherwise considered by the Engineer to be undesirable, and such person shall not be again allowed upon the Works without the consent of the Engineer. Any person so removed from the Works shall be replaced as soon as possible.

Setting-out

17.1 The Contractor shall be responsible for:

(a) the accurate setting-out of the Works in relation to original points, lines and levels of reference given by the Engineer in writing,

(b) the correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of the Works, and

(c) the provision of all necessary instruments, appliances and labor in connection with the foregoing responsibilities.
If, at any time during the execution of the Works, any error appears in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required so to do by the Engineer, shall, at his own cost, rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer, in which case the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

The checking of any setting-out or of any line or level by the Engineer shall not in any way relieve the Contractor of his responsibility for the accuracy thereof and the Contractor shall carefully protect and preserve all benchmarks, sight-rails, pegs and other things used in setting-out the Works.

Boreholes and Exploratory Excavation

18.1 If, at any time during the execution of the Works, the Engineer requires the Contractor to make boreholes or to carry out exploratory excavation, such requirement shall be the subject of an instruction in accordance with Clause 51, unless an item or a Provisional Sum in respect of such work is included in the Bill of Quantities.

Safety, Security and Protection of the Environment

19.1 The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein:

(a) have full regard for the safety of all persons entitled to be upon the Site and keep the Site (so far as the same is under his control) and the Works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons.

(b) provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and

(c) take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

Employer's Responsibilities

19.2 If under Clause 31 the Employer shall carry out work on the Site with his own workmen he shall, in respect of such work:

(a)) have full regard to the safety of all persons to be entitled upon the Site, and

(b) keep the Site in an orderly state appropriate to the avoidance of danger to such persons.

If under Clause 31 the Employer shall employ other contractors on the Site he shall require them to have the same regard for safety and avoidance of danger.

Care of Works

20.1 The Contractor shall take full responsibility for the care of the Works and materials and Plant for incorporation therein from the Commencement Date until the date of issue of the Taking-Over Certificate for the whole of the Works, when the responsibility for the said care shall pass to the Employer. Provided that:

(a)) if the Engineer issues a Taking-Over Certificate for any Section or part of the Permanent Works the Contractor shall

cease to be liable for the care of that Section or part from the date of issue of the Taking-Over Certificate. When the responsibility for the care of that section or part shall pass to the Employer. and

(b) the Contractor shall take full responsibility for the care of any outstanding Works and materials and Plant for incorporation therein which he undertakes to finish during the Defects Liability Period until such outstanding Works have been completed pursuant to Clause 49.

Responsibility to Rectify Loss or Damage

20.2 If any loss or damage happens to the Works, or any part thereof, or materials or Plant for incorporation therein, during the period for which the Contractor is responsible for the care thereof, from any cause whatsoever, other than the risks defined in Sub-Clause 20.4, the Contractor shall, at his own cost, rectify such loss or damage so that the Permanent Works conform in every respect with the provisions of the Contract to the satisfaction of the Engineer. The Contractor shall also be liable for any loss or damage to the Works occasioned by him in the course of any operations carried out by him for the purpose of complying with his obligations under Clauses 49 and 50.

Loss or Damage due to Employer's Risks

20.3 In the event of any such loss or damage happening from any of the risks defined in Sub-Clause 20.4, or in combination with other risks, the Contractor shall, if' and to the extent required by the Engineer, rectify the loss or damage and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer. In the case of a combination of risks causing loss or damage any such determination shall take into account the proportional responsibility of the Contractor and the Employer.

Employer's Risks

20.4 The Employer's risks are:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,

(b) rebellion, revolution, insurrection, or military or usurped power, or civil war,

(c) ionizing radiations, or contamination by radio-activity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof.

(d) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,

(c) riot commotion or disorder, unless solely restricted to employees of the Contractor or of his Subcontractors and arising from the conduct of the Works,

(f) 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,

(g) 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

(h) any operation of the forces of nature against which an experienced contractor could not reasonably have been expected to take precautions.

Insurance of Works and Contractor's Equipment

21.1 The Contractor shall, without limiting his or the Employer's obligations and responsibilities under Clause 20, insure:

(a) the Works, together with materials and Plant for incorporation therein, to the full replacement cost (the term "cost" in this context shall include profit).

(b) an additional sum of 15 per cent of such replacement cost, or as may be specified in Part II of these Conditions, to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature, and

(c) the Contractor's Equipment and other things brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.

Scope of Cover

21.2 The insurance in paragraphs (a) and (b) of Sub-Clause 21.1 shall be in the joint names of the Contractor and the Employer and shall cover:

(a) the Employer and the Contractor against all loss or damage from whatsoever cause arising, other than as provided in Sub-Clause 21.4, from the start of Work at the Site until the date of issue of the relevant Taking-Over Certificate in respect of the Works or any Section or part thereof as the case may be, and

(b) the Contractor for his liability:

(i) during the Defects Liability Period for loss or damage, arising from a cause occurring prior to the commencement of the Defects Liability Period, and

(ii) for loss or damage occasioned by the Contractor in the course of any operations carried out by him for the purpose of complying with his obligations under Clauses 49 and 50.

Responsibility for amounts not Recovered

21.3 Any amounts not insured or not recovered from the insurers shall be borne by the Employer or the Contractor in accordance with their responsibilities under Clause 20.

Exclusions

21.4 There shall be no obligation for the insurances in Sub-Clause 21.1 to include loss or damage caused by:

(a) war, hostilities (whether war be declared or not), invasion act of foreign enemies,

(b) rebellion, revolution, insurrection, or military or usurped power, or civil war,

(c) ionizing radiations, or contamination by radio-activity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof, or

(d) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds.

Damages to Persons and Property

22.1 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.

Exceptions

22.2 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, in 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.

Indemnity by Employer

22.3 The Employer shall indemnify the Contractor against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the exceptions defined in Sub-Clause 22.2.

Third Party Insurance (including Employer's Property)

23.1 The Contractor shall, without limiting his or the Employer's obligations 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.

Minimum amount of Insurance

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

Cross Liabilities

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

Accident or Injury to Workmen

24.1 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 of the 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.

Insurance against

24.2 The Contractor shall insure against such liability and shall

Accident to Workmen

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 this 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.

Evidence and terms of Insurances

25.1 The Contractor shall provide evidence to the Employer prior to the start of work at the Site that the insurances required under the Contract have been effected and shall, within 84 days of the Commencement Date, provide the insurance policies to the Employer. When, providing such evidence and such policies to the Employer, the Contractor shall notify the Engineer of so doing. Such insurance policies shall be consistent with the general terms agreed prior to the issue of the Letter of Acceptance. The Contractor shall effect all insurances for which he is responsible with insurers and in terms approved by the Employer.

Adequacy of Insurances

25.2 The Contractor shall notify the insurers of changes in the nature, extent or programme for the execution of the Works and ensure the adequacy of the insurances at all times in accordance with the terms of the Contract and shall, when required, produce to the Employer the insurance policies in force and the receipts for payment of the current premiums.

Remedy on Contractor's Failure to Insure

25.3 If the Contractor fails to effect and keep in force any of the insurances required under the Contract or fails to provide the policies to the Employer within the period required by Sub-Clause 25. 1, then and in any such case the Employer may effect and keep in force any such insurances and pay any premium as may be necessary for that purpose and from time to time deduct the amount so paid from any monies due or to become due to the Contractor, or recover the same as a debt due from the Contractor.

Compliance with Policy conditions

25.4 In the event that the Contractor or the Employer fails to comply with conditions imposed by the insurance policies effected pursuant to the Contract, each shall indemnify the other against all losses and claims arising from such failure.

Compliance with Statutes, Regulations

26.1 The Contractor shall conform in all respects, including by the giving of all notices and the paying of all fees, with the provisions of:

(a) any National or State Statute, Ordinance or other Law, or

any regulation, or bye-law of any local or other duly constituted authority in relation to the execution and completion of the Works and the remedying of any defects therein, and

(b) the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works, and the Contractor shall keep the Employer indemnified against all penalties and liability of every kind for breach of any such provisions. Provided always that the Employer shall be responsible for obtaining any planning, zoning or other similar permission required for the Works to proceed and shall indemnify the Contractor in accordance with Sub-Clause 22.3.

Fossils

27.1 All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall, as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same. If, by reason of such instructions, the Contractor suffers delay and/or incurs costs then 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 (h) the amount of such costs which shall be added to the Contract Price,
and shall notify the Contractor accordingly, with a copy to the Employer.

Patent Rights

28.1 The Contractor shall save harmless and indemnify the Employer from and against all claims and proceedings for or on account of infringement of any patent rights, design trademark or name or other protected rights in respect of any Contractor's Equipment, materials or Plant used for or in connection with or for incorporation in the Works and from and against all damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, except where such infringement results from compliance with the design or Specification provided by the Engineer.

Royalties

28.2 Except where otherwise stated, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation, if any, for getting stone, sand, gravel, clay or other materials required for the Works.

Interference with Traffic and Adjoining Properties

29.1 All operations necessary for the execution and completion of the Works and the remedying of any defects therein shall, so far as compliance with the requirements of the Contract permits, to be carried on so as not to interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) the access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

The Contractor shall save harmless and indemnify the Employer in respect of all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of, or in relation to, any such matters insofar as the Contractor is responsible thereof.

Avoidance of Damage to Roads

30.1 The contractor shall use every reasonable means to prevent any of the roads or bridges communicating with or on the routes to the Site from being damaged or injured by any traffic of the Contractor or any of his Subcontractors and, in particular, shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of materials, Plant, Contractor's Equipment or Temporary Works from and to the Site shall be limited, as far as reasonably possible, and so that no unnecessary damages or injury may be occasioned to such roads and bridges.

Transport of Contractor's Equipment or Temporary Works

30.2 Save insofar as the Contract otherwise provides, the Contractor shall be responsible for and shall pay the cost of strengthening any bridges or altering or improving any road communicating with or on the routes to the Site to facilitate the movement of Contractor's Equipment or Temporary Works and the Contractor shall indemnify and keep indemnified the Employer against all claims for damage to any such road or bridge caused by such movement, including such claims as may be made directly against the Employer, and shall negotiate and pay all claims arising solely out of such damage.

Transport of Materials or Plant

30.3 If, notwithstanding Sub-Clause 30.1, any damage occurs to any bridge or road communicating with or on the routes to the Site arising from the transport of materials or Plant, the Contractor shall notify the Engineer with a copy to the Employer, as soon as he becomes aware of such damage or as soon as he receives any claim from the authority entitled to make such claim. Where under any law or regulation the haulier of such materials or Plant is required to indemnify the road authority against damage the Employer shall not be liable for any costs, charges or expenses in respect thereof or in relation thereto. In other cases

the Employer shall negotiate the settlement of and pay all sums due in respect of such claim and shall indemnify the Contractor in respect thereof and in respect of all claims, proceedings, damages, costs, charges and expenses in relation thereto. Provided that if and so far as any such claim or part thereof is, in the opinion of the Engineer, due to any failure on the part of the Contractor to observe and perform his obligations under Sub-Clause 30.1, then the amount, determined by the Engineer, after due consultation with the Employer and the Contractor, to be due to such failure shall be recoverable from the Contractor by the Employer and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Provided also that the Employer shall notify the Contractor whenever a settlement is to be negotiated and, where any amount may be due from the Contractor, the Employer shall consult with the Contractor before such settlement is agreed.

Waterborne Traffic

30.4 Where the nature of the Works is such as to require the use by the Contractor of waterborne transport the foregoing provisions of this Clause shall be construed as though "road" included a lock, dock, sea wall or other structure related to a waterway and "vehicle" included craft, and shall have effect accordingly.

Opportunities for other Contractors

31.1 The Contractor shall, in accordance with the requirements of the Engineer, afford all reasonable opportunities for carrying out their work to:

(a) any other contractors employed by the Employer and their workmen,

(b) the workmen of the Employer, and

(c) the workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any contract which the Employer may enter into in connection with or ancillary to the Works.

Facilities for other Contractors

31.2 If, however, pursuant to Sub-Clause 31.1 the Contractor shall, on the written request of the Engineer:

(a) make available to any such other contractor, or to the Employer or any such authority, any roads or ways for the maintenance of which the Contractor is responsible.

(b) permit the use, by any such, of Temporary Works or Contractor's Equipment on the Site, or

(c) provide any other service of whatsoever nature for any such, the Engineer shall determine an addition to the Contract Price in

accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

Contractor to keep Site Clear

32.1 During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required.

Clearance of Site on Completion

33.1 Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period.

Labour

Engagement of Staff and Labour

34.1 The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

Returns of Labour and Contractor's Equipment

35.1 The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such information respecting Contractor's Equipment as the Engineer may require.

Materials, Plant and Workmanship

Quality of materials, Plant and Workmanship

36.1 All materials, Plant and workmanship shall be:

(a) of the respective kinds described in the Contract and in accordance with the Engineer's instructions, and

(b) subjected from time to time to such test as the Engineer may require at the place of manufacture, fabrication or preparation, or on the Site or at such other place or places as may be specified in the Contract, or at all or any of such places.

The Contractor shall provide such assistance, labour, electricity,

fuels, stores apparatus and instruments as are normally required for examining, measuring and testing any materials or Plant and shall supply samples of materials, before incorporation in the Works, for testing as may be selected and required by the Engineer.

Cost of Samples

36.2 All samples shall be supplied by the Contractor at his own cost if the supply thereof is clearly intended by or provided for in the Contract.

Cost of Tests

36.3 The cost of making any test shall be borne by the Contractor if such test is:

(a) clearly intended by or provided for in the Contract, or

(b) particularised in the Contract (in cases only of a test under load or of a test to ascertain whether the design of any finished or partially finished work is appropriate for the purposes which it was intended to fulfil) in sufficient detail to enable the Contractor to price or allow for the same in his Tender.

Cost of Tests not Provided for

36.4 If any test required by the Engineer which is:

(a)) not so intended by or provided for,

(b) (in the cases above mentioned) not so particularised, or

(c) (though so intended or provided for) required by the Engineer to be carried out at any place other than the Site or the place of manufacture, fabrication or preparation of the materials or Plant tested, shows the materials, plant or workmanship not to be in accordance with the provisions of the Contract to the satisfaction of the Engineer, then the cost of such test shall be borne by the Contractor, but in any other case Sub-Clause 36.5 shall apply.

Engineer's Determination where Tests not Provided for

36.5 Where, pursuant to Sub-Clause 36.4, 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 of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

Inspection of Operations

37.1 The Engineer, and any person authorised by him, shall at all reasonable times have access to the Site and to all workshops and places where materials or Plant are being manufactured,

fabricated or prepared for the Works and the Contractor shall afford every facility for and every assistance in obtaining the right to such access.

Inspection and Testing

37.2 The Engineer shall be entitled, during manufacture, fabrication or preparation to inspect and test the materials and Plant to be supplied under the Contract. If materials or Plant are being manufactured, fabricated or prepared in workshops or places other than those of the Contractor, the Contractor shall obtain permission for the Engineer to carry out such inspection and testing in those workshops or places. Such inspection or testing shall not release the Contractor from any obligation under the Contract.

Dates for Inspection and Testing

37.3 The Contractor shall agree with the Engineer on the time and place for the inspection or testing of any materials or Plant as provided in the Contract. The Engineer shall give the Contractor not less than 24 hours notice of his intention to carry out the inspection or to attend the tests. If the Engineer, or his duly authorised representative, does not attend on the date agreed, the Contractor may, unless otherwise instructed by the Engineer, proceed with the tests, which shall be deemed to have been made in the presence of the Engineer. The Contractor shall forthwith forward to the Engineer duly certified copies of the test readings. If the Engineer has not attended the tests, he shall accept the said readings as accurate.

Rejection

37.4 If, at the time and place agreed in accordance with Sub-Clause 37.3, the materials or Plant are not ready for inspection or testing or if, as a result of the inspection or testing referred to in this Clause, the Engineer determines that the materials or Plant are defective or otherwise not in accordance with the Contract, he may reject the materials or Plant and shall notify the Contractor thereof immediately. The notice shall state the Engineer's objections with reasons. The Contractor shall then promptly make good the defect or ensure that rejected materials or Plant comply with the Contract. If the Engineer so requests, the tests of rejected materials or Plant shall be made or repeated under the same terms and conditions. All costs incurred by the Employer by the repetition of the tests shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer and may be deducted from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Independent Inspection

37.5 The Engineer may delegate inspection and testing of materials or Plant to an independent inspector. Any such delegation shall be effected in accordance with Sub-Clause 2.4 and for this

purpose such independent inspector shall be considered as an assistant of the Engineer. Notice of such appointment (not being less than 14 days) shall be given by the Engineer to the Contractor.

Examination of Work before Covering up

38.1 No part of the Works shall be covered up or put out of view without the approval of the Engineer and the Contractor shall afford full opportunity for the Engineer to examine and measure any such part of the Works which is about to be covered up or put out of view and to examine foundations before any part of the Works is placed thereon. The Contractor shall give notice to the Engineer whenever any such part of the Works or foundations is or are ready or about to be ready for examination and the Engineer shall, without unreasonable delay, unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such part of the Works or of examining such foundations.

Uncovering and Making Openings

38.2 The Contractor shall uncover any part of the Works or make openings in or through the same as the Engineer may from time to time instruct and shall reinstate and make good such part. If any such part has been covered up or put out of view after compliance with the requirement of Sub-Clause 38.1 and is found to be executed in accordance with the Contract, the Engineer shall after due consultation with the Employer and the Contractor, determine the amount of the Contractor's costs in respect of such of uncovering, making openings in or through, reinstating and making good the same, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer. In any other case all costs shall be borne by the Contractor.

Removal of Improper work, Materials or Plant

39.1 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.

Default of Contractor in Compliance

39.2 In case of default on the part of the Contractor in carrying out such instruction within the time specified therein or, if none, within a reasonable time, the Employer shall be entitled to employ and pay other persons to carry out the same and all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Suspension

Suspension of Work

40.1 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 on 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 act or default by the Engineer or the Employer or from any of risks defined in Sub-Clause 20.4), Sub-Clause 40.2 shall apply.

Engineer's Determination following Suspension

40.2 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.

Suspension lasting more than 84 Days

40.3 If the progress of the Works or any part thereof is suspended on the instructions of the Engineer and if permission to resume work is not given by the Engineer within a period of 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 terminate his employment under the Contract in accordance with the provisions of Sub-Clause 69.1, whereupon the provisions of Sub-Clauses 69.2 and 69.3 shall apply.

Commencement and Delays

Commencement of Works

41.1 The Contractor shall commence the Works as soon as is reasonably possible after the receipt by him of a notice to this effect from the Engineer, which notice shall be issued within the time stated in the Appendix to Tender after the date of the Letter of Acceptance. Thereafter, the Contractor shall proceed with the Works with due expedition and without delay.

Possession of Site and Access Thereto

42.1 Save insofar as the Contract may prescribe:

(a) the extent of portions of the Site of which the Contractor is to be given possession from time to time,

(b) the order in which such portions shall be made available to the Contractor, and, subject to any requirement in the Contract as to the order in which the Works shall be executed, the Employer will, with the Engineer's notice to commence the Works, give to the Contractor possession of

(c)) so much of the Site, and

(d) such access as, in accordance with the Contract, is to be provided by the Employer as maybe required to enable the Contractor to commence and proceed with the execution of the Works in accordance with the programme referred to in Clause 14, if any, and otherwise in accordance with such reasonable proposals as the Contractor shall, by notice to the Engineer with a copy to the Employer, make. The Employer will, from time to time as the Works proceed, give to the Contractor possession of such further portions of the Site as may be required to enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with such programme or proposals, as the case may be.

Failure to Give Possession

42.2 If the Contractor suffers delay and/or incurs costs from failure on the part of the Employer to give position in accordance with the terms of Sub-Clauses 42.1, the Engineer shall, after due consultation with the Employer and the Contractor determine:

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

(b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly with a copy to the Employer.

Rights of way and facilities

42.3 The Contractor shall bear all costs and charges for special or temporary rights of way required by him in connection with access to the Site. The Contractor shall also provide at his own cost any additional facilities outside the Site required by him for the purposes of the Works.

Time for Completion

43.1 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, 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.

Extension of Time for Completion

44.1 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.

Contractor to Provide Notification and Detailed Particulars

44.2 Provided that the Engineer is not bound to make any determination unless the Contractor has

(a) within 28 days after such event has first arisen notified the Engineer with a copy to the Employer, and

(b) within 28 days, or such other reasonable time as may be agreed by the Engineer after such notification submitted to the Engineer detailed particulars of any extension of time to which he may consider himself entitled in order that such submission may be investigated at the time.

Interim Determination of Extension

44.3 Provided also that where an event has a continuing effect such that it is not practicable for the Contractor to submit detailed particulars within the period of 28 days referred to in Sub-Clause 44.2(b), he shall nevertheless be entitled to an extension of time provided that he has submitted to the Engineer interim particulars at intervals of not more than 28 days and final particulars within 28 days of the end of the effects resulting from the event. On receipt of such interim particulars, the Engineer shall, without undue delay, make an interim determination of extension of time and on receipt of the final particulars, the Engineer shall review all the circumstances and shall determine an overall extension of time in regard to the event. In both such cases the Engineer shall make his determination after due consultation with the Employer and the Contractor and shall notify the Contractor of the determination, with a copy to the Employer. No final review shall result in a decrease of any extension of time already determined by the Engineer.

Restriction on Working Hours

45.1 Subject to any provision to the contrary contained in the Contract, none of the Works shall, save as hereinafter provided, be carried on during the night or on locally recognized days of rest without the consent of the Engineer, except when work is unavoidable or absolutely necessary for the saving of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer. Provided that the provisions of this Clause shall not be applicable in the case of any work which it is customary to carry out by multiple shifts.

Rate of Progress

46.1 If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works or any Section is at any time, in the opinion of the Engineer, too slow to comply with the Time for Completion, the Engineer shall so notify the Contractor who shall thereupon take such steps as are necessary, subject to the consent of the Engineer, to expedite progress so as to comply with the Time for Completion. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer under this Clause, the Contractor considers that it is necessary to do any work at night or on locally recognised days of rest, he shall be entitled to seek the consent of the Engineer so to do. Provided that if any steps, taken by the Contractor in meeting his obligations under this Clause, involve the Employer

in additional supervision costs, such costs shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Liquidated Damages for Delay

47.1 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.

Reduction of liquidated Damages

47.2 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 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 Certificates, 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.

Taking-Over Certificate

48.1 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 days of 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 Works 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.

Taking-Over of Section of Part

48.2 Similarly, in accordance with the procedure set out in Sub-Clause 48.1, the Contractor may request and the Engineer shall issue a Taking-Over Certificate in respect of:

(a) any Section in respect of which a separate Time for Completion is provided in the Appendix to Tender,

(b) any substantial part of the Permanent Works which has been both completed to the satisfaction of the Engineer and, otherwise than as provided for in the Contract, occupied or used by the Employer, or

(c) any part of the Permanent Works which the Employer has elected to occupy or use prior to completion (where such prior occupation or use is not provided for in the Contract or has not been agreed by the Contractor as a temporary measure).

Substantial Completion of Parts

48.3 If any part of the Permanent Works has been substantially completed and has satisfactorily passed any Tests on Completion prescribed by the Contract, the Engineer may issue a Taking-Over Certificate in respect of that part of the Permanent Works before completion of the whole of the Works and, upon the issue of such Certificate, the Contractor shall be deemed to have undertaken to complete with due expedition any outstanding work in that part of the Permanent works during the Defects Liability Period.

Surfaces Requiring Reinstatement

48.4 Provided that a Taking-Over Certificate given in respect of any Section or part of the Permanent Works before completion of the whole of the Works, shall not be deemed to certify completion of any ground or surfaces requiring reinstatement unless such Taking-Over Certificate shall expressly so state.

Defects Liability

Defects Liability Period

49.1 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 been 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.

Completion of Outstanding Work and remedying Defects

49.2 To the intent that the Works shall, at or as soon as practicable after expiration of the Defects Liability Period, be delivered to the Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall:

(a) complete the work, if any, outstanding on the date stated in the Taking-Over Certificate as soon as practicable after such date, and

(b) execute all such work of amendment, reconstruction, and remedying defects, shrinkages or other faults as the Engineer may, during the Defects Liability Period or within 14 days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration, instruct the Contractor to execute.

Cost of Remedying Defects

49.3 All work referred to in Sub-Clause 49.2 (b) shall be executed by the Contractor at his own cost if the necessity thereof is, in the opinion of the Engineer, due to:

(a) the use of materials, Plant or, workmanship not in accordance with the Contract,

(b) where the Contractor is responsible for the design of part of the Permanent Works, any fault in such design, or

(c) the neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

If, in the opinion of the Engineer, such necessity is due to any other cause, he shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

Contractor's failure to carry out Instructions

49.4 In case of default on the part of the Contractor in carrying out such instruction within a reasonable time, the Employer shall be entitled to employ and pay other persons to carry out the same and if such work is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the

Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Contractor to search

50.1 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 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 in accordance with the provisions of Clause 49.

Alterations, Additions and Omissions

Variations

51.1 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 the Works, 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 by some 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.

Instructions for Variation

51.2 The Contractor shall not make any such variation without an instruction of the Engineer. Provided that no instruction shall be required for increase or decrease in the quantity of any work where such increase or decrease is not the result of an instruction given under this Clause, but is the result of the quantities exceeding or being less than those stated in the Bill of Quantities.

Valuation of Variations

52.1 All variations referred to in Clause 51 and any additions to the Contract Price which are required to be determined in accordance with Clause 52 (for the purposes of this Clause referred to as "varied work"), shall be valued at the rates and prices set out in the Contract if, in the opinion of the Engineer, the same shall be applicable. If the Contract does not contain any rates or prices applicable to the varied work, the rates and prices in the Contract shall be used as the basis for valuation so far as may be reasonable, failing which, after due consultation by the Engineer with the Employer and the Contractor, suitable rates or prices shall be agreed upon between the Engineer and the Contractor. In the event of disagreement the Engineer shall fix such rates or prices as are, in his opinion appropriate and shall notify the Contractor accordingly, with a copy to the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to be included in certificates issued in accordance with Clause 60.

Power of Engineer to Fix Rates

52.2 Provided that if the nature or amount of any varied work relative to the nature or amount of the whole of the Works or to any part thereof, is such that, in the opinion of the Engineer, the rate or price contained in the Contract for any item of the Works is, by reason of such varied work, rendered inappropriate or inapplicable, then, after due consultation by the Engineer with the Employer and the Contractor, a suitable rate or price shall be agreed upon between the Engineer and the Contractor. In the event of disagreement the Engineer shall fix such other rate or price as is, in his opinion, appropriate and shall notify the Contractor accordingly, with a copy to the Employer. Until such time as rates or prices are agreed or fixed, the Engineer shall determine provisional rates or prices to enable on-account payments to be included in certificates issued in accordance

with Clause 60.

Provided also that no varied work instructed to be done by the Engineer pursuant to Clause 51 shall be valued under Sub-Clause 52.1 or under this Sub-Clause unless, within 14 days of the date of such instruction and, other than in the case of omitted work, before the commencement of the varied work, notice shall have been given either:

(a) by the Contractor to the Engineer of his intention to claim extra payment or varied rate or price, or

(b) by the Engineer to the Contractor for his intention to vary a rate or price.

Variations Exceeding 15 Percent

52.3 If, on the issue of the Taking-Over Certificate for the whole of the Works, it is found that as a result of:

(a) all varied work valued under Sub-Clauses 52.1 and 52.2 and

(b) all adjustments upon measurement of the estimated quantities set out in the Bill of Quantities, excluding provisional Sums, dayworks and adjustments of price made under Clause 70, but not from all other cause, there have been additions to or deductions from the Contract Price which taken together are in excess of 15 percent of the "Effective Contract Price" (which for the purposes of this Sub-Clause shall mean the Contract Price, excluding Provisional Sums, and allowance for dayworks, if any) then and in such event (subject to any action already taken under any other Sub-Clause of this Clause), after due consultation by the Engineer with the Employer and the Contractor, there shall be added to or deducted from the Contract Price such further sum as may be agreed between the Contractor and the Engineer or, failing agreement, determined by the Engineer having regard to the Contractor's Site and general overhead costs of the Contract. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer. Such sum shall be based only on the amount by which such additions or deductions shall be in excess of 15 percent of the Effective Contract Price.

Daywork

52.4 The Engineer may, if in his opinion it is necessary desirable, issue an instruction that any varied work shall be executed on a daywork basis. The Contractor shall then be paid for such varied work under the terms set out in the daywork schedule included in the Contract and at the rates and prices affixed thereto by him in the Tender.

The Contractor shall furnish to the Engineer such receipts or other vouchers as may be necessary to prove the amounts paid and, before ordering materials, shall submit to the Engineer quotations for the same for his approval.

In respect of such of the Works executed on a daywork basis, the Contractor shall, during the continuance of such work, deliver each day to the Engineer an exact list in duplicate of the names, occupation and time of all workmen employed on such work and a statement, also in duplicate, showing the description and quantity of all materials and Contractor's Equipment used thereon or therefore other than Contractor's Equipment which is included in the percentage addition in accordance with such daywork schedule. One copy of each list and statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor.

At the end of each month the Contractor shall deliver to the Engineer a priced statement of the labour, materials and Contractor's Equipment, except as aforesaid, used and the Contractor shall not be entitled to any payment unless such lists and statements have been fully and punctually rendered. Provided always that if the Engineer considers that for any reason the sending of such lists or statements by the Contractor, in accordance with the foregoing provision, was impracticable he shall nevertheless, be entitled to authorized payment for such work, either as daywork, on being satisfied as to the time employed and the labour, materials and Contractor's Equipment used on such work, or at such value therefore as shall, in his opinion, be fair and reasonable.

Procedure for Claims

Notice of Claims

53.1 Notwithstanding any other provision of the Contract, if the Contractor intends to claim any additional payment pursuant to any Clause of these Conditions or otherwise, he shall give notice of his intention to the Engineer, with a copy to the Employer, within 28 days after the event giving rise to the claim has first arisen.

Contemporary Records

53.2 Upon the happening of the event referred to in Sub-Clause 53.1, the Contractor shall keep such contemporary records as may reasonably be necessary to support any claim he may

subsequently wish to make. Without necessarily admitting the Employer's liability, the Engineer shall, on receipt of a notice under Sub-Clause 53.1, inspect such contemporary records and may instruct the Contractor to keep any further contemporary records as are reasonable and may be material to the claim of which notice has been given. The Contractor shall permit the Engineer to inspect all records kept pursuant to this Sub-Clause and shall supply him with copies thereof as and when the Engineer so instructs.

Substantiation of Claims

53.3 Within 28 days, or such other reasonable time as may agreed by the Engineer of giving notice under Sub-Clause 53.1, the Contractor shall send to the Engineer an account giving detailed particulars of the amount claimed and the grounds upon which the claim is based. Where the event giving rise to the claim has a continuing effect, such account shall be considered to be an interim account and the Contractor shall, at such intervals as the Engineer may reasonably require, send further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. In cases where interim accounts are sent to the Engineer, the Contractor shall send a final account within 28 days of the end of the effects resulting from the event. The Contractor shall, if required by the Engineer so to do, copy to the Employer all accounts sent to the Engineer pursuant to this Sub-Clause.

Failure to Comply

53.4 If the Contractor fails to comply with any of the provisions of this Clause in respect of any claim which he seeks to make, his entitlement to payment in respect thereof shall not exceed such amount as the Engineer or any arbitrator or arbitrators appointed pursuant to Sub-Clause 67.3 assessing the claims considers to be verified by contemporary records (whether or not such records were brought to the Engineer's notice, as required under Sub-Clauses 53.2 and 53.3).

Payment of Claims

53.5 The Contractor shall be entitled to have included in any Interim payment certified by the Engineer pursuant to Clause 60 such amount in respect of any claim as the Engineer, after due consultation with the Employer and the Contractor, may consider due to the Contractor provided that the Contractor has supplied sufficient particulars to enable the Engineer to determine the amount due. If such particulars are insufficient to substantiate the whole of the claim, the Contractor shall be entitled to payment in respect of such part of the claim as such particulars may substantiate to the satisfaction of the Engineer. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer.

Contractor's Equipment, Temporary Works and Materials

Contractor's Equipment, Temporary Works and Materials; Exclusive use for the works

54.1 All Contractor's Equipment, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof, except for the purpose of moving it from one part of the Site to another, without the consent of the Engineer. Provided that consent shall not be required for vehicles engaged in transporting any staff, labour, Contractor's Equipment, Temporary Works, Plant or materials to or from the Site.

Employer not Liable for Damage

54.2 The Employer shall not at any time to be liable, save as mentioned in Clauses 20 and 65, for the loss of or damage to any of the said Contractor Equipment, Temporary Works or materials.

Customs Clearance

54.3 The Employer will use his best endeavours in assisting the Contractor, where required, in obtaining clearance through the Customs of Contractor's Equipment, materials and other things required for the Works.

Re-exports of Contractor's Equipment

54.4 In respect of any Contractor's Equipment which the Contractor has imported for the purposes of the Works, the Employer will use his best endeavours to assist the Contractor, where required, in procuring any necessary Government consent to the re-export of such Contractor's Equipment by the Contractor upon the removal thereof pursuant to the terms of the Contract.

Conditions of Hire of Contractor's Equipment

54.5 With a view to securing, in the event of termination under Clause 63, the continued availability, for the purpose of executing the Works, of any hired Contractor's Equipment, the Contractor shall not bring on to the Site any hired Contractor's Equipment unless there is an agreement for the hire thereof (which agreement shall be deemed not to include an agreement for hire purchase) which contains a provision that the owner thereof will, on request in writing made by the Employer within 7 days after the date on which any termination has become effective, and on the Employer undertaking to pay all hire charges in respect thereof from such date, hire such Contractor's Equipment to the Employer on the same terms in all respects as the same was hired to the Contractor save that the Employer shall be entitled to permit the use thereof by any other contractor employed by him for the purpose of executing and completing the Works and remedying any defects therein, under the terms of the said Clause 63.

Costs for the purpose of Clause

54.6 In the event of the Employer entering into any agreement for the hire of Contractor's Equipment pursuant to Sub-Clause 54.5, all

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sums properly paid by the Employer under the provisions of any such agreement and all costs incurred by him (including stamp duties) in entering into such agreement shall be deemed, for the purpose of Clause 63, to be part of the cost of executing and completing the Works and the remedying of any defects therein.

Incorporation of Clause in Subcontracts

54.7 The Contractor shall, where entering into any subcontract for the execution of any part of the Works, incorporate in such subcontract (by reference or otherwise) the provisions of this Clause in relation to Contractor's Equipment, Temporary Works or materials brought on to the Site by the Subcontractor.

Approval of Materials not Implied

54.8 The operation of this Clause shall not be deemed to imply any approval by the Engineer of the materials or other matters referred to therein nor shall it prevent the rejection of any such materials at any time by the Engineer.

Measurement

Quantities

55.1 The quantities set out in the Bill of Quantities are the estimated quantities for the Works, and they are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfilment of his obligations under the Contract.

Works to be Measured

56.1 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 authorised 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.

Method of Measurement

57.1 The Works shall be measured net, notwithstanding any general or local customs, except where otherwise provided for in the Contract.

Breakdown of Lump sum Items

57.2 For the purposes of statements submitted in accordance with Sub-Clause 60.1, the Contractor shall submit to the Engineer, within 28 days after the receipt of the Letter of Acceptance, a breakdown for each of the lump sum items contained in the Tender. Such breakdowns shall be subject to the approval of the Engineer.

Provisional Sums

Definition of "Provisional Sums"

58.1 "Provisional Sum" means a sum included in the Contract and so designated in the Bill of Quantities for the execution of any part of the Works or for the supply of goods, materials, Plant or services, or for contingencies, which sum may be used, in whole or in part, or not at all, on the instructions of the Engineer. The Contractor shall be entitled to only such amounts in respect of the work, supply or contingencies to which such Provisional Sums relate as the Engineer shall determine in accordance with this Clause. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer.

Use of Provisional Sums

58.2 In respect of every Provisional Sum the Engineer shall have authority to issue instructions for the execution of work or for the supply of goods, materials, Plant or services by:

(a) the Contractor, in which case the Contractor shall be entitled to an amount equal to the value thereof determined in accordance with Clause 52, and

(b) a nominated Subcontractor, as hereinafter defined, in which case the sum to be paid to the Contractor therefore shall be determined and paid in accordance with Sub-Clause 59.4.

Production of Vouchers

58.3 The Contractor shall produce to the Engineer all quotations, invoices, vouchers and accounts or receipts in connection with expenditure in respect of Provisional Sums, except where work is valued in accordance with rates or prices set out in the Tender.

Nominated Subcontractors

Definition of "Nominated Subcontractor"

59.1 All specialists, merchants, tradesmen and others executing any work or supplying any goods, materials, Plant or services for which Provisional Sums are included in the Contract, who may have been or be nominated or selected or approved by the Employer or the Engineer, and all persons to whom by virtue of the provisions of the Contract the Contractor is required to subcontract shall, in the execution of such work or the supply of such goods, materials, Plant or services, be deemed to be subcontractors to the Contractor and are referred to in this Contract as "nominated Subcontractors".

Nominated Subcontractors; Objection to Nomination

59.2 The Contractor shall not be required by the Employer or the Engineer, or be deemed to be under any obligation, to employ any nominated Subcontractors against whom the Contractor may raise reasonable objection, or who declines to enter into a subcontract with the Contractor containing provisions:

(a) that in respect of the work, goods, materials, Plant or services the subject of the subcontract, the nominated Subcontractor will undertake towards the Contractor such obligations and liabilities as will enable the Contractor to discharge his own obligations and liabilities towards the Employer under the terms of the Contract and will save harmless and indemnify the Contractor from and against the same and from all claims, proceeding, damages, costs, charges and expenses whatsoever arising out of or in connection therewith, or arising out of or in connection with any failure to perform such obligations or to fulfil such liabilities, and

(b) that the nominated Subcontractor will save harmless and indemnify the Contractor from and against any negligence by the nominated subcontractor, his agents, workmen and servants and from and against any misuse by him or them of any Temporary Works provided by the Contractor for the purposes of the Contract and from all claims as aforesaid.

Design Requirements to be Expressly Stated

59.3 If in connection with any Provisional Sum the services to be provided included any matter of design or specification of any part of the Permanent Works or of any Plant to be incorporated therein, such requirement shall be expressly stated in the Contract and shall be included in any nominated Subcontract. The nominated Subcontract shall specify that the nominated Subcontractor providing such services will save harmless and indemnify the Contractor from and against the same and from all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of or in connection with any failure to perform such obligations or to fulfil such liabilities.

Payments to Nominated Subcontractors

59.4 For all work executed or goods, materials, Plant or services supplied by any nominated Subcontractor, the Contractor shall be entitled to:

(a) the actual price paid or due to be paid by the Contractor, on the instructions of the Engineer, and in accordance with the Subcontract;

(b) in respect of all labour supplied by the contractor, the sums, if any, entered in the Bill of Quantities or, if instructed by the Engineer pursuant to paragraph (a) of Sub-Clause 58.2, as may be determined in accordance with Clause 52; and

(c) in respect of all other charges and profit, a sum being a percentage rate of the actual price paid or due to be paid calculated, where provision has been made in the Bill of Quantities for a rate to be set against the relevant Provisional Sum, at the rate inserted by the Contractor against that item or, where no such provision has been made, at the rate inserted by the Contractor in the Appendix to Tender and repeated where provision for such is made in a special item provided in the Bill of Quantities for such purpose

Certification of Payments to Nominated Subcontractors

59.5 Before issuing, under Clause 60, any certificate, which includes any payment in respect of work done or goods, materials, Plant or services supplied by any nominated Subcontractor, the Engineer shall be entitled to demand from the Contractor reasonable proof that all payments, less retentions, included in previous certificates in respect of the work or goods, materials, Plant or services of such nominated Subcontractor have been paid or discharged by the Contractor. If the Contractor fails to supply such proof then, unless the Contractor:

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

(b) produces to the Engineer reasonable proof that he has so informed such nominated Subcontractor in writing, the Employer shall be entitled to pay to such nominated Subcontractor direct, upon the certificate of the Engineer, all payments, less retentions, provided for in the nominated Subcontract, which the Contractor has failed to make to such nominated Subcontractor and to deduct by way of set-off the amount so paid by the Employer from any sums due or to become due from the Employer to the Contractor.

Provided that, where the Engineer has certified and the Employer has paid direct as aforesaid, the Engineer shall, in issuing any further certificate in favour of the Contractor,

deduct from the amount thereof the amount so paid, direct as aforesaid, but shall not withhold or delay the issue of the certificate itself when due to be issued under the terms of the Contract.

Certificates and Payment

Monthly Statements

60.1 The Contractor shall submit to the Engineer after the end of each month six copies, each signed by the Contractor's representative approved by the Engineer in accordance with Sub-Clause 15.1, of a statement, in such form as the Engineer may from time to time prescribe, showing the amounts to which the Contractor considers himself to be entitled up to the end of the month in respect of:

(a) the value of the Permanent Works executed,

(b) any other items in the Bill of Quantities including those for Contractor's Equipment, Temporary Works, dayworks and the like,

(c) the percentage of the invoice value of listed materials, all as stated in the Appendix to Tender, and Plant delivered by the Contractor on the Site for incorporation in the Permanent Works but not incorporated in such Works,

(d) adjustments under Clause 70, and

(c) any other sum to which the Contractor may be entitled under the Contract or otherwise.

Monthly Payments

60.2 The Engineer shall, within 15 days of receiving such statement, deliver to the Employer an Interim Payment Certificate stating the amount of payment to the Contractor which the Engineer considers due and payable in respect of such statement, subject:

(a) firstly, to the retention of the amount calculated by applying the Percentage of Retention stated in the Appendix to Tender, to the amount to which the Contractor is entitled under paragraphs (a), (b), (c) and (e); of Sub-Clause 60.1 until the amount so retained reaches the Limit of Retention Money stated in the Appendix to Tender, and

(b) secondly, to the deduction, other than pursuant to Clause 47, of any sums which may have become due and payable by the Contractor to the Employer.

Provided that the Engineer shall not be bound to certify any payment under this Sub-Clause if the net amount thereof, after all retentions and deductions, would be less than the Minimum

Amount of Interim Payment Certificates stated in the Appendix to Tender.

Notwithstanding the terms of this Clause or any other Clause of the Contract no amount will be certified by the Engineer for payment until the performance security, if required under the Contract, has been provided by the Contractor and approved by the Employer.

Payment of Retention Money

60.3 (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 parts 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 Clauses 49 and 50, in respects 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.

Correction of Certificates

60.4 The Engineer may be any Interim Payment Certificate make any correction or modification in any previous Interim Payment Certificate which shall have been issued by him and shall have authority, if any work is not being carried out to his satisfaction, to omit or reduce the value of such work in any Interim Payment Certificate.

Statement at Completion

60.5 Not later than 84 days after the issue of the Taking-Over Certificate in respect of the whole of the Works, the Contractor shall submit to the Engineer six copies of a Statement at Completion with supporting documents showing in detail, in the form approved by the Engineer:
(a) the final value of all work done in accordance with the Contract up to the date stated in such Taking-Over Certificate.

(b) any further sums which the Contractor considers to be due, and

(c) an estimate of amounts which the Contractor considers will become due to him under the Contract.

The estimated amounts shall be shown separately in such Statement at Completion. The Engineer shall certify payment in accordance with Sub-Clause 60.2.

Final Statement

60.6 Not later than 56 days after the issue of the Defects Liability Certificate pursuant to Sub-Clause 62.1, the Contractor shall submit to the Engineer for consideration six copies of a draft final statement with supporting documents showing in detail, in the form approved by the Engineer:

(a) the value of all work done in accordance with the Contract, and

(b) any further sums which the Contractor considers to be due to him under the Contract or otherwise. If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed (for the purposes of these Conditions referred to as the "Final Statement").

If, following discussions between the Engineer and the Contractor and any changes to the draft final statement which may be agreed between them, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer an Interim Payment Certificate for those parts of the draft final statement, if any, which are not in dispute. The dispute may then be settled in accordance with Clause 67.

Discharge

60.7 Upon submission of the Final Statement, the Contractor shall give to the Employer, with a copy to the Engineer, a written discharge confirming that the total of the Final Statement represents full and final settlement of all monies due to the Contractor arising out of or in respect of the Contract. Provided that such discharge shall become effective only after payment due under the Final Payment Certificate issued pursuant to Sub-Clause 60.8 has been made and the performance security referred to in Sub-Clause 10.1, if any, has been returned to the Contractor.

Final Payment Certificate

60.8 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.

Cessation of Employer's Liability

60.9 The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or execution of the Works, unless the Contractor shall have included a claim in respect thereof in his Final Statement and (except in respect of matters or things arising after the issue of the Taking-Over Certificate in respect of the whole of the Works) in the Statement at Completion referred to in Sub-Clause 60.5.

Time for Payment

60.10 The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause or to any other term of the Contract, shall subject to Clause 47, be paid by the Employer to the Contractor within 28 days after such Interim payment Certificate has been delivered to the Employer, or in the case of the Final Payment Certificate referred to in Sub-Clause 60.8, within 56 days after such Final Payment Certificate has been delivered to the Employer. In the eve of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor interest at the rate stated in the Appendix to Tender upon all sums unpaid from the date by which the same should have been paid. The provision of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69 or otherwise.

Approval only by Defects Liability Certificate

61.1 Only the Defects Liability Certificate, referred to in Clause 62, shall be deemed constitute approval of the Works.

Defects Liability Certificates

62.1 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 Defect Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works, the expiration of the late such period, or as soon thereafter as any works instructed, pursuant to Clauses 40 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.

Unfulfilled Obligations

62.2 Notwithstanding the issue of the Defects Liability Certificate the Contractor and the Employer shall remain liable for the fulfilment of any obligation incurred under the provisions of the Contract prior to the issue of the Defects Liability Certificate which remains unperformed at the time such Defects Liability Certificate is issued and, for the purposes of determining the nature and extent to any such obligation, the Contract shall be deemed to remain in force between the parties to the Contract.

Remedies

Default of Contractor

63.1 If the Contractor is deemed by law unable to pay his debts as they fall due, or enters into voluntary or involuntary bankruptcy, liquidation or dissolution (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), or becomes insolvent, or makes an arrangement with, or assignment in favour of, his creditors, or agree to carry out the Contract under a committee of inspection of his creditors, or if a receiver, administrator, trustee or liquidator is appointed over any substantial part of his assets, or if, under any law or regulation relating to reorganization, arrangement or readjustment of debts, proceedings are commenced against the Contractor or resolutions passed in connection with dissolution or liquidation or if any steps are taken to enforce any security interest over a substantial part of the assets of the Contractor, or if any act is done or event occurs with respect to the Contractor or his assets which, under any applicable law has a substantially similar effect to any of the foregoing acts or events, or if the Contractor has contravened Sub-Clause 3.1, or has an execution levied on his goods, or if the Engineer certifies to the Employer, with a copy to the Contractor, that, in his opinion, the Contractor:

(a) has repudiated the Contract,

(b) without reasonable excuse has failed
   (i) to commence the Works in accordance with Sub-Clause 41.1, or
   (ii) to proceed with the Works, or any Section thereof, within 28 days after receiving notice pursuant to Sub-Clause 46.1,

(c) has failed to comply with a notice issued pursuant to Sub-Clause 37.4 or an instruction issued pursuant to Sub-Clause 39.1 within 28 days after having received it,

(d) despite previous warning from the Engineer, in writing, is otherwise persistently or flagrantly neglecting to comply with

any of his obligations under the Contract, or

(e) has contravened Sub-Clause 4. 1, then the Employer may, after giving 14 days' notice to the Contractor, enter upon the Site and the Works and terminate the employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the Contract, or affecting the rights and authorities conferred on the Employer or the Engineer by the Contract, and may himself complete the Works or may employ any other contractor to complete the Works. The Employer or such other contractor may use for such completion so much of the Contractor's Equipment, Temporary Works and materials as he or they may think proper.

Valuation at Date of Termination

63.2 The Engineer shall, as soon as may be practicable after any such entry and termination by the Employer, fix and determine ex part, or by or after reference to the parties or after such investigation or enquiries as he may think fit to make or institute, and shall certify:

(a) what amount (if any) had, at the time of such entry and termination, been reasonably earned by or would reasonably accrue to the Contractor in respect of work then actually done by him under the Contract, and

(b) the value of any of the said unused or partially used materials, any Contractor's Equipment and any Temporary Works.

Payment after Termination

63.3 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 there after 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.

Assignment of

63.4 Unless prohibited by law, the Contractor shall, if so instructed

Benefit of Agreement

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.

Urgent Remedial Works

64.1 If, by reason of any accident, or failure, or other event occurring to, in, or in connection with the Works, or any part thereof, either during the execution of the Works, or during the Defects Liability Period, any remedial or other work is, in the opinion of the Engineer, urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work, the Employer shall be entitled to employ and pay other persons to carry out such work as the Engineer may consider necessary. If the work or repair so done by the Employer is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Provided that the Engineer shall, as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof.

Special Risks

No Liability for Special Risks

65.1 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.

Special Risks

65.2 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 these relate to the country in which the Works are to be executed.

Damage to Works by Special Risks

65.3 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.

Projectile, Missile

65.4 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, ammunition, or explosive of war, shall be deemed to be a consequence of the said special risks.

Increased Costs arising from Special Risks

65.5 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 Works (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.

Outbreak of War **65.6** 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 endeavours 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.

Removal of Contractor's Equipment on Termination

65.7 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.

Payment if Contract Terminated

65.8 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 proportion 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 the 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.

Release from Performance

Payment in Event of Release from Performance

66.1 If any circumstance outside the control of both parties arises after the issue of the Letter of Acceptance which renders it impossible or unlawful for either or both parties to fulfil his or their contractual obligations, or under the law governing the Contract the parties are released from further performance, then the parties shall be discharged from the Contract, except as to their rights under this Clause and Clause 67 and without prejudice to the rights of either party in respect of any antecedent breach of the Contract, and the sum payable by the Employer to the Contractor in respect of the work executed shall be the same as that which would have been payable under Clause 65 if the Contract had been terminated under the provisions of Clause 65.

Settlement of Disputes

Engineer's Decision

67.1 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.

Unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works with all due diligence and the Contractor and the Employer shall give effect forthwith to every such decision of

the Engineer unless and until the same shall be revised, as hereinafter provided, in an amicable settlement or an arbitral award.

If either the Employer or the Contractor be dissatisfied with any decision of the Engineer, or if the Engineer fails to give notice of his decision on or before the eighty-fourth day after the day on which he received the reference, then either the Employer or the Contractor may, on or before the seventieth day after the day on which he received notice of such decision, or on or before the seventieth day after the day on which the said period of 84 days expired, as the case may be, give notice to the other party, with a copy for information to the Engineer, of his intention to commence arbitration, as hereinafter provided, as to the matter in dispute. Such notice shall establish the entitlement of the party giving the same to commence arbitration, as hereinafter provided, as to such dispute and, subject to Sub-Clause 67.4, no arbitration in respect thereof may be commenced unless such notice is given.

If the Engineer has given notice of his decision as to a matter in dispute to the Employer and the Contractor and no notice of intention to commence arbitration as to such dispute has been given by either the Employer or the Contractor on or before the seventieth day after the day on which the parties received notice as to such decision from the Engineer, the said decision shall become final and binding upon the Employer and the Contractor.

Amicable Settlement

67.2 Where notice of intention to commence arbitration as to a dispute has been given in accordance with Sub-Clause 67.1, arbitration of such dispute shall not be commenced unless an attempt has first been made by the parties to settle such dispute amicably. 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, whether or not any attempt at amicable settlement thereof has been made.

Arbitration

67.3 Any dispute in respect of which:

(a) the decision, if any, of the Engineer has not become final and binding pursuant to Sub-Clause 67.1, and

(b) amicable settlement has not been reached within the period stated in Sub-Clause 67.2 shall be finally settled, unless otherwise specified in the Contract, under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed under such Rules. The said arbitrator/s shall have full power to open up, review and revise any decision, opinion, instruction, determination, certificate or valuation of the Engineer related to the dispute.

Neither party shall be limited in the proceedings before such arbitrator/s to the evidence or arguments put before the Engineer for the purpose of obtaining his said decision pursuant to Sub-Clause 67.1. No such decision shall disqualify the Engineer from being called as a witness and giving evidence before the arbitrator/s on any matter whatsoever relevant to the dispute.

Arbitration may be commenced prior to or after completion of the works, provided that the obligations of the Employer, the Engineer and the Contractor shall not be altered by reason of the arbitration being conducted during the progress of the Works.

Failure to Comply with Engineer's Decision

67.4 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 other rights it may have, refer the failure to arbitration in accordance with Sub-Clause 67.3. The provisions of Sub-Clauses 67.1 and 67.2 shall not apply to any such reference.

Notices

Notice to Contractor

68.1 All certificates, notices or instructions to be given to the Contractor by the Employer or the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the Contractor's principal place of business or such other address as the Contractor shall nominate for that purpose.

Notice to Employer and Engineer

68.2 Any notice to be given to the Employer or to the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the respective address as nominated for that purpose in Part II of these Conditions.

Changes of Address

68.3 Either party may change a nominated address to another address in the country where the Works are being executed by prior notice to the other party, with a copy to the Engineer, and the Engineer may do so by prior notice to both parties.

Default of Employer

Default of Employer

69.1 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 subtracting 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 unforeseen economic reasons it is impossible for him to continue to meet his contractual obligations, the Contractor shall be entitled to terminate is 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.

Removal of Contractor's Equipment

69.2 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 Contactor's Equipment brought by him thereon.

Payment on Termination

69.3 In the event of such termination the Employer shall be under the same obligations to the Contractor in regard to payment as if the Contractor 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 loss or damage to the Contractor arising out of or in connection with or by consequence of such termination.

Contractor's Entitlement to Suspend Work

69.4 Without prejudice to the Contactor's entitlement to interest under Sub-Clause 60.10 and to terminate under Sub-Clause 69.1, the Contactor may, if the Employer fails to pay 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 made under the Contractor, after giving 28 days prior notice to the Employer,

with a copy to the Engineer, suspend work or reduce the rate of work.

If the Contractor suspends work or reduces the rate of work in accordance with the provisions of this Sub-Clause and thereby suffers delay or incurs costs 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 of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

Resumption of Work

69.5 Where the Contractor suspends work or reduces the rate of work, having given notice in accordance with Sub-Clause 69.4, and the Employer subsequently pays the amount due, including interest pursuant to Sub-Clause 60.10, the Contractor's entitlement under Sub-Clause 69.1 shall, if notice of termination has not been given, lapse and the Contractor shall resume normal working as soon as is reasonably possible.

Changes in Costs and Legislation

Increase or Decrease of Cost

70.1 There shall be added to or deducted from the Contract Price such sums in respect of rise or fall in the cost of labour and/or materials or any other matters affecting the cost of the execution of the Works as may be determined in accordance with Part II of these Conditions.

Subsequent Legislation

70.2 If, after the date 28 days prior to the latest date for submission of tenders for the Contract there occur in the country in which the Works are being or are to be executed changes to any National or State Statute, Ordinance, Decree or other Law or any regulation or bye-law of any local or other duly constituted authority, or the introduction of any such State Statute, Ordinance, Decree, Law, regulation or bye-law which causes additional or reduced cost to the Contractor, other than under Sub-Clause 70.1, in the execution of the Contract, such additional or reduced cost shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be added to or deducted from the Contract Price and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

Currency and Rates of Exchange

Currency Restrictions

71.1 If, after the date 7 days prior to the latest date for submission of tenders for the Contract, the Government or authorised agency

of the Government of the country in which the Works are being or are to be executed imposes currency restrictions and/or transfer of currency restrictions in relation to the currency or currencies in which the Contract Price is to be paid, the Employer shall reimburse any loss or damage to the Contractor arising there from, without prejudice to the right of the Contractor to exercise any other rights or remedies to which he is entitled in such event.

Rates of Exchange **72.1** 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.

Currency Proportions **72.2** Where the Employer has required the Tender to be expressed in a single currency but 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 date 28 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.

Currencies of Payment for Provisional Sums **72.3** 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-Clause 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.

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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 Chandka Medical College - 77170

Tel: (9274) 9410715, PABX: +9274-9410750

(a) (iv) The Engineer is ESS.I.AAR, 314, Mashrique Center, Block-4 S.S.Suleman Rd. Gulshan-e-Iqbal, Karachi, Sindh, Pakistan.
Firm/Company/Person nominated as Engineer along with his full address), or any other competent person appointed by the Employer, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineers is to formulate his certifications/recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure.

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 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 therefrom 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:

(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-Clause 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 less than 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 under Clause 53.

(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

The following paragraph is added:

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

2.8 Replacement of the Engineer

"If the Employer intends to replace the Engineer, the Employer shall, not less than 14 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."

5.1 Language(s) and Law

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

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 28 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.

14.1 Programme to be Submitted

The programme shall be submitted within 21 days from the date of receipt of Letter of Acceptance, which shall be in the form of:

i) a Bar Chart identifying the critical activities.

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) Labour 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 5th day of the following month, 03 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 to enable 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, and proposals 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 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 authorised 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 labour 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 authorise 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).

The following Sub-Clause 25.5 is added:

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.

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 Labour

The Contractor shall pay rates of' wages and observe conditions of labour not less favourable 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 labour so established, the Contractor shall pay rates of wages and observe conditions of labour which are not less favourable 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 labour 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 Labour

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 labour, 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 labour 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 and labour.

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 labour.

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.

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:

47.3 Bonus for Early Completion of Works

This clause stands as “deleted”.

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”.

51.2 Instructions for Variations

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

53.3 Failure to Comply

This Sub-Clause is deleted in its entirety.

54.4 Customs Clearance

The following lines are added "All related charges related to custom clearance will be paid by the contractor"

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 the hire thereof contains a provision in accordance with the requirements set forth above.

The following Sub-Clauses 59.4 & 59.5 are added:

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) submits reasonable evidence to the Engineer, or
b) i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and
   ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

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)

60.10 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 if 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 consumption basis.

60.11 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**:**

Mobilization Advance

(1) Mobilization Advance up to 10 % of the Contract Price stated in the Letter of Acceptance shall be paid by the Procuring Agency to the Contractor on the works costing Rs.2.5 million or above on following conditions:

(i) On submission by the Contractor of a Mobilization Advance Guaranty By the full amount of the Advance in the specified form against the Bank Gaurantee from a Scheduled Bank in Pakistan to the Procuring Agency;
(ii) Contractor will pay interest on the mobilization advance at the rate of 10% per annum on the advance; and.
(iii) This Advance including the interest shall be recovered in 5 equal instalments from the five (05) R.A bills and in case the number of bills is less than five (05) then 1/5th of the advance **inclusive of the interest** thereon shall be recovered from each bill and the balance together with interest be recovered from the final bill. It may be insured that there is sufficient amount in the final bill to enable recovery of the Mobilization Advance.

Or The list of materials, quantities and rates to be charged to the Contractor shall be provided alongwith Appendix-A to Bid “Special Stipulations”.

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

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.

65.2 Special Risks

The text is deleted and substituted with the following:

The Special Risks are the risks defined under Sub-Clause 20.4 sub paragraphs (a) (i) to (a) (v).

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 Larkana, Sindh, Pakistan.

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 address are:

a) The Employer :

"Chandka Medical College" - 77170
Phone: (9274) 9410715, PABX: +9274-9410750

b) The Engineer:

M/s ESS.I.AAR, 314, Mashrique Center, Block-4 S.S.Suleman Rd. Gulshan-e-Iqbal, Karachi, Sindh, Pakistan.
Phone: +9221-4852589

70.1 Increase or Decrease of Cost

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

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

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

$$Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + \ldots\ldots\ldots\ldots\ldots$$

Where:

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 daywork are 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 proportion of each cost element (labour, 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 the above 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 approval by the Engineer.

(d) Base, Current, and Provisional Indices

The base cost indices or prices shall be those prevailing on the day 28 days prior to the 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 to the 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.

(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:

73.1 Payment of Income Tax

The Contractor, Subcontractors and their employees shall be responsible for payment of 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 (c) 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 labour 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

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 any dispute 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.

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SPECIFICATIONS-
SPECIAL PROVISIONS

SPECIFICATIONS-
TECHNICAL PROVISIONS

DRAWINGS

PROJECT:

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TENDERS DRAWINGS

CLIENT:

Chandka Medical Hospital, Larkana

DWG NO.	SHEET NO.	INDEX	DRAWING TITLE	REV NO.
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AR-02	01 OF 01	-	DEMOLISHED LAYOUT PLAN	
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STRUCTURE				
S-01	01 OF 01	-	STRUCTURE GENERAL NOTES	
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CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

LIST OF DRAWINGS

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .

DATE: APRIL.2025

DRAWN BY: A-A

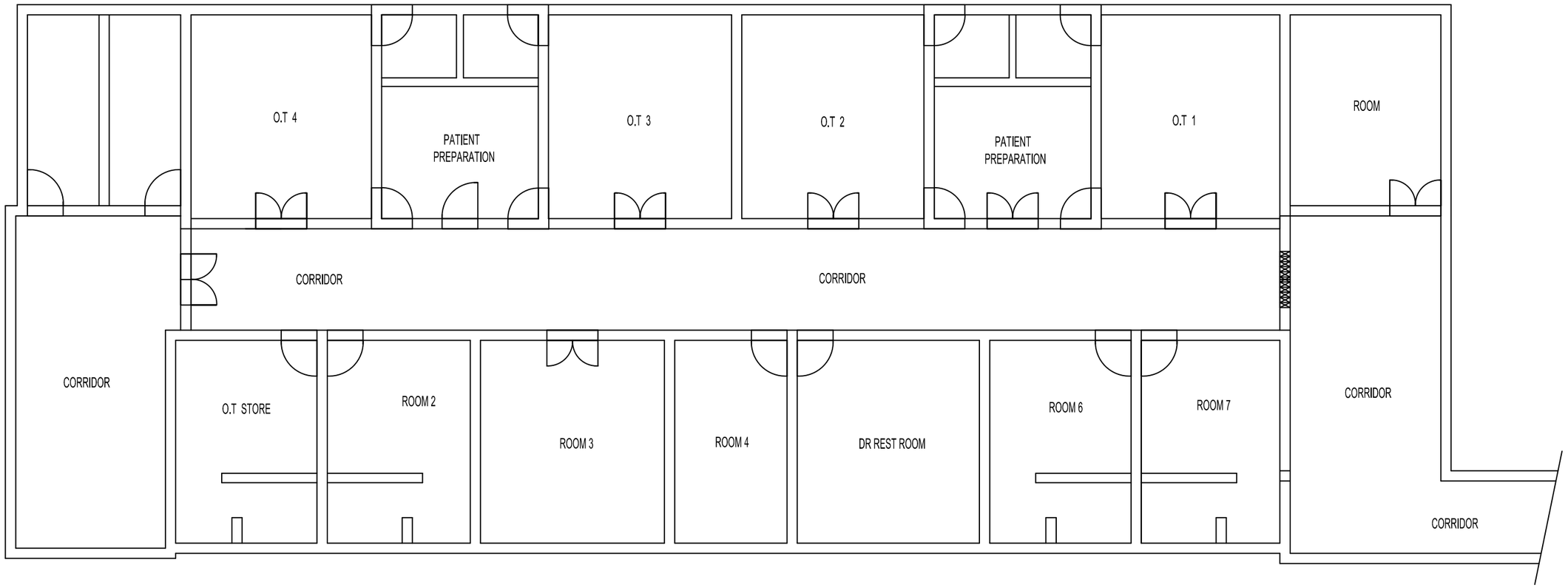
SCALE: AS SHOWN

CHECKED BY: O-A

DWG. NO.: GE-01

GENERAL NOTES

1. ALL DIMENSIONS ARE SHOWN IN FEETS AND INCHES.
2. CONCRETE STRENGTH SHOULD BE MINIMUM OF 4000PSI CYLINDRICAL.
3. STEEL SHALL CONFIRMS TO ASTM A615.
4. ALL BLOCK WORK SHALL BE SOLID BLOCK AND SHALL HAVE MINIMUM OF 600Psi STRENGTH.
5. READ THIS DRAWING IN CONJUNCTION WITH OTHER DRAWINGS OF ALL SPECIALITIES.



CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

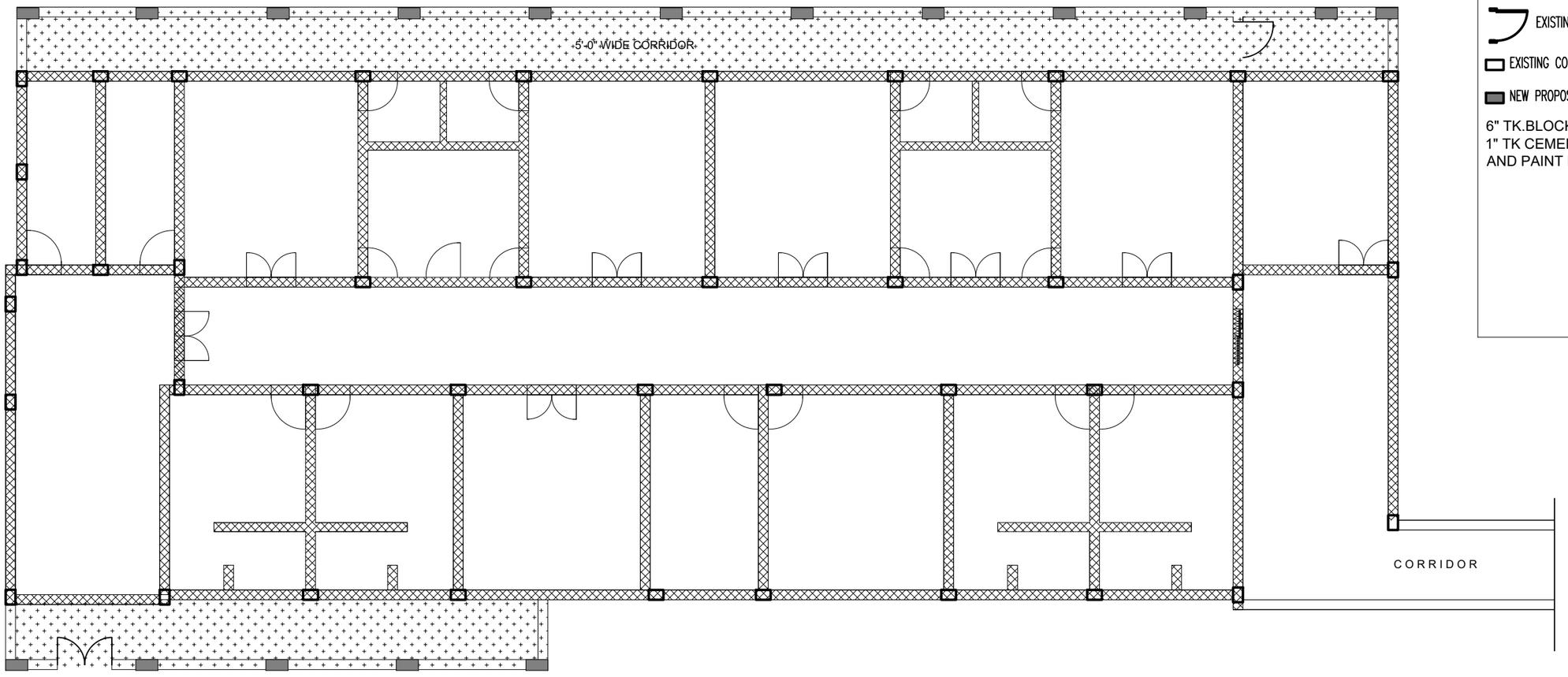
RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

EXISTING AS BUILT PLAN

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .	DATE APRIL.2025
DRAWN BY A-A	SCALE AS SHOWN
CHECKED BY O-A	DWG. NO. AR-01



GENERAL NOTES

1. ALL DIMENSIONS ARE SHOWN IN FEETS AND INCHES.
2. CONCRETE STRENGTH SHOULD BE MINIMUM OF 4000PSI CYLINDRICAL.
3. STEEL SHALL CONFIRMS TO ASTM A615.
4. ALL BLOCK WORK SHALL BE SOLID BLOCK AND SHALL HAVE MINIMUM OF 600Psi STRENGTH.
5. READ THIS DRAWING IN CONJUNCTION WITH OTHER DRAWINGS OF ALL SPECIALITIES.

LEGENDS

EXISTING BLOCK MASONRY TO BE DEMOLISHED

NEW PROPOSED SLAB

EXISTING DOOR TO BE DEMOLISHED

EXISTING COLUMN

NEW PROPOSED COLUMN

6" TK.BLOCK MASONRY
1" TK CEMENET PLASTER
AND PAINT FINISH BOTH SIDE

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

DEMOLISHED LAYOUT PLAN

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .	DATE APRIL.2025
DRAWN BY A-A	SCALE AS SHOWN
CHECKED BY O-A	DWG. NO. AR-02



GENERAL NOTES

1. ALL DIMENSIONS ARE SHOWN IN FEETS AND INCHES.
2. CONCRETE STRENGTH SHOULD BE MINIMUM OF 4000PSI CYLINDRICAL.
3. STEEL SHALL CONFIRMS TO ASTM A615.
4. ALL BLOCK WORK SHALL BE SOLID BLOCK AND SHALL HAVE MINIMUM OF 600Psi STRENGTH.
5. READ THIS DRAWING IN CONJUNCTION WITH OTHER DRAWINGS OF ALL SPECIALITIES.

LEGENDS

EXISTING COLUMN

NEW PROPOSED COLUMN

6" TK.BLOCK MASONRY
1" TK CEMENET PLASTER
AND PAINT FINISH BOTH SIDE

SCHEDULE OF DOORS

D	5'-0"x7'-0"
SD1	5'-0"x7'-0"
SD2	4'-0"x7'-0"
D1	3'-4"x7'-0"
D1a	3'-4"x7'-0"
D2	3'-0"x7'-0"
D3	3'-0"x7'-0"
D4	2'-6"x6'-0"

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

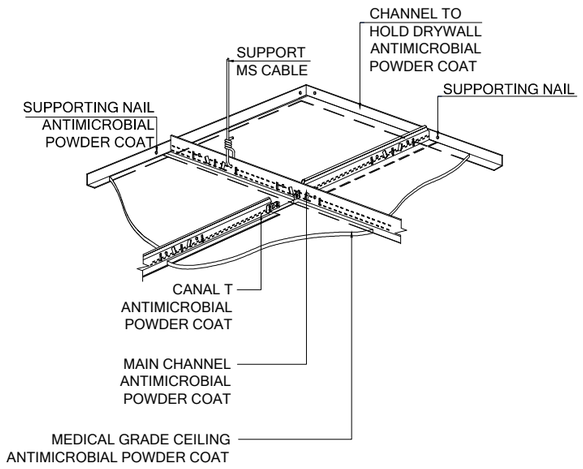
RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

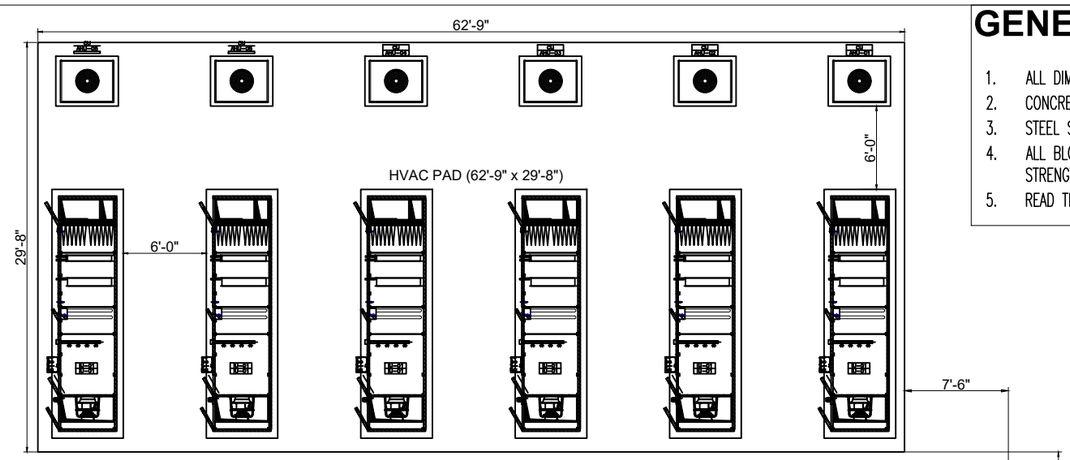
PROPOSED LAYOUT PLAN

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .	DATE APRIL.2025
DRAWN BY A-A	SCALE AS SHOWN
CHECKED BY O-A	DWG. NO. AR-03

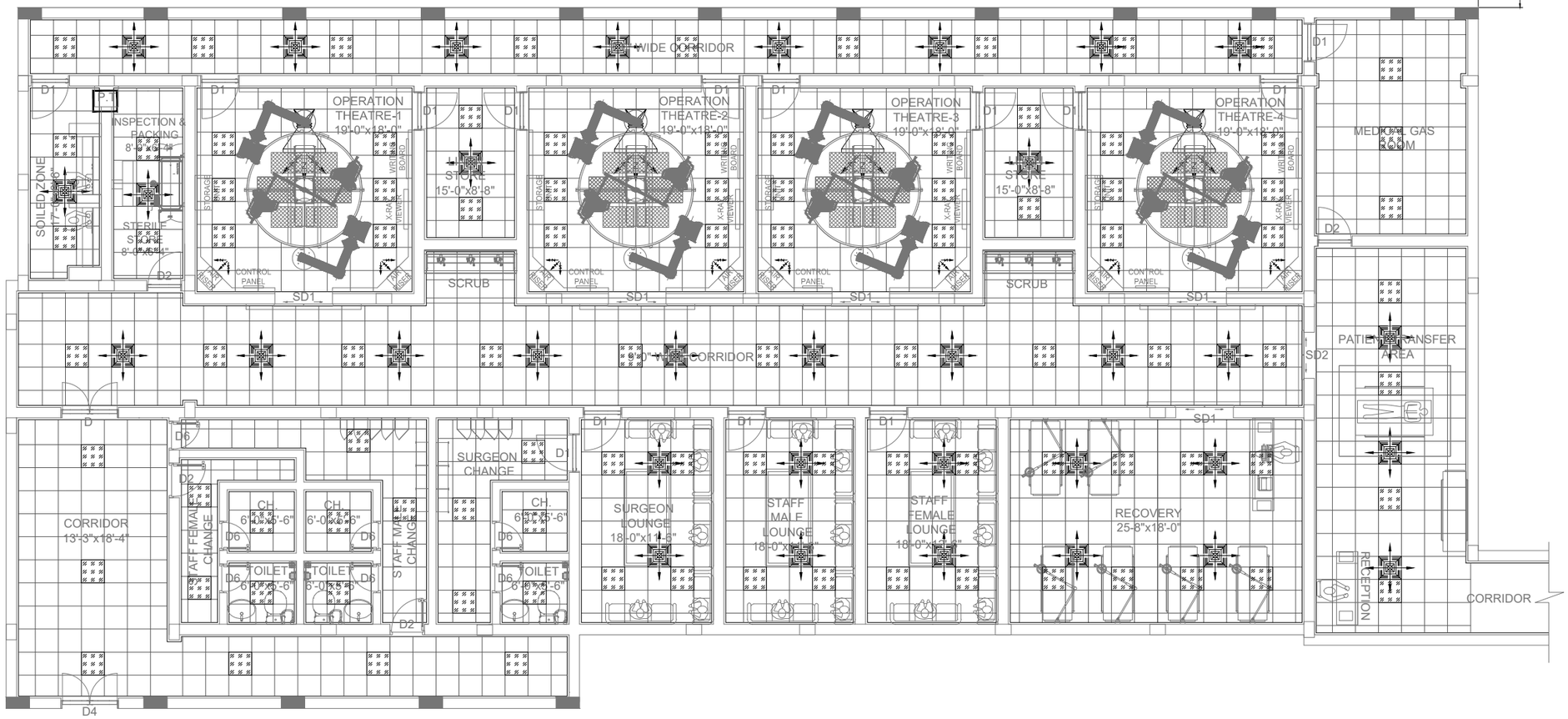


CEILING FIXING DETAILS

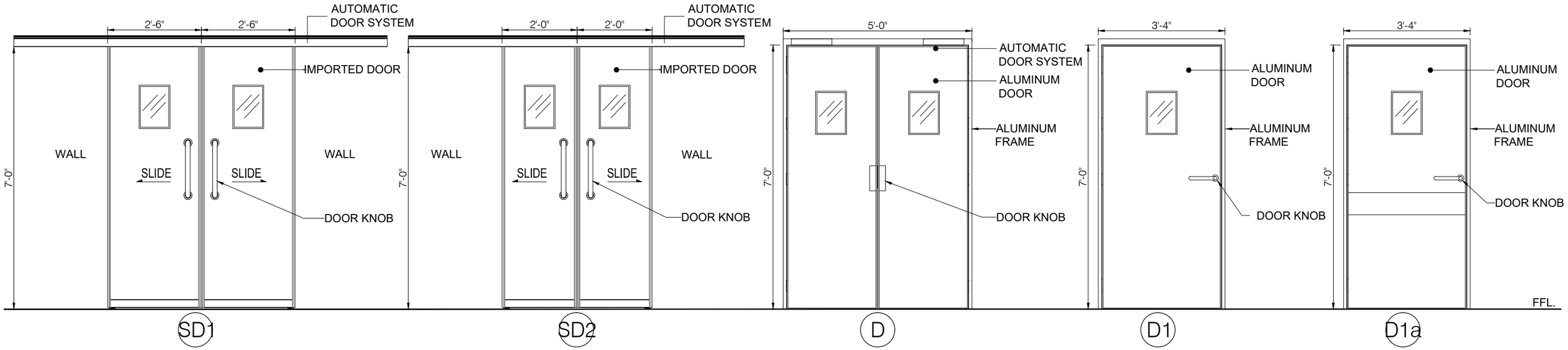


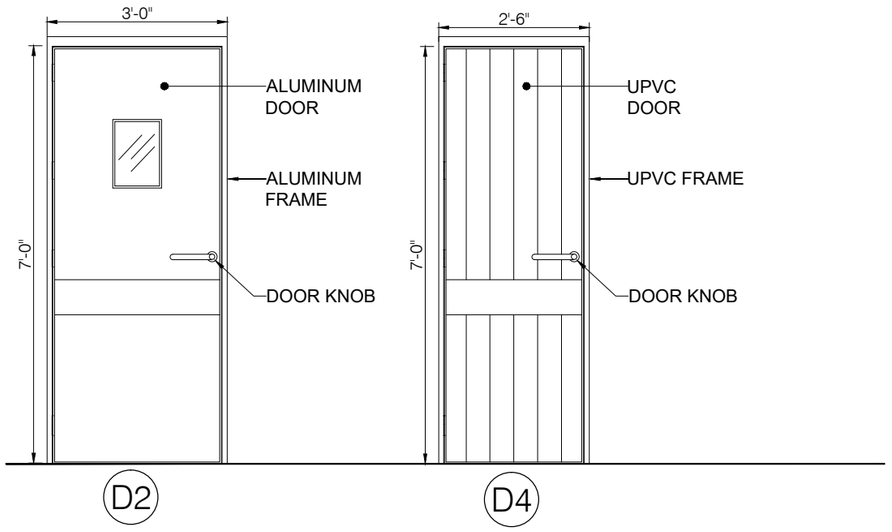
GENERAL NOTES

1. ALL DIMENSIONS ARE SHOWN IN FEETS AND INCHES.
2. CONCRETE STRENGTH SHOULD BE MINIMUM OF 4000PSI CYLINDRICAL.
3. STEEL SHALL CONFIRMS TO ASTM A615.
4. ALL BLOCK WORK SHALL BE SOLID BLOCK AND SHALL HAVE MINIMUM OF 600Psi STRENGTH.
5. READ THIS DRAWING IN CONJUNCTION WITH OTHER DRAWINGS OF ALL SPECIALITIES.



CLIENT:- **Chandka Medical Hospital, Larkana**	CONSULTANT:	PROJECT:- RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	TITLE:- CEILING LAYOUT PLAN	REV # / DATE / DESCRIPTION / CHK'D / APP'D	Project Ref: .	DATE: APRIL.2025	
					DRAWN BY: A-A	SCALE: AS SHOWN	
					CHECKED BY: O-A	DWG. NO.: AR-04	





SCHEDULE OF DOORS & WINDOWS

DOOR NAME	DOOR TYPE	DOORS								
		WIDTH(W) (ft)	HEIGHT(H) (ft)	FRAME			ALUMINUM DOOR	UPVC DOOR	WOOD DOOR	REMARKS
				UPVC	ALUMINUM	GI				
D	DOUBLE LEAF	5'-0"	7'-0"		◉		◉			
SD1	AUTOMATIC SLIDING	5'-0"	7'-0"							IMPORTED
SD2	AUTOMATIC SLIDING	4'-0"	7'-0"							IMPORTED
D1	SINGLE LEAF	3'-4"	7'-0"							IMPORTED
D1a	SINGLE LEAF	3'-4"	7'-0"		◉		◉			
D2	SINGLE LEAF	3'-0"	7'-0"		◉		◉			
D4	SINGLE LEAF	2'-6"	7'-0"	◉				◉		

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

SCHEDULE OF DOORS OTHER DETAILS

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .

DATE: APRIL.2025

DRAWN BY: A-A

SCALE: AS SHOWN

CHECKED BY: O-A

DWG. NO.: AR-05

INTERIOR FINISHES (FLOORING)

DESCRIPTION		SUB FLOOR			MAIN FLOORING				
GROUND FLOOR		COMPACTED EARTH FILLING	6" SOLING	4" PCC 1:4:8	2" PCC 1:2:4	PORCELAIN TILE	GLAZED TILE	MALBLE TILE	VINYL
1	OPERATION THEATRE-1								◉
2	OPERATION THEATRE-2								◉
3	OPERATION THEATRE-3								◉
4	OPERATION THEATRE-4								◉
5	LINEN STORE								◉
6	SOILED ZONE								◉
7	INSPECTION PACKING & STERILE STORE								◉
8	5'-0"WIDE CORRIDOR	◉	◉	◉	◉				◉
9	9'-0"WIDE CORRIDOR								◉
10	CORRIDOR	◉	◉	◉	◉	◉			
11	MEDICAL GAS ROOM	◉	◉	◉	◉	◉			
12	PATIENT TRANSFER AREA					◉			
13	RECOVERY AREA					◉			
14	STAFF FEMALE LOUNGE					◉			
15	STAFF MALE LOUNGE					◉			
16	SURGEON CHANGE						◉		
17	STAFF MALE CHANGE						◉		
18	STAFF FEMALE CHANGE						◉		

INTERIOR FINISHES (PLASTER/ PAINT/ VERNISHED

DESCRIPTION								
GROUND FLOOR		WALL TILE	CEILING PLASTER	WALL PLASTER	CEILING PAINT DISTEMPER	WALL PAINT MATT FINISH	VINYL	WEATHER SHEET
1	OPERATION THEATRE-1						◉	
2	OPERATION THEATRE-2						◉	
3	OPERATION THEATRE-3						◉	
4	OPERATION THEATRE-4						◉	
5	LINEN STORE						◉	
6	SOILED ZONE						◉	
7	INSPECTION PACKING & STERILE STORE						◉	
8	5'-0"WIDE CORRIDOR						◉	
9	9'-0"WIDE CORRIDOR						◉	
10	CORRIDOR					◉		
11	MEDICAL GAS ROOM					◉		
12	PATIENT TRANSFER AREA					◉		
13	RECOVERY AREA					◉		
14	STAFF FEMALE LOUNGE					◉		
15	STAFF MALE LOUNGE					◉		
16	SURGEON CHANGE	◉				◉		
17	STAFF MALE CHANGE	◉				◉		
18	STAFF FEMALE CHANGE	◉				◉		

EXTERIOR FINISHES

BUILDING EXTERIOR							◉
WALL CLADING							

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

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TITLE:-

SCHEDULE OF DOORS OTHER DETAILS

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .

DRAWN BY A-A

CHECKED BY O-A

DATE APRIL.2025

SCALE AS SHOWN

DWG. NO. AR-06

GENERAL

G1 STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER DISCIPLINE DRAWINGS, DOCUMENTS, SPECIFICATIONS ETC. AS PART OF THE CONTRACT DOCUMENT OR. MAY BE ISSUED DURING THE COURSE OF THE CONTRACT.

G2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE. DIMENSIONS SHALL NOT BE OBTAINED BY SCALING DRAWINGS.

G3 FOR MAIN SETTING OUT LINES AND LEVELS REFER TO ARCHITECTURAL DRAWINGS.

G4 THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THE SAFETY OF CONSTRUCTION AT ALL TIMES AND SHALL ENSURE THAT NO PART OF INTERMEDIATE COMPLETED CONSTRUCTION IS HAZARDOUS (FOR EXAMPLE: SIDES OF EXCAVATION, STARTER BARS ETC.)

G5 THE CONTRACTOR SHALL PROVIDE TEMPORARY BRACING AND SHORING AGAINST LATERAL FORCES AND ALL CONSTRUCTION LOADS THROUGHOUT THE CONSTRUCTION PROCESS.

G6 ALL ELEMENTS OF THE STRUCTURE DESIGNED BY THE CONTRACTOR SHALL BE SUBMITTED TO DESIGN CONSULTANT FOR REVIEW.

G7 THE DESIGN CONSULTANT'S REVIEW PROCESS FOR ALL SUBMITTALS, DRAWINGS, METHOD STATEMENTS AND DOCUMENTS IS ONLY COMPLETE ONCE A STATUS OF 'NO OBJECTION' IS REACHED. THE SUBMITTAL SHALL BE REVIEWED BY THE DESIGN CONSULTANT FOR COMPLIANCE WITH THE DESIGN INTENT THIS DOES NOT RELIEVE THE CONTRACTOR FROM HIS CONTRACTUAL RESPONSIBILITIES.

G8 FOR ALL BUILDERS WORK INFORMATION (OPENINGS IN STRUCTURAL ELEMENTS):- LIGHTING POINTS, GULLIES, CAST-IN PIPES, SLEEVES, ELECTRICAL TRENCHES, MANHOLES ETC, REFER TO MEP DRAWINGS FOR LOCATION, THE CONTRACTOR SHALL PREPARE COORDINATED SERVICES DRAWINGS IDENTIFYING STRUCTURAL, MEP AND ARCHITECTURAL ELEMENTS/DETAILS FOR CONSULTANT'S REVIEW BEFORE COMMENCEMENT OF CONSTRUCTION IN THE AREA CONCERNED.

G9 ALL DESIGN, WORKMANSHIP AND MATERIAL SHALL BE IN ACCORDANCE WITH THE CURRENT ACI, UBC, IBC, AISC AND LOCAL AUTHORITY STANDARDS AND PROJECT DESIGN CRITERIA UNLESS NOTED OTHERWISE.

GENERAL CONSTRUCTION CONDITION

GC1 ALL EXCAVATION SHALL BE BASED ON ENGINEERING SHOP DRAWINGS PREPARED BY THE CONTRACTOR, INCLUDING PLANS AND SECTIONS OF EXCAVATION SEQUENCES. THE EXCAVATION SEQUENCES SHALL BE CONTROLLED TO MATCH THE REQUIREMENTS OF THE DESIGN OF THE SOIL RETENTION SYSTEM AND SHALL INCLUDE MONITORING OF WALL AND GROUND MOVEMENTS.

GC2 THE CONTRACTOR SHALL PROVIDE SURFACE DRAINAGE CHANNELS AND SUMPS AND SUMP PUMPS TO PROTECT ALL EXCAVATIONS FROM FLOODING. FLOODING OF ANY EXCAVATION AFTER APPROVAL OF SUB GRADE WILL BE CAUSE FOR REVOCATION OF APPROVAL AND COMPLETE RE-PREPARATION OF THE SUBGRADE.

GC3 THE CONTRACTOR SHALL PROVIDE POSITIVE PROTECTION (MAT/SHEET COVERING) FOR ALL EXCAVATED SLOPES TO PROTECT SLOPES FROM INSTABILITY AND DETERIORATION DUE TO ENVIRONMENTAL CONDITIONS.

GC4 THE EXCAVATION RETENTION SYSTEM SHALL BE DESIGNED AND INSTALLED BY THE CONTRACTOR, UNLESS NOTED OTHERWISE, IN ACCORDANCE WITH THE GEOTECHNICAL DESIGN PARAMETERS AND SOIL PRESSURES AS INDICATED IN THE GEOTECHNICAL INVESTIGATION REPORT.

GC5 THE CONTRACTOR SHALL INSTALL AND CONTINUOUSLY SURVEY VERTICAL AND HORIZONTAL MOVEMENTS OF THE TOP OF THE SOIL RETENTION SYSTEM, IF INSTALLED, BENCH MARKS ADJACENT TO AND AWAY FROM THE SITE PERIMETER FOR VERTICAL AND HORIZONTAL MOVEMENTS AND OBSERVATION WELLS FOR MONITORING WATER LEVELS BELOW GROUND SURFACE.

GC6 AFTER COMPLETION OF THE PERIMETER SOIL RETENTION SYSTEM, THE SITE SHALL BE DE-WATERED, AS NECESSARY, BEFORE (OR AS) THE EXCAVATION PROCEEDS. THE CONTRACTOR SHALL PROVIDE ALL CONSTRUCTION AND EQUIPMENT FOR THE DE-WATERING SYSTEM INCLUDING, BUT NOT LIMITED TO, TRENCHES, SUMPS, DE-WATERING WELLS, WELL POINTS, OBSERVATION WELLS, PUMPING SYSTEM, DISPOSAL LOCATION, SETTLING BASINS, MAINTENANCE AND EMERGENCY BACK-UP EQUIPMENT, ETC.

GC7 THE DE-WATERING SYSTEM SHALL MAINTAIN THE WATER LEVEL A MINIMUM OF (900) BELOW THE DEEPEST FOUNDATION SUBGRADE AT ALL TIMES.

GC8 THE DE-WATERING SYSTEM SHALL BE MAINTAINED UNTIL THE CASTING OF FOUNDATION / GROUND SLAB.

FOUNDATIONS

F1 ALL FOUNDATIONS ARE DESIGNED USING BEARING CAPACITY OF 1.9Tsf AT 6 FEET BELOW NGL AS PER GEOTECH SOIL INVESTIGATION REPORT.

F2 LOOSE POCKETS OF SOIL WHICH ARE ENCOUNTERED SHALL BE REMOVED AND REPLACED WITH GOOD SOIL COMPACTED TO ACHIEVE THE DESIRED BEARING PRESSURE.

F3 ANY ADJACENT FOOTING IN THE VICINITY OF THE WORK SHALL BE PROPERLY PROTECTED BEFORE EXECUTION OF WORK.

F4 SINCE AS PER SOIL REPORT WATER IS ENCOUNTERED AT 1.05m BELOW NGL THEREFORE DEWATERING MUST BE DONE UNTIL PLINTH BEAMS ARE CASTED ALONG WITH COMPACTED BACKFILL.

DESIGN LOADS

DL1 THIS BUILDING IS DESIGNED FOR GRAVITY LOADS ONLY.
DESIGN CODES FOR STRUCTURAL ELEMENTS ACI-318-02

DESIGN LOADS:
FINISHES : 36psf
LIVE LOAD : 40psf, 100psf (gym.)
WALL LOAD : AS PER ARCHITECTURE DRAWINGS

REINFORCED CONCRETE

C1 THE CONTRACTOR SHALL SUBMIT DETAILED RC SHOP DRAWINGS AND BAR BENDING SCHEDULES SHOWING BAR SIZES, SPACING, PLACEMENT AND SUPPORT DETAILS DOWELS AT EXPANSION JOINTS AND LAPS ETC. FOR REVIEW AND ACCEPTANCE OF THE DESIGN CONSULTANT. WORK SHALL NOT COMMENCE UNTIL THE SHOP DRAWINGS ARE REVIEWED AND ACCEPTED REVIEW OF SHOP DRAWINGS DOES NOT ALLEVIATE THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE THE INPUT OFALL TRADES ON THE SHOP DRAWINGS.

C2 REFER TO SPECIFICATIONS FOR QUALITY AND PERFORMANCE REQUIREMENTS OF CONCRETE.

(i) NORMAL CONCRETE NOT IN CONTACT WITH THE GROUND:

CEMENT	ORDINARY PORTLAND CEMENT (OPC)
MIN. CEMENT CONTENT	24 lb/ft (380kg/m) ^{3}
MAX. W/C RATIO	0.40

C3. THE MINIMUM CONCRETE STRENGTH FOR DIFFERENT STRUCTURE ELEMENT SHALL HAVE MINIMUM 28 DAYS CYLINDRICAL STRENGTH AND ARE AS BELOW.

STRUCTURAL ELEMENT

* COLUMN = 4000 psi
* BEAMS/SLAB/FOUNDATION/OTHERS = 3000 psi
* BLINDING = 1500 psi

C4 WATER CEMENT RATIO SHALL NOT EXCEED 0.4.

C5 MAXIMUM POSSIBLE WATER-SOLUBLE CHLORIDE ION (CL)CONTENT IN CONCRETE SHALL NOT EXCEED 0.15% BY WEIGHT OF CEMENT.

C6 MAXIMUM SIZE OF COURSE AGGREGATE SHALL BE 25MM UNLESS NOTED OTHERWISE.

C7 CONTRACTOR SHALL GET APPROVAL FROM DESIGN CONSULTANT OF A CONCRETE MIX DESIGN.

C8 THE CONTRACTOR SHALL PERFORM AND SUBMIT FOR REVIEW INSTRUMENT SURVEYS OF FINISHED CONCRETE SLAB SURFACES, BOTH BEFORE AND AFTER REMOVAL OF FORM WORK AND/OR SHORING SYSTEM TO VERIFY AS-BUILT TOLERANCES.

C9 REFER TO SPECIFICATIONS FOR REQUIREMENTS OF CONCRETE SURFACE FINISH AND CASTING TOLERANCE.

C10 PROVIDE UPWARD CAMBER TO SLABS AND BEAMS AS NOTED ON STRUCTURAL DRAWINGS AND/OR SPECIFICATIONS CAMBER BOTH UNDERSIDE AND TOP OF CONCRETE TO MAINTAIN THE SLAB AND BEAM DEPTH SHOWN ON THE DRAWINGS UNLESS NOTED OTHERWISE.

C11 BEAMS, SLABS, COLUMNS, WALLS AND FOUNDATION ELEMENTS SHALL NOT BE SLEEVED OR BOXED-OUT OR HAVE THE REINFORCEMENT INTERRUPTED EXCEPT AS INDICATED ON THE STRUCTURAL DRAWINGS.

C12 ALL CONCRETE SHALL CONTAIN AN APPROVED WATER REDUCING, PLASTICIZING ADMIXTURE. APPROVED HIGH RANGE WATER REDUCING ADMIXTURE MAY BE UTILIZED AT THE CONTRACTOR'S OPTION. ALL CONCRETE PERMANENTLY EXPOSED TO WEATHER SHALL ALSO CONTAIN AN APPROVED AIR-ENTRAINING ADMIXTURE TO PROVIDE PERCENTAGE OF AIR REQUIRED FOR SEVERE EXPOSURE AS PER ACI 318.

C13 ADMIXTURE/WATER CONTAINING CHLORIDE IONS SHELL NOT BE USED IN ANY CONCRETE.

C14 THE FOLLOWING CONCRETE CLEAR COVER TO PRIMARY REINFORCEMENT SHALL BE PROVIDED, UNLESS LARGER COVER IS NOTED ON THE STRUCTURAL DRAWINGS.

ELEMENT	CONCRETE CLEAR COVER SCHEDULE	
	ABOVE GROUND INTERIOR ENVIRONMENT	ABOVE GROUND EXTERIOR ENVIRONMENT
COLUMNS(VERTICAL BARS)	1.625"	2"
BEAMS(LONGITUDINAL BARS)	1.625"	2"
WALLS	1"	1.375"
GRADE SLAB	1"	1.375"
SUSPENDED SLAB	1"	1.375"
EQUIPMENT PAD	1"	1.375"
WATER TANK	2"	2"

NOTE: - CLEAR COVER SHALL NOT BE LESS THAN ONE BAR DIA.
- CONCRETE COVER FOR SURFACE CAST AGAINST SOIL SHALL BE 3" AND FOR SURFACE INCONTACT WITH SOIL SHALL BE 2".

C15 AGGREGATE FOR CONCRETE SHALL BE FROM APPROVED SOURCE AND SHALL COMPLY WITH THE SPECIFICATION REQUIREMENTS.

C16 HORIZONTAL CONSTRUCTION JOINTS SHALL NOT BE MADE IN BEAMS UNLESS SHOWN OR REVIEWED BY DESIGN CONSULTANT, VERTICAL CONSTRUCTION JOINTS MAY BE MADE AT MIDSPAN OF BEAMS, OR SLABS HAVING NO POINT LOADS AT CENTER OF SPAN. UNLESS OTHERWISE NOTED OR SHOWN OR DIRECTED BY THE DESIGN CONSULTANT.

C17 ALL CONCRETE SHALL BE COMPACTED USING ONLY MECHANICAL VIBRATION PROCESS.

C18 ALL CONCRETE SHALL BE CURED IN ACCORDANCE WITH THE SPECIFICATIONS.

REINFORCEMENT

R1 ALL REINFORCING BARS SHALL BE DEFORMED BARS WITH YIELD STRENGTH OF 414MPa CONFORMING TO ASTM A615.

R2 EPOXY COATED REINFORCING BARS SHALL NOT BE PERMITTED.

R3 ALL REINFORCING BARS SHALL BE DETAILED, FABRICATED, LABELED, SUPPORTED, SPACED IN FORMS AND SECURED IN PLACE IN ACCORDANCE WITH THE PROCEDURES AND REQUIREMENTS OUTLINED IN THE CURRENT ACI 318 AND ACI 315 UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS.

R4 ALL STARTER BARS SHALL BE SURVEYED AND LOCATION CONFIRMED IN AS-BUILT CONDITION PRIOR TO PLACING WALL/COLUMN REINFORCEMENT AND ANY DISCREPANCIES SHALL BE REPORTED TO THE DESIGN CONSULTANT FOR INSTRUCTIONS.

R5 PROVIDE STARTER BARS TO WALLS AND COLUMNS SIMILAR IN NUMBER AND SIZE AND SPACING TO THE VERTICAL BARS ABOVE UNLESS NOTED OTHERWISE.

R6 WELDING AND/OR SITE CUTTING OF THE REINFORCING BARS SHALL NOT BE PERMITTED UNLESS REVIEWED AND ACCEPTED BY THE DESIGN CONSULTANT.

R7 ALL PROPRIETARY FIXING SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

R8 ALL REINFORCING SPLICES SHALL BE CLASS B TENSION SPLICES IN ACCORDANCE WITH THE CURRENT ACI 318 UNLESS NOTED OTHERWISE. REFER TO SCHEDULE BELOW FOR SPLICE LENGTHS.

TENSION SPLICE LENGTH	
CLASS A	1.0X DEVELOPMENT LENGTH
CLASS B	1.3X DEVELOPMENT LENGTH

CLASS A = As PROVIDED ≥ 2 As REQUIRED AND PERCENTAGE As SPLIES < 50%

CLASS B = ALL OTHER CONDITIONS

R9 ALL WIRE MESH REINFORCEMENT SHALL BE LAPPED AT LEAST 2 MESH PANELS AND SECURELY TIED. ALL REINFORCING DEVELOPMENT LENGTHS SHALL BE TENSION DEVELOPMENT LENGTHS IN ACCORDANCE WITH THE CURRENT ACI 318 UNLESS NOTED OTHERWISE, REFER TO SCHEDULE BELOW.

	TENSION DEVELOPMENT LENGTHS* FOR f'c= 3ksi					
	#3	#4	#5	#6	#8	#10
CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED NOT LESS THAN DIA OF BAR, AND BEAM STIRRUPSOR COLUMNS TIES THROUGHOUT SPACE LENGTH NOT LESS THAN THE CODE MINMUM OR CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED NOT LESSTHAN TWICE THE DIA OF BAR, AND CLEAR COVER NOT LESS THAN DIA OF BAR	18"	24"	30"	33"	57"	69"
OTHER CASES	27"	33"	42"	51"	84"	105"
*ABOVE DEVELOPMENT LENGTH SHALL BE MULTIPLIED BY 1.3 WHERE HORIZONTAL REINFORCEMENT IS PLACED SUCH THAT MORE THEN 12" OF FRESH CONCRETE IS CAST BELOW.						

	TENSION DEVELOPMENT LENGTHS* FOR f'c= 4ksi					
	#3	#4	#5	#6	#8	#10
CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED NOT LESS THAN DIA OF BAR, AND BEAM STIRRUPSOR COLUMNS TIES THROUGHOUT SPACE LENGTH NOT LESS THAN THE CODE MINMUM OR CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED NOT LESSTHAN TWICE THE DIA OF BAR, AND CLEAR COVER NOT LESS THAN DIA OF BAR	15"	21"	24"	30"	48"	60"
OTHER CASES	24"	30"	36"	45"	72"	90"
*ABOVE DEVELOPMENT LENGTH SHALL BE MULTIPLIED BY 1.3 WHERE HORIZONTAL REINFORCEMENT IS PLACED SUCH THAT MORE THEN 12" OF FRESH CONCRETE IS CAST BELOW.						

R10 MECHANICAL SPLICING OF LARGE DIAMETER BARS MAY BE ACCEPTABLE SUBJECT TO REVIEW BY THE DESIGN CONSULTANT

R11 FOR HOUSE KEEPING PADS AND FLOATING SLABS PROVIDE REINFORCEMENT IN ACCORDANCE WITH THE CURRENT ACI 318 UNLESS NOTED OTHERWISE OR SHOWN ON THE STRUCTURAL DRAWINGS.

R12 COUPLERS TO BE PROVIDED IF COLUMN REINFORCEMENT EXCEEDS 3.0%

ANCHORAGE OF BARS BY HOOKS:

* THE DIMENSIONS AND BENDING RADII FOR HOOKS TO BE USE AS STANDARDIZED IN THE ACI CODE:

1- A 180° BEND PLUS AN EXTENSION OF AT LEAST 4 BAR DIAMETERS, BUT NOT LESS THAN 2.5 IN AT THE FREE END OF BAR OR

2- A 90° BEND PLUS AN EXTENSION OF AT LEAST 12 BAR DIAMETERS AT THE FREE END OF THE BAR, OR

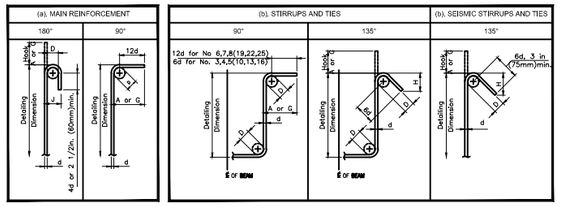
3- FOR STIRRUP AND TIE ANCHORAGE ONLY:

a. FOR NO. 5 BARS AND SMALER, A 90° BEND PLUS AN EXTENSION OF AT LEAST 6 BAR DIAMETERS AT THE FREE END OF THE BAR, OR

b. FOR NOS. 6.7 AND 8 BARS, A 90° BEND PLUS AN EXTENSION OF AT LEAST 12 BAR DIAMETERS AT THE FREE END OF THE BAR, OR

c. FOR NO. 8 BARS AND SMALLER, A 135° BEND PLUS AN EXTENSION OF AT LEAST 6 BAR DIAMETERS AT THE FREE END OF THE BAR,

THE MINIMUM DIAMETER OF BEND, MEASURED ON THE INSIDE OF THE BAR, FOR STANDARD HOOKS OTHER THAN FOR STIRRUPS OR TIES IN SIZES NOS. 3 THROUGH 5, SHOULD NOT BE LESS THAN 6 BAR DIAMETER. FOR STIRRUP AND TIE HOOKS, FOR BAR SIZES NO.5 AND SMALLER, THE INSIDE DIAMETER OF BEND SHOULD NOT BE LESS THEN 4 BAR DIAMETERS, ACCORDING TO ACI CODE:



RECOMMENDED END HOOKS
All grades
D= Finished bend diameters

BAR SIZE, NO.	D, IN (mm)	180 degree hook		90 degree hook
		A or G, ft-in (mm)	J, ft-in (mm)	A or G, ft-in, (mm)
3(10)	2 1/4(60)	5 (125)	3(80)	6 (155)
4(13)	3(80)	6 (155)	4(105)	8 (200)
5(16)	3 3/4 (94)	7 (180)	5(130)	10 (250)
6(19)	4 1/2 (115)	8 (205)	6(155)	1–0 (300)
7(22)	5 1/4 (135)	10 (250)	7(175)	1–2 (375)
8(25)	6 (155)	11 (275)	8(205)	1–4 (425)
9(29)	9 1/2(240)	1–3 (375)	11 3/4 (300)	1–7 (475)
10(32)	10 3/4 (275)	1–5 (425)	1–1 1/4 (335)	1–10 (550)
11(36)	12 (305)	1–7 (475)	1–2 3/4 (375)	2–0 (600)
14(43)	18 1/4 (465)	2–3 (675)	1–9 3/4 (550)	2–7 (775)
18(57)	24 (610)	3–0(925)	2–4 1/2 (725)	3–5 (1050)

STIRRUP (TIES SIMILAR)
STIRRUP AND TIE HOOK DIMENSIONS
ALL GRADES

BAR SIZE, NO.	D, IN (mm)	90 degree hook	135 degree hook	
		Hook A or G ft-in (mm)	Hook A or G ft-in (mm)	H approx, ft-in (mm)
3 (10)	1 1/2 (40)	4 (105)	4 (105)	2 1/2 (65)
4(13)	2(50)	4 1/2 (115)	4 1/2 (115)	3 (80)
5(16)	2 1/2 (65)	6 (155)	5 1/2 (140)	3 3/4 (95)
6(19)	4 1/2 (115)	1–0 (305)	8 (205)	4 1/2 (115)
7(22)	5 1/4 (135)	1–2 (355)	9 (230)	5 1/4 (135)
8(25)	6 (155)	1–4 (410)	10 1/2 (270)	6 (156)

135 DEGREE SEISMIC STIRRUP/TIE HOOK DIMENSIONS
ALL GRADES

BAR SIZE, NO.	D, IN (mm)	135 degree hook	
		Hook A or G ft-in (mm)	H approx, ft-in (mm)
3 (10)	1 1/2 (40)	4 1/4 (110)	3 (80)
4(13)	2(50)	4 1/2 (115)	3 (80)
5(16)	2 1/2 (65)	5 1/2 (140)	3 3/4 (96)
6(19)	4 1/2 (115)	8 (205)	4 1/2 (115)
7(23)	5 1/4 (135)	9 (230)	5 1/4 (135)
8(25)	6 (155)	10 1/2 (270)	6 (155)

MASONRY WORKS

M1 ALL MASONRY DESIGN AND CONSTRUCTION SHALL CONFORM TO ACI 530-99/ASCE 5-99 LOCAL AUTHORITY REQUIREMENTS AND SPECIFICATIONS. EQUIVALENT BRITISH STANDARDS MAY BE CONSIDERED SUBJECT TO APPROVAL OF THE DESIGN CONSULTANT. CONSULTANT.

M2 THE CONTRACTOR IS TO TAKE PARTICULAR CARE THAT ALL THE PERPENDS AND BEDS ARE PROPERLY FILLED WITH MORTOR.

M3 ALL CONTROL JOINTS SHALL BE FILLIED WITH COMPRESSIBLE EXPANDABLE FILLER. REFER TO SPECIFICATIONS FOR FIRE RATED WALLS.

M4 FIRE RATING, SOUND AND THERMAL INSULATION PROPERTIES SHALL BE IN ACCORDANCE WITH THE PROJEC SPECIFICATIONS.

M5 PROVIDE LINTELS OVER ALL OPENING OR RECESSES IN MASONRY WALLS INCLUDING THOSE FOR MECHANICAL OR ELECTRICAL SERVICES OR EQUIPMENT. SEE STANDARD DETAIL DRAWINGS FOR LINTEL SIZES AND DETAILS.

M6 PROVIDE RESTRAINT TO ALL MASONRY WALLS AT SLAB SOFFIT AND SIDES AS SHOWN IN STANDARD DETAIL DRAWINGS.

M7 ALL MASONRY UNITS SHALL BE NORMAL WEIGHT CONCRETE UNLESS NOTED OTHERWISE.

M8 ALL MASONRY ANCHORS, MASONRY TIES AND EMBEDDED ITEMS SHALL BE HOT DIP GALVANIZED.

M9 PROVIDE HORIZONTAL BED JOINT REINFORCEMENT IN ACCORDANCE WITH STANDARD DETAIL DRAWINGS AND SPECIFICATIONS.

GENERAL ABBREVIATIONS

A1.

APPROX	-	APPROXIMATELY
BP	-	BASE POINT
CHAM	-	CHAMFERED
CJ	-	CONSTRUCTION JOINT
CONC	-	CONCRETE
DEG	-	DEGREES
DIA	-	DIAMETER
D	-	DEPTH
DWG	-	DRAWING
EGL	-	EXISTING GROUND LEVEL
EJ	-	EXPANSION JOINT
EXTG	-	EXISTING
FFL	-	FINISHED FLOOR LEVEL
FGL	-	FINISHED GROUND LEVEL
GA	-	GENERAL ARRANGEMENT
NGL	-	NATURAL GROUND LEVEL
GWT	-	GROUND WATER TABLE
IJ	-	ISOLATION JOINT
S.S.L.	-	STRUCTURAL SLAB LEVEL
STD	-	STANDARD
TBC	-	TO BE CONFIRMED
THK	-	THICKNESS
TJ	-	TRANSVERSE JOINT
TW	-	THICKNESS OF WALL
TYP	-	TYPICAL
UNO	-	UNLESS NOTED OTHERWISE
W	-	WIDE
P.L	-	PLINTH LEVEL
BOF	-	BOTTOM OF FOOTING
SOG	-	SLAB ON GRADE
LG	-	LONG
M	-	METRE
MAX	-	MAXIMUM
MIN	-	MINIMUM
MJ	-	MOVEMENT JOINT
MM	-	MILLIMETRES
No	-	NUMBER
NOM	-	NOMINAL
NTS	-	NOT TO SCALE
P/O	-	PERMANENT OPENING
RAD	-	RADIUS
RC	-	REINFORCED CONCRETE
REF	-	REFER
REQD	-	REQUIRED
REV	-	REVISION
SOP	-	SETTING OUT POINT
SQ	-	SQUARE
FT	-	FEET
IN	-	INCH

A2.

ABR	-	ALT. BARS REVERSED
ABS	-	ALT. BARS STAGGERED
ALT	-	ALTERNATE
B	-	BOTTOM
CRS	-	CENTRES
EF	-	EACH FACE
EW	-	EACH WAY
EXTF	-	EXTERNAL FACE
FF	-	FAR FACE
H	-	HORIZONTAL
INTF	-	INTERNAL FACE
NF	-	NEAR FACE
PRS	-	PAIRS
REFT	-	REINFORCEMENT
STG	-	STAGGERED
T	-	TOP
T/O	-	TEMPORARY OPENING
Ta	-	TENSION ANCHORAGE
TOC	-	TOP OF CONCRETE
V	-	VERTICAL
ADD.	-	ADDITIONAL
DIA	-	DIAMETER
N.S.I.P	-	NOT SHOWN IN PLAN

CLIENT:-
Chandka Medical Hospital, Larkana

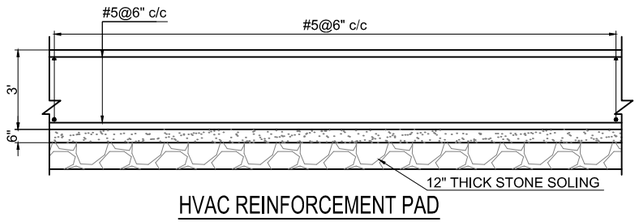
CONSULTANT:

PROJECT:-
RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

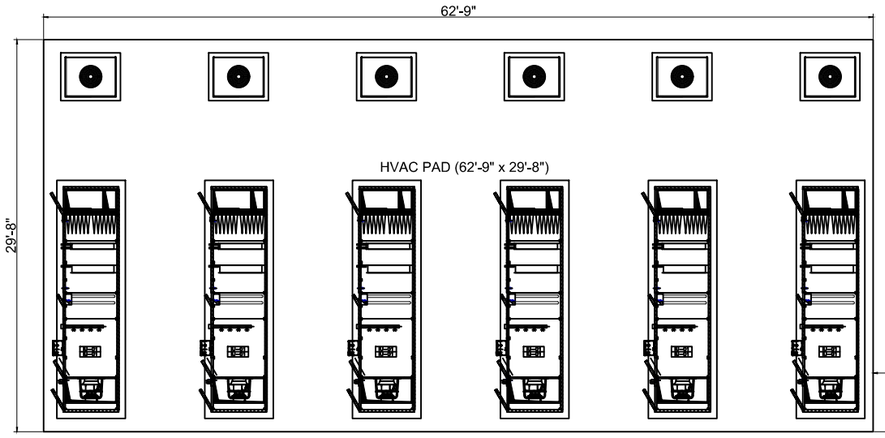
TITLE:-
STRUCTURE GENERAL NOTES

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .
DATE: APRIL.2025
DRAWN BY: A-A
SCALE: AS SHOWN
CHECKED BY: O-A
DWG. NO.: S-01



HVAC REINFORCEMENT PAD

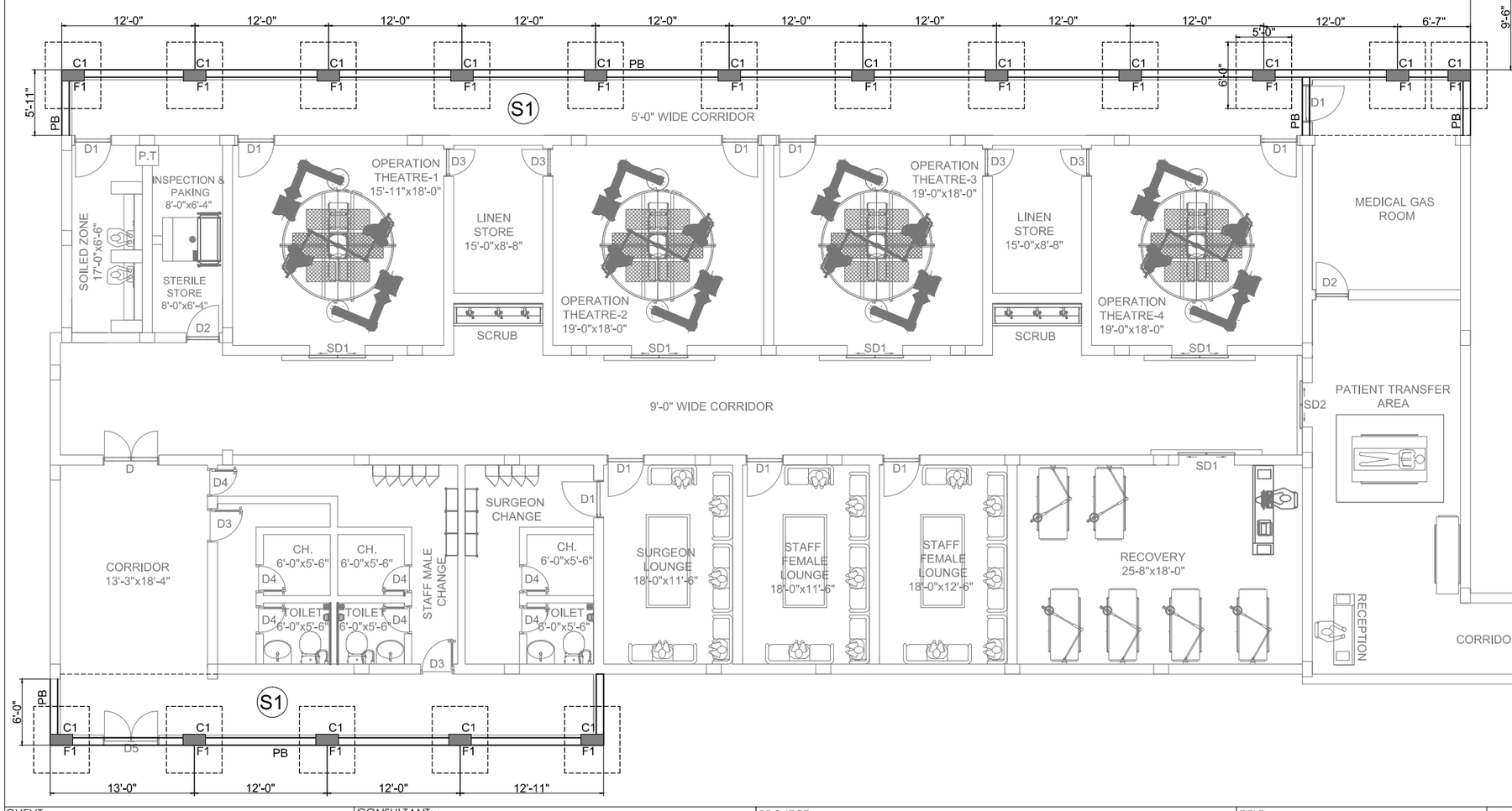


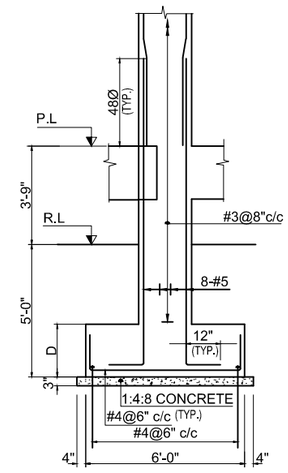
GENERAL NOTES

1. ALL DIMENSIONS ARE SHOWN IN FEETS AND INCHES.
2. CONCRETE STRENGTH SHOULD BE MINIMUM OF 4000PSI CYLINDRICAL.
3. STEEL SHALL CONFIRMS TO ASTM A615.
4. ALL BLOCK WORK SHALL BE SOLID BLOCK AND SHALL HAVE MINIMUM OF 600Psi STRENGTH.
5. READ THIS DRAWING IN CONJUNCTION WITH OTHER DRAWINGS OF ALL SPECIALITIES.

SCHEDULE OF SLAB

SLAB NO.	LONG WAY	LONG WAY	EXTRA DISTRIBUTION BAR	SLAB TYPE
S1	⅜"Ø@ 6" C/C	⅜"Ø@ 6" C/C	1/2"Ø@ 8" C/C	

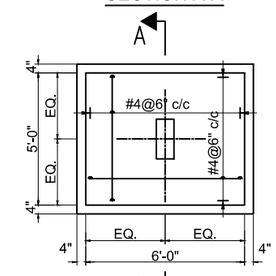




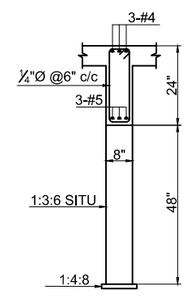
SECTION A-A



COLUMN C1



TYP. PLAN OF FOOTING F1



PLINTH BEAM

CLIENT:-	CONSULTANT:	PROJECT:-	TITLE:-	REV #	DATE	DESCRIPTION	CH'K'D	APP'D		
Chandka Medical Hospital, Larkana		RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	FOUNDATION LAYOUT AND OTHER DETAILS						Project Ref: .	DATE APRIL.2025
									DRAWN BY A-A	SCALE AS SHOWN
									CHECKED BY O-A	DWG. NO. S-02

GENERAL NOTES :-

1. FOLLOWING NOTES SHALL IN GENERAL APPLY TO ALL ELECTRICAL DRAWINGS. THE INSTRUCTIONS IN THESE NOTES SHALL BE FOLLOWED UNLESS STATED OTHERWISE.
2. THESE NOTES SHALL BE APPLICABLE TO THE ENTIRE ELECTRICAL WORKS. IF THE SITE CONDITIONS NECESSITATE ANY ALTERATIONS OR DEVIATIONS THE DIRECTIONS OF THE ENGINEER SHALL BE OBSERVED AS FINAL INSTRUCTIONS.
3. ALL ELECTRICAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH BOQ, TECHNICAL SPECIFICATIONS, ARCHITECTURAL, STRUCTURAL, PLUMBING AND HVAC DRAWINGS & ALL OTHER RELEVANT DETAILS.
4. DIMENSIONS / MEASUREMENTS GIVEN IN LAYOUT AND DETAILED DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE TO CALCULATE THE ACTUAL DIMENSIONS/ MEASUREMENTS ACCORDING TO STRUCTURAL AND ARCHITECTURAL DRAWINGS.
5. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS WITH ALL RELEVANT DETAILS TO THE ENGINEER FOR APPROVAL ACCORDING TO THE GENERAL CONDITIONS OF CONTRACT WELL IN TIME BEFORE COMMENCEMENT OF THAT WORK.
6. PROPER COORDINATION OF ELECTRICAL WORKS WITH OTHER SERVICES SHALL BE CARRIED OUT AT SITE.
7. ELECTRICAL POINTS FOR EQUIPMENT SHALL BE INSTALLED IN COORDINATION WITH THE RELEVANT EQUIPMENT DRAWINGS OF OTHER SERVICES SUCH AS COMMUNICATION SYSTEMS, HVAC, PLUMBING ECT.
8. RUN GREEN–YELLOW OR GREEN SINGLE CORE PVC INSULATED COPPER CONDUCTOR CABLE OF SPECIFIED SIZES AS CONTINUITY EARTH CONDUCTOR (ECC) ALL ALONG LIGHT AND POWER WIRING. WHEREVER THE SIZE IS NOT SPECIFIED THE FOLLOWING CRITERIA SHALL BE OBSERVED TO DETERMINE MINIMUM CROSS SECTIONAL AREA OF EARTH CONTINUITY CONDUCTOR (ECC) IN RELATION TO THE AREA OF ITS PHASE CONDUCTORS. RUN SEPARATE ECC FOR EACH CIRCUIT.
9. THE No. OF SINGLE CORE CABLES IN ANY CONDUIT SHALL BE DETERMINED SUCH THAT THE RATIO OF CABLE AREA INCLUDING EARTH CONTINUITY CONDUCTOR (ECC) TO CONDUIT AREA IS NOT MORE THAN 0.4:1.0. WHERE DIFFERENT SIZES OF CABLES RUN IN SAME CONDUIT.THE SIZE SHALL BE BASED ON ACTUAL CABLE AREA. WHEREVER CONDUIT SIZE IS NOT SPECIFIED, 20 mm. DIA CONDUIT SHALL BE INSTALLED PROVIDED IT MEETS THE ABOVE CRITERIA.THE FOLLOWING TABLE IS GIVEN AS GENERAL GUIDELINE.

S.NO	NOMINAL CONDUCTOR SIZE(SQMM)	NO. & DIA OF WIRES	NOMINAL OVERALL DIA	20 MM DIA (3/4" DIA)	25 MM DIA (1" DIA)	32 MM DIA (1¼ " DIA)
1	1.5	1/1.38	3.1	10	18	30
2	2.5	1/1.78	3.5	8	14	23
3	2.5	7/0.67	3.8	7	12	20
4	4	7/0.85	4.3	5	9	15
5	6	7/1.04	4.9	4	7	12
6	10	7/1.35	6.2	2	4	7
7	16	7/1.70	7.3	–	3	5
8	25	7/2.14	9.0	–	2	3
9	35	19/1.53	10.3	–	–	2

10. ALL LIGHTING & SMALL POWER PLUG WIRING SHALL BE CARRIED OUT IN PVC CONDUIT CONCEALED/SURFACE IN/ON CEILING BEAM, COLUMN, WALL ETC.
11. RUN PVC INSULATED (GREEN) AS EARTH CONTINUITY CONDUCTOR ALL ALONG LIGHTING AND POWER PLUG WIRING.
12. WHERE SIZE OF CONDUIT IS NOT INDICATED USE 3/4" DIA CONDUIT WHICH SHALL BE THE MINIMUM SIZE.
13. LIGHT CONTROL SWITCH BOARDS IN ROOM SHALL BE INSTALLED AT MINIMUM DISTANCE OF 0'–10" FROM DOOR OPENING.
14. THE CONDUIT SHALL HAVE A MINIMUM COVER OF 1–1/2" OF CONCRETE WHEN INSTALLED IN WALL , COLUMN OR CEILING.
15. ONLY GANG TYPE SWITCH SHALL BE USED. ALL SWITCH OUTLET BOXES SHALL BE 16 SWG SHEET STEEL.
16. BEFORE DETERMINING THE CUT LENGTHS OF CABLE,THE ACTUAL MEASUREMENT AT SITE SHALL BE MADE WITH PROVISION FOR SLACK / DISTRIBUTION BOARDS AND SPARE LENGTH FOR LOOPS AS REQUIRED.
17. ALL UNDERGROUND PIPES AFTER INSTALLATION SHALL BE PLUGGED AND SEALED AT BOTH ENDS AND JOINTS TO AVOID INGRESS OF WATER INTO PIPES.
18. NORMAL & EMERGENCY CIRCUITS SHALL RUN IN SEPARATE CONDUITS.
19. ALL WIRING FOR CONTROLS SHALL BE CARRIED OUT WITH SINGLE CORE PVC CABLES OF SPECIFIED REQUIRED VOLTAGE GRADE AND SIZES.
20. THE WIRING SHALL BE CONTINUOUS LOOPING–IN TYPE AND NO JOINT IN WIRES SHALL BE ALLOWED.
21. THE WIRING SYSTEM SHALL BE CARRIED OUT ONLY AFTER THE CONDUIT SYSTEM IS COMPLETELY INSTALLED AND ALL OUTLET BOXES, ETC. ARE FIXED IN POSITION. ALL ROUGH EDGES OF CONDUITS / ACCESSORIES SHALL BE SMOOTH BEFORE WIRING.
22. MOUNTING HEIGHTS OF ELECTRICAL FITTINGS WHEN MEASURED FROM FINISHED FLOOR LEVEL (F.F.L.) TO THE BOTTOM OF FITTINGS SHALL BE AS UNDER, UNLESS OTHERWISE SHOWN OR INSTRUCTED.

DISTRIBUTION BOARD	1200mm / AS PER SITE REQUIREMENT
PA RACK	1200mm / AS PER SITE REQUIREMENT
LIGHT CONTROL SWITCH	1200mm ABOVE F.F.L
16A SOCKET OUTLETS	250mm / REFER ARCH. DRAWINGS.

23. THE MINIMUM BENDING RADIOUS OF CABLES SHALL BE 8 TO 10 TIME OVERALL DIAMETER OF CABLE OR AS RECOMMENDED BY THE MANUFACTURER.
24. ALL TEST SHALL BE CONDUCTED IN THE PRESENCE OF ENGINEER'S REPRESENTING
25. RUN GREEN–YELLOW OR GREEN SINGLE CORE PVC INSULATED COPPER CONDUCTOR CABLE OF SPECIFIED SIZES AS EARTH CONTINUITY CONDUCTOR (ECC) ALL ALONG LIGHT AND POWER WIRING. WHEREVER THE SIZE IS NOT SPECIFIED THE FOLLOWING CRITERIA SHALL BE OBSERVED TO DETERMINE MINIMUM CROSS SECTIONAL AREA OF EARTH CONTINUITY CONDUCTOR (ECC) IN RELATION TO THE CROSS SECTIONAL AREA OF ITS PHASE CONDUCTORS. RUN SEPARATE ECC FOR EACH CIRCUIT.
   - ECC & PHASE CONDUCTOR OF SAME SIZE FOR UPTO AND INCLUDING 16 Sqmm CABLES.
   - 16 Sqmm ECC FOR PHASE CONDUCTOR OF 16 Sqmm, 25 Sqmm & 35 Sqmm CABLES.
   - FOR CABLES OF 50 Sqmm AND ABOVE SIZES, ECC IS HALF SIZE OF PHASE CONDUCTOR.
   - MAXIMUM SIZE OF ECC IS 70 Sqmm (IF NOT MENTIONED OTHERWISE).

ELECTRICAL LEGEND

S.NO	SYMBOL	DESCRIPTION
1		CEILING LIGHT 18W LED
2		CEILING LIGHT 12W LED
3		CEILING LIGHT 12W LED
4		SURFACE MOUNTED LIGHT 12W LED
5		2'x2' RECESSED TYPE 36W SMART LED
6		DECORATIVE LIGHT LED(1X10W)
7		PLANTER LIGHT (5.5W) LED
8		BOUNDARY WALL LIGHT
9		GATE LIGHT
10		SPOT LIGHT
11		18" FAN FOR 2'x2' FALSE CEILING
13		CEILING FAN
14		WALL BRACKET FAN
15		EXHAUST FAN
16		AIR SUCTION CEILING EXHAUST FAN
17		CHANDELIER POINT
18		DIMMER
19		1, 2, 3, 4 & 5 GANG LIGHT SWITCH

S.NO	SYMBOL	DESCRIPTION
1		CCTV CAMERA
2		DOME TYPE CAMERA
3		CCTV HEADEND EQUIPMENT
4	M	MICRO PHONE
5	S	CEILING SPEAKER
6	PB	PULL BOX
7	M	MICRO PHONE
8		PA RECK
9	SD	FIRE ALARM SMOKE SENSOR / DETECTOR
10	HD	FIRE ALARM HEAT SENSOR / DETECTOR
11	ES	ELECTRONIC SOUNDER/BELL
12		FIRE ALARM SOUNDER WITH FLASHER
13	MS	MANUAL BREAK GLASS STATION
14	F.A.C.P	FIRE ALARM CONTROL PANEL

S.NO	SYMBOL	DESCRIPTION
1		MULTY PIN 13A SWITCHED SOCKET OUTLET
2		3 PIN 15A SWITCHED SOCKET OUTLET
3		3 PIN 15A SWITCHED SOCKET DUPLEX
4		20A AC SWITCH SOCKET OUTLET
5		INDICATES 3PIN 3PHASE+N+E INDUSTRIAL POWER SOCKET (32A OR 64A
6		TV OUTLET
7		DATA OUTLET/VOICE
8		OUTDOOR INTERCOM
9		PUSH BUTTON & BELL
10	AC UNIT	INDOOR SPLIT UNIT
11		DISTRIBUTION BOARD
12		MAIN DISTRIBUTION BOARD
13	ATS	AUTOMATIC TRANSFER SWITCH
14	UPS	UNINTERRUPTED POWER SUPPLY (UPS)
15	G	GENSET
16	M.T.J.B	MAIN TELEPHONE JUNCTION BOX
17	TV.SPLITER	TV SPLITER
18		COUNTER NUMBER SCREEN

S.NO	SYMBOL	DESCRIPTION
1		DOUBLE OXYGEN TAKE
2		DOUBLE AIR TAKE
3		DOUBLE VACUUM SOCKET
4		TAKE DOUBLE NITROUS OXIDE
5		POLARIZED CONTACT 110V–400 WATTS
6		ELECTRICAL CONTACT FOR PORTABLE X RAY EQUIPMENT
7		ELECTRICAL POWER BOX 110V–400 WATTS
8		2'X2' LED CLEANROOM IP 55/65
9		
10		
11		
12		
13		
14		
15		

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:- ELECTRICAL GENERAL NOTES AND LEGENDS

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .

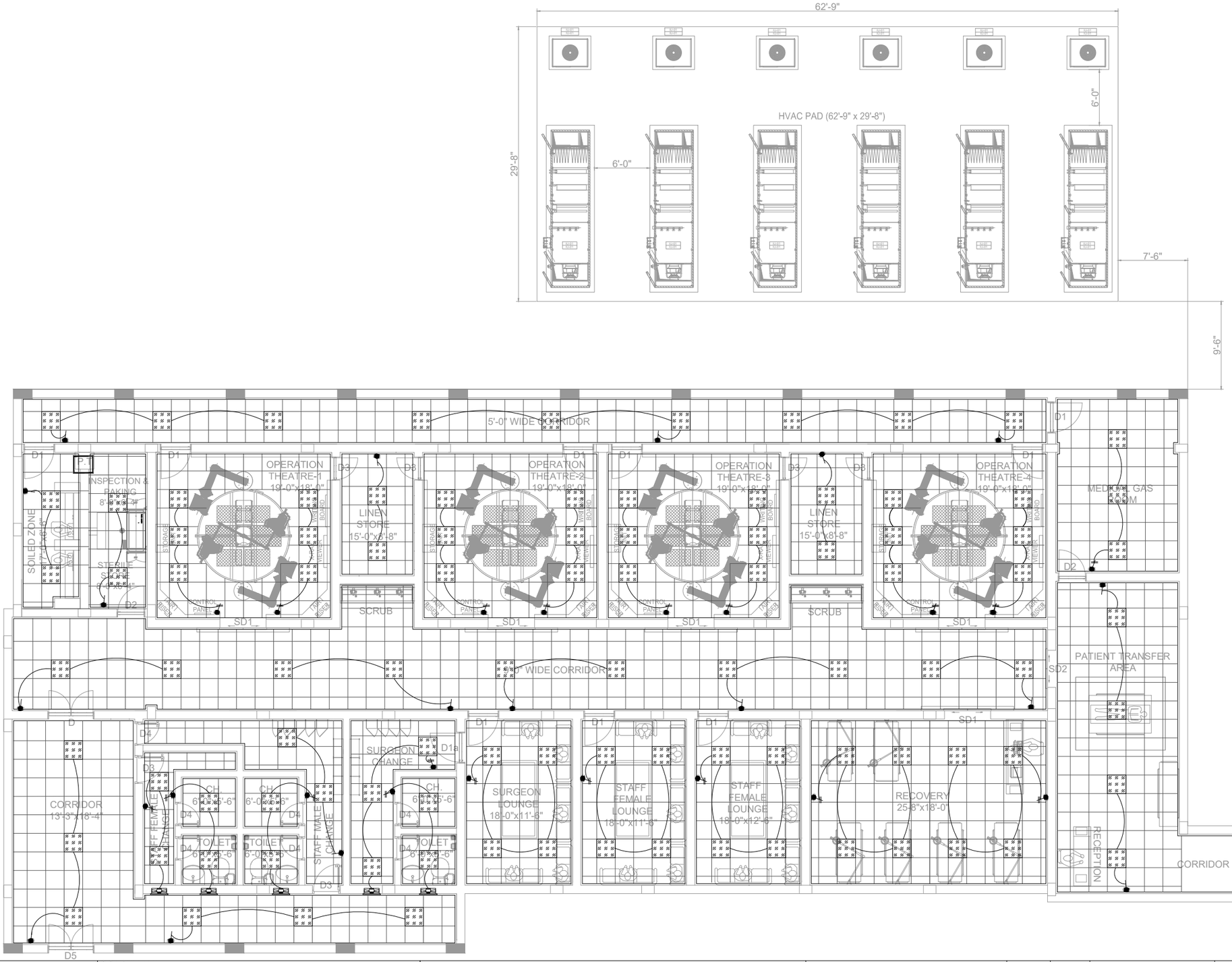
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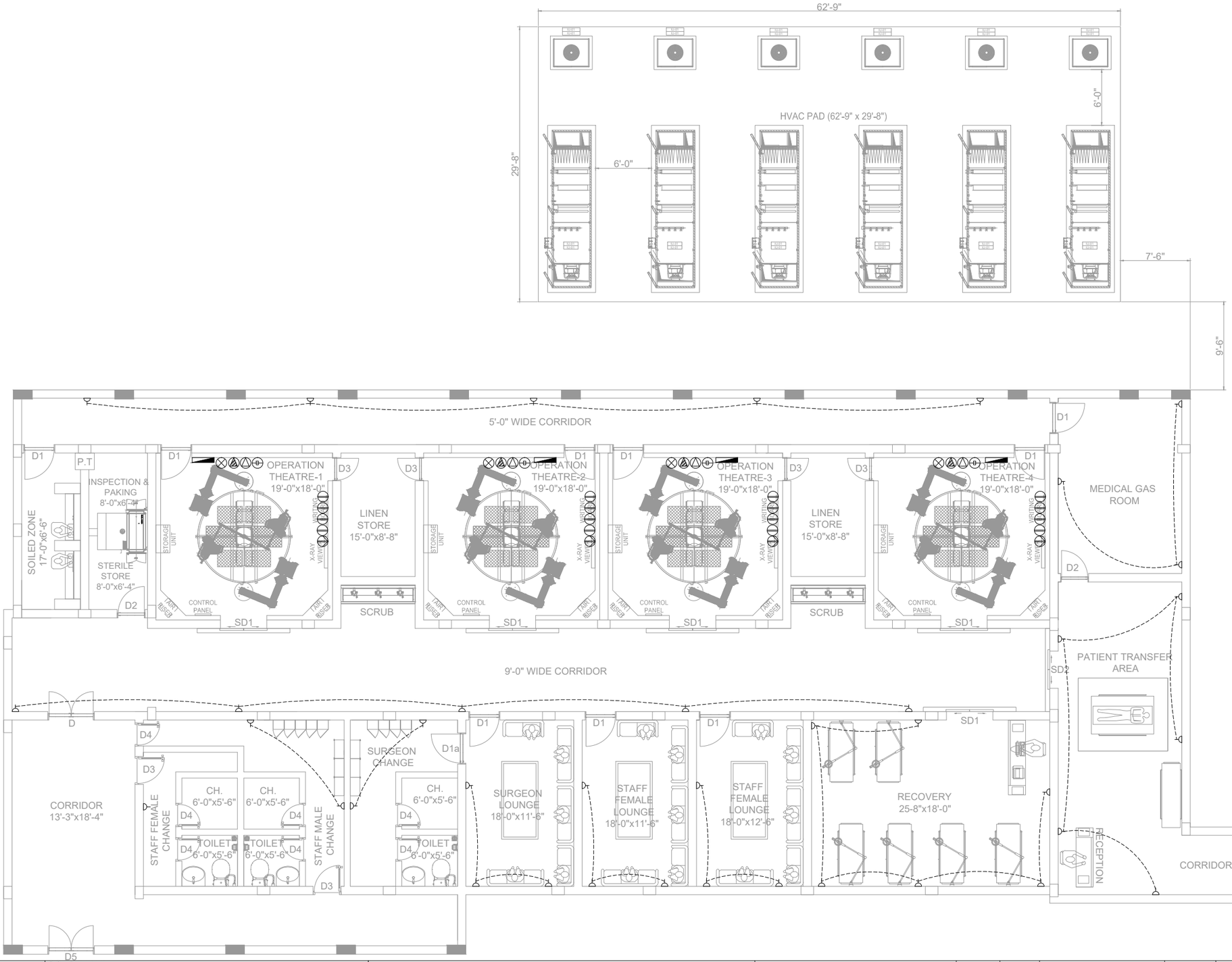
DATE APRIL.2025

SCALE AS SHOWN

DWG. NO. EL-01

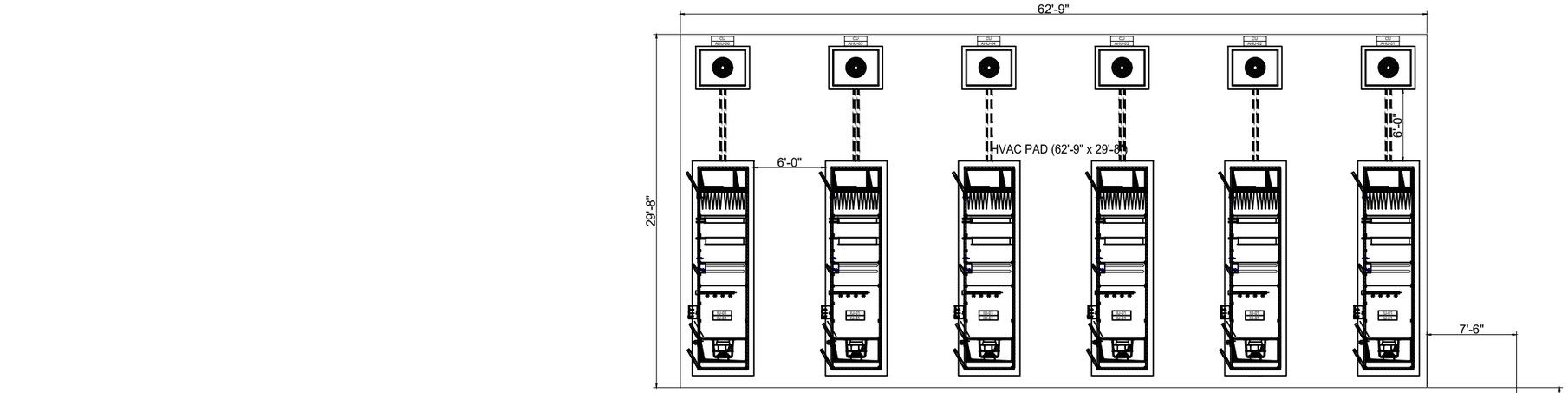


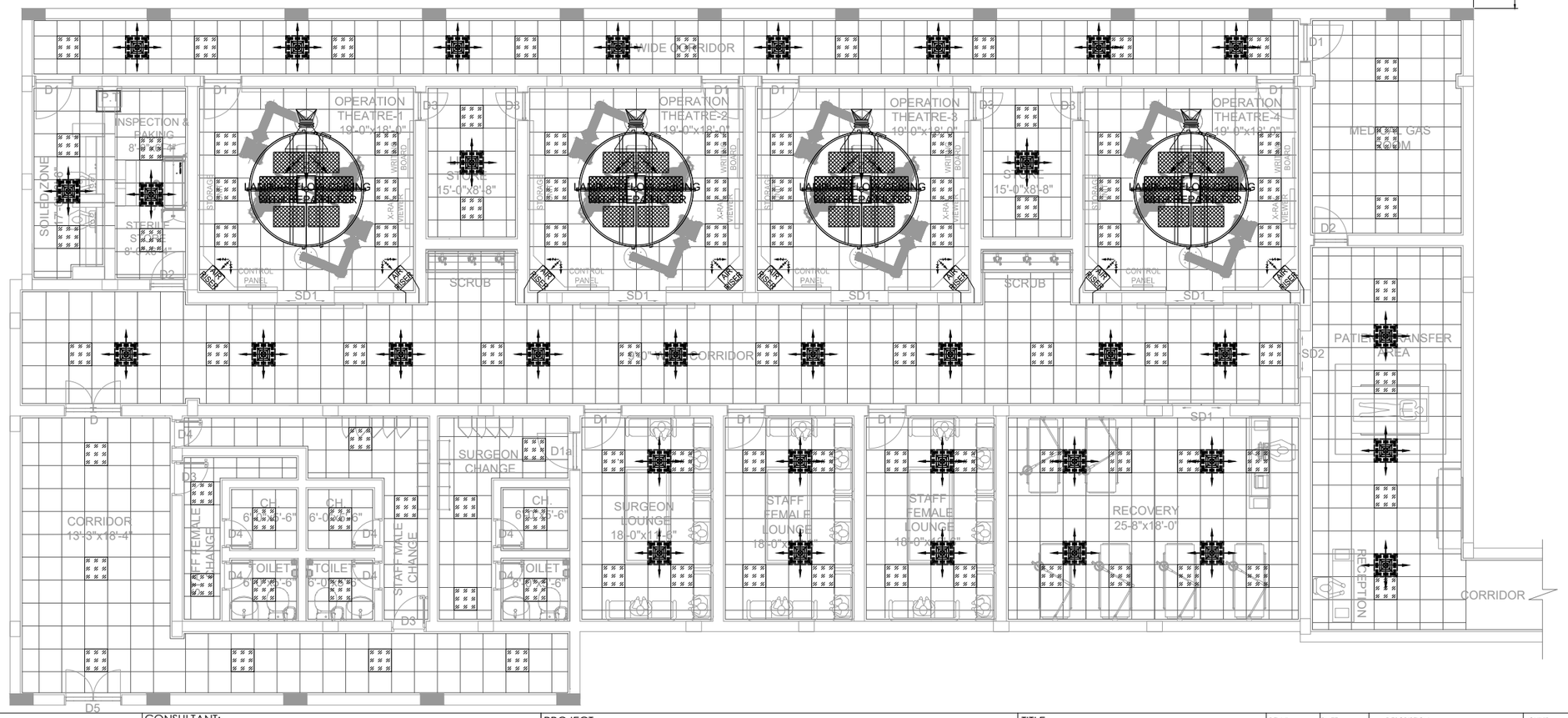
CLIENT:- **Chandka Medical Hospital, Larkana**	CONSULTANT:	PROJECT:- RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	TITLE:- LIGHTING LAYOUT PLAN	REV # / DATE / DESCRIPTION / CH'K'D / APP'D	Project Ref: .	DATE: APRIL.2025
					DRAWN BY: A-A	SCALE: AS SHOWN
					CHECKED BY: O-A	DWG. NO.: EL-02



CLIENT:- **Chandka Medical Hospital, Larkana**	CONSULTANT:	PROJECT:- RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	TITLE:- POWER LAYOUT PLAN	REV # / DATE / DESCRIPTION / CHK'D / APP'D	Project Ref: .	DATE: APRIL.2025	
					DRAWN BY: A-A	SCALE: AS SHOWN	
					CHECKED BY: O-A	DWG. NO.: EL-03	

LEGENDS	
SYMBOLS	DESCRIPTION
	REFRIGERANT PIPE
	DRAIN PIPE
	AIR DIFFUSER





CLIENT:-	CONSULTANT:	PROJECT:-	TITLE:-	REV #	DATE	DESCRIPTION	CH'K'D	APP'D	Project Ref: .	DATE: APRIL.2025
Chandka Medical Hospital, Larkana		RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	HVAC SYSTEM LAYOUT PLAN						DRAWN BY: A-A	SCALE: AS SHOWN
									CHECKED BY: O-A	DWG. NO.: EL-04

GENERAL NOTES:

1-THE CONTRACTOR SHALL THOROUGHLY REVIEW ALL THE DRAWING BEFORE START OF WORK AND SHALL COORDINATE WITH ALL OTHER DISCIPLINE AND ANY DISCREPANCY APPEARS IT SHOULD BE BROUGHT TO THE CONSULTANT'S KNOWLEDGE IMMEDIATELY.

2-NO WORK SHALL BE CARRIED OUT UNLESS SHOP DRAWING ARE SUBMITTED BY THE CONTRACTOR AND APPROVED BY CONSULTANT.

3-CONTRACTOR SHALL COORDINATE ALL WORKS WITH ELECTRICAL, STRUCTURAL & ARCHITECTURAL LAYOUTS.

4-MECHANICAL SERVICES SHALL NOT CUT IN ANY STRUCTURAL BEAMS, RIBS OR ANY OTHER STRUCTURAL ELEMENTS UNLESS A PRIOR WRITTEN APPROVAL HAS BEEN TAKEN FROM THE ENGINEER.

5-ALL EQUIPMENTS SHALL BE INSTALLED STRICTLY AS PER MANUFACTURES RECOMMENDATIONS.

6-MECHANICAL CONTRACTOR SHALL PROVIDE SLEEVE ON ALL PIPES PENETRATING WALL SLABS OR BEAMS.

7-ALL WORK SHALL CONFIRM TO THE LATEST INTERNATIONAL BUILDING CODE, AND THE REQUIREMENTS OF LOCAL AUTHORITIES.

8-MANHOLE COVERS AND FRAMES ARE TO BE HEAVY DUTY IN TRAFFIC AREAS AND MEDIUM DUTY IN PEDESTRIAN AREAS.

9-MANHOLES SHALL BE OF CONCRETE CONSTRUCTION.

10-ALL UNDER GROUND SEWERAGE PIPES SHALL HAVE A MINIMUM SLOPE OF 0.6%.

11-ALL SANITARY APPLIANCES SHALL BE PROVIDED WITH TRAPS.

12-JOINTS TO W.C PANS SHALL BE WITH UPVC CONNECTORS & RUBBER GASKETS.

13-ISOLATING VALVES SHALL BE PROVIDED TO SEPARATE THE INDIVIDUAL TOILETS.

14-EXACT LOCATION OF WATER PIPE WORK SHALL BE DETERMINED ON SITE.

15-PROVIDE ISOLATING VALVE ON ALL MAIN AND BRANCH LINES FOR MAINTENANCE.

16-ALL ELECTRICAL POWER AND CONTROL WIRING/CONDUITING FROM M.C.C TO PLUMBING EQUIPMENTS SHALL BE CARRIED OUT BY ELECTRICAL CONTRACTOR.

17-FOR COLD AND HOT WATER SUPPLY PPRC PN-20 PIPES SHALL BE USED.

18-FOR COLD AND HOT WATER PIPE FITTINGS PPRC PN-25 SHALL BE USED.

19-FOR SOIL, WASTE AND RAIN WATER PIPES & FITTINGS UPVC CLASS-D, PIPE SHALL BE USED.

20-FOR NATURAL GAS SYSTEM G.I PIPE SHALL BE USED.

21-THE INVERT LEVEL OF THE ENTIRE MANHOLE TO BE VERIFIED ON SITE.

SCHEDULE OF PIPE SUPPORTS (SWV) FOR uPVC PIPES (INSIDE THE BUILDING)

PIPE SIZE	HORIZONTAL DIST.	VERTICAL DIST.
32Ø TO 40Ø	10 TIME DIA OF PIPE	15 TIME DIA OF PIPE
50Ø	10 TIME DIA OF PIPE	15 TIME DIA OF PIPE
75Ø & 100Ø	10 TIME DIA OF PIPE	15 TIME DIA OF PIPE
150Ø TO 200Ø	10 TIME DIA OF PIPE	15 TIME DIA OF PIPE

- SUPPORT IN ALL CHANGES IN DIRECTION & UNDER FLOOR GULLY.
- ALL PPR PIPE SUPPORTS RECOMMENDED AS PER MANUFACTURE.

SCHEDULE OF PIPE SUPPORTS FOR PPRC PIPES

PIPE SIZES	HORIZONTAL DIST.	VERTICAL DIST.
1/2" Ø TO 3/4"Ø	5 FT. C/C	6 FT. C/C
1"Ø TO 1-1/4"Ø	6 FT. C/C	10 FT. C/C
1-1/2"Ø TO2-1/2"Ø	10 FT. C/C	10 FT. C/C
3"Ø TO 4"Ø	12 FT. C/C	12 FT. C/C
6"Ø AND LARGER	15 FT. C/C	12 FT. C/C

FIXTURE CONNECTIONS SCHEDULE

FIXTURES	COLD WATER	HOT WATER	DRAIN PIPE
WC (ENGLISH)	20	-	100
WC (ASIAN)	20	-	100
LAVATORY	20	20	100
SHOWER	20	20	100
KITCHEN SINK	20	20	100
URINAL	20	-	100

MANHOLE DEPTH	DETAILS
<1 METER	600mm x 600mm
<1.75 METER	900mm x 600mm or Ø 1000 mm
<2.5 METER	12OOmm x 750mm or Ø 1200 mm
>2.5 METER	1400mm x 900mmor Ø 1400 mm

SCHEDULE OF MANHOLE

TYPE	SIZE OF LARGEST PIPE (Millimeters)	CIRCULAR DIAMETER (Millimeters)	CIRCULAR COVER DIAMETER (Millimeters)
<1.5m DEEP TO SOFFIT	200	1200	600
	300	1200	600
>1.5m DEEP TO SOFFIT	200	1200	600
	300	1200	600
>3.0m DEEP TO SOFFIT OF PIPE	STEPS	1050	600
	LADDER	1200	600

PPRC PIPE SIZES

DIAMETER IN INCHES INTERNAL DIA. (ID)	DIAMETER IN MILLIMETRE INTERNAL DIA. (ID)	DIAMETER IN MILLIMETRE OUTER DIA. (OD)
1/2"Ø	15	20
3/4"Ø	20	25
1"Ø	25	32
1-1/4"Ø	32	40
1-1/2"Ø	40	50
2"Ø	50	63
2-1/2"Ø	63	75
3"Ø	75	90
4"Ø	100	110

RECOMMENDED uPVC PIPE SLOPES

PIPE SIZES	SLOPE RATIO
40Ø TO 50Ø	1:20, 1:30
75Ø & 150Ø	1:120
200Ø TO 250Ø	1:250
300Ø	1:450

CLIENT:-
Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-
RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-
PLUMBING GENERAL NOTES

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .
DRAWN BY A-A
CHECKED BY O-A
DATE APRIL.2025
SCALE AS SHOWN
DWG. NO. P-01

LEGEND

ABBREVIATIONS	DESCRIPTION
T/A	TO ABOVE
F/A	FROM ABOVE
T/B	TO BELOW
F/B	FROM BELOW
DN	DOWN
TYP.	TYPICAL
GW	GRAY WATER PIPE
HWR	HOT WATER RETURN PIPE
CW	COLD WATER PIPE
HW	HOT WATER PIPE
BAS	BASEMENT FLOOR
FF	FIRST FLOOR
GR	GROUND FLOOR
BC	BIB COCK
MS	MUSLIM SHOWER
(A.F.C)	ABOVE FALSE CEILING

LEGEND

ABBREVIATIONS	DESCRIPTION
(B.F.S)	BELOW FLOOR SLAB
U/G	UNDER GROUND
O/H	OVER HEAD
AAV	AUTO AIR VENT
PRV	PRESSURE RELIEF VALVE
T.L	TOP LEVEL
I.L	INVERT LEVEL
RD	ROOF DRAIN
RWD	RAIN WATER DRAIN
FD	FLOOR DRAIN
GV	GATE VALVE
IV	ISOLATING VALVE
GT	GULLY TRAP
MH	MANHOLE
COP	CLEAN OUT PLUG
CO	CEILING CLEAN OUT
RE	RODING EYE / END CAP

LEGEND

SYMBOL/ABBR	DISCRIPTION
	GRAVITY COLD WATER
	DRAIN PIPE
	SOIL PIPE
	WASTE PIPE
	SEWERAGE PIPE
	GRAVITY HOT WATER
	FLOOR CLEAN OUT
	CHECK VALVE
	GATE VALVE
	ASIAN WATER CLOSET
	EUROPEAN WATER CLOSET
	WASH BASIN COUNTER TOP
	WASH BASIN / VANITY
	MUSLIM SHOWER

LEGEND

SYMBOL/ABBR	DISCRIPTION
	COLD WATER CONNECTION
	HOT WATER CONNECTION
	MUSLIM SHOWER WITH BIB COCK
	SHOWER ROSE
	STAINLESS STEEL KITCHEN SINK DOUBLE BOWL DOUBLE DRAIN BOARD
	BIB COOK WITH MUSLIM SHOWER
	FLOOR DRAIN
GT	GULLY TRAP
M-H	MANHOLE
BD	BALCONY DRAIN
	FLOW ARROW
	ROOF DRAIN
	BOOSTER PUMP
	GATE VALVE
	GAS GEYSER
	FLOAT SWITCH
	ELECTRIC GEYSER

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

PLUMBING LEGENDS

REV #	DATE	DESCRIPTION	CHK'D	APP'D

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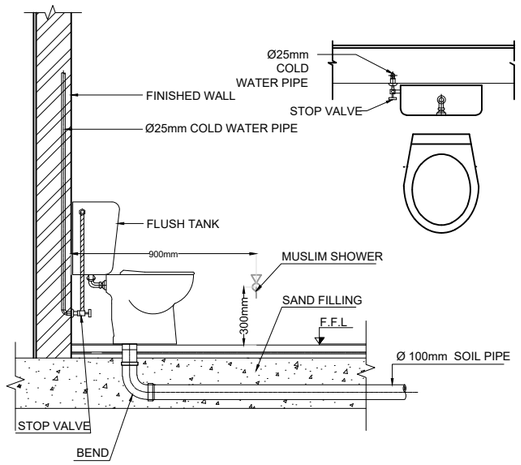
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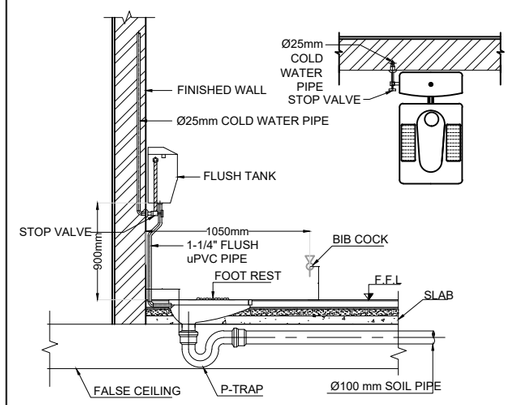
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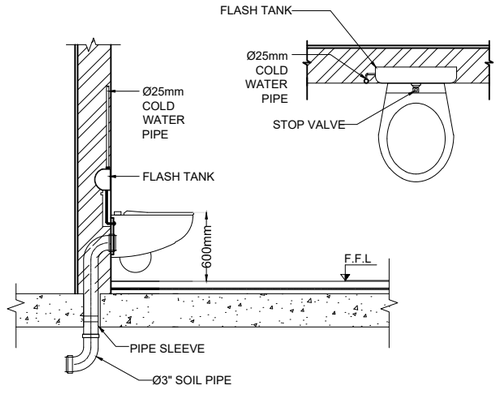
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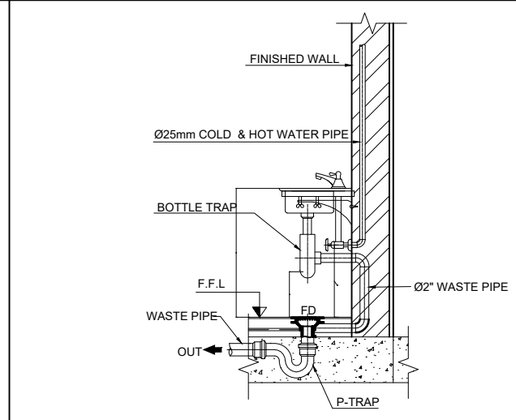
DETAIL OF ENGLISH WATER CLOSET



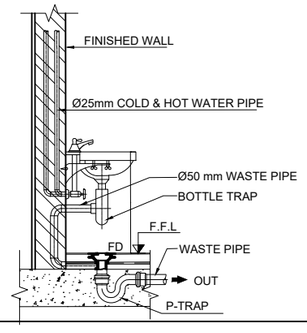
DETAIL OF INDIAN WATER CLOSET



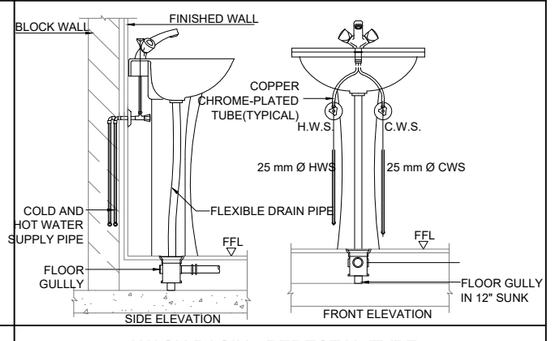
DETAIL OF WALL HUNG WATER CLOSET



DETAIL OF FLOOR KITCHEN SINK



DETAIL OF VANITY



WASH BASIN - PEDESTAL TYPE

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

PLUMBING STANDARD DETAILS-1

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .

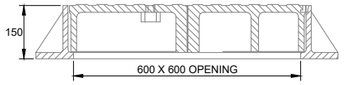
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DATE APRIL.2025

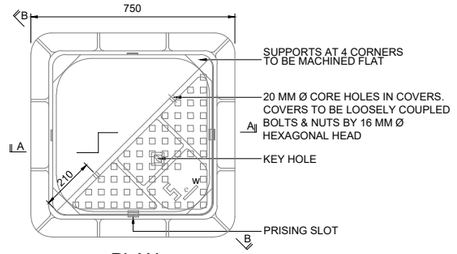
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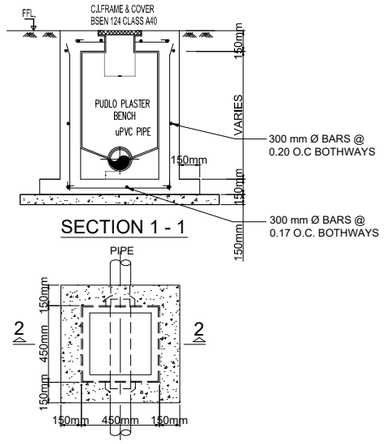
SECTION A-A

NOTES:
1-MANHOLE COVER AND FRAME SHALL IN GENERAL COMPLY WITH S.S 30:1971 (REVISED).
2-ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3-ALL BOLTS AND NUTS SHALL BE OF STAINLESS STEEL.



PLAN

(HALF COVER REMOVED)

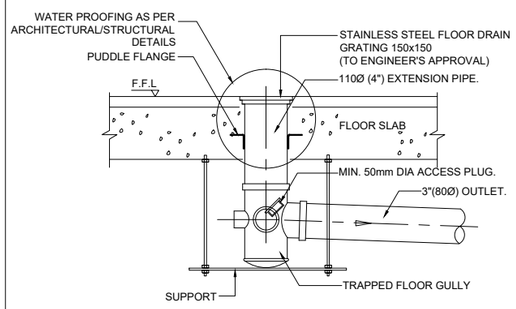


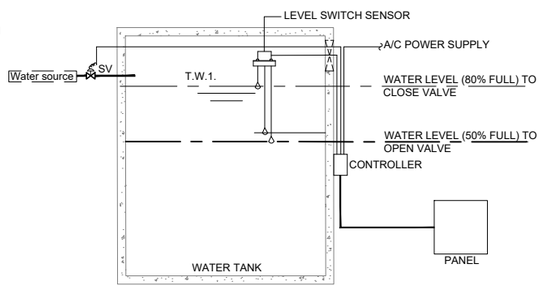
PLAN

DETAIL OF MANHOLE (TYPE -1, UP TO 1800mm DEEP)

MANHOLE COVER

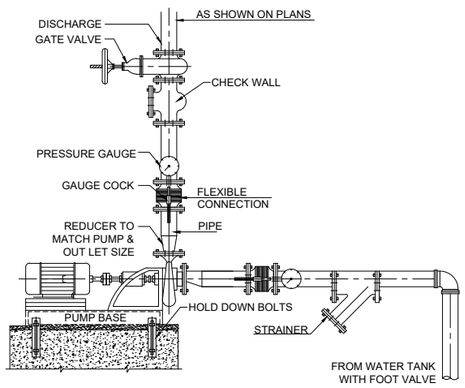
DETAIL OF MANHOLES



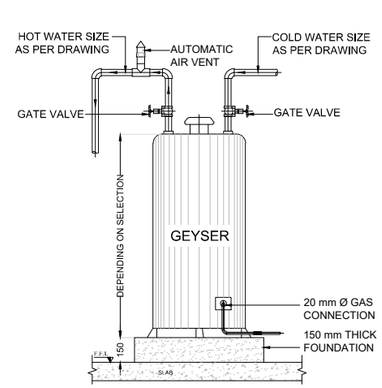


HANGING TYPE FLOOR DRAIN DETAIL

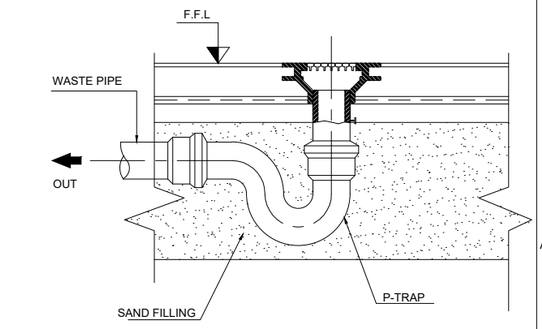
WATER TANK FLOAT SWITCH



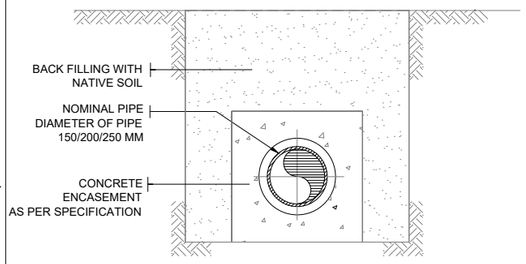
PUMP FITTINGS DETAIL



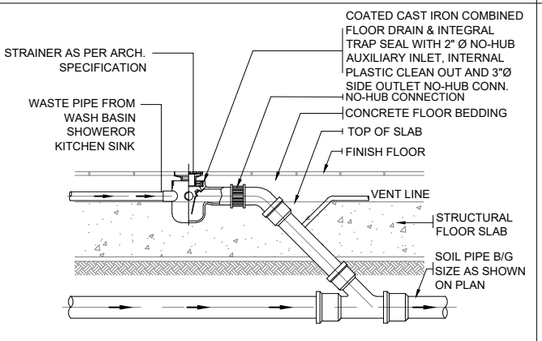
DETAIL OF GYSER



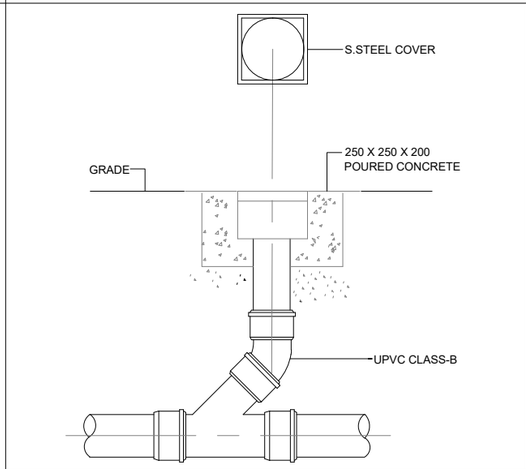
DETAIL OF FLOOR DRAIN



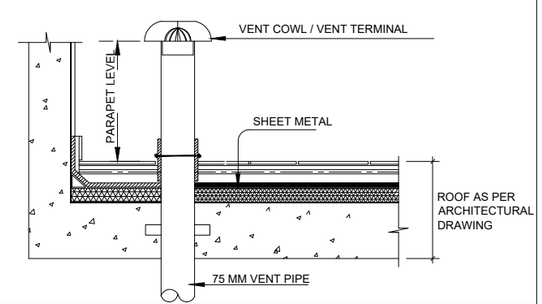
BURIED SEWER PIPE



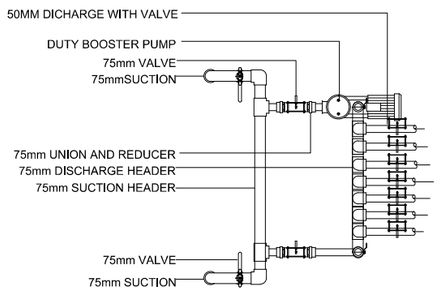
FLOOR GULLY CONNECTION TO MAIN PIPE



FLOOR CLEAN OUT INSTALLATION DETAIL



VENT THROUGH ROOF



TYPICAL DETAIL OF WATER HEADER

CLIENT:-

Chandka Medical Hospital, Larkana

CONSULTANT:

PROJECT:-

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA

TITLE:-

PLUMBING STANDARD DETAILS-2

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .

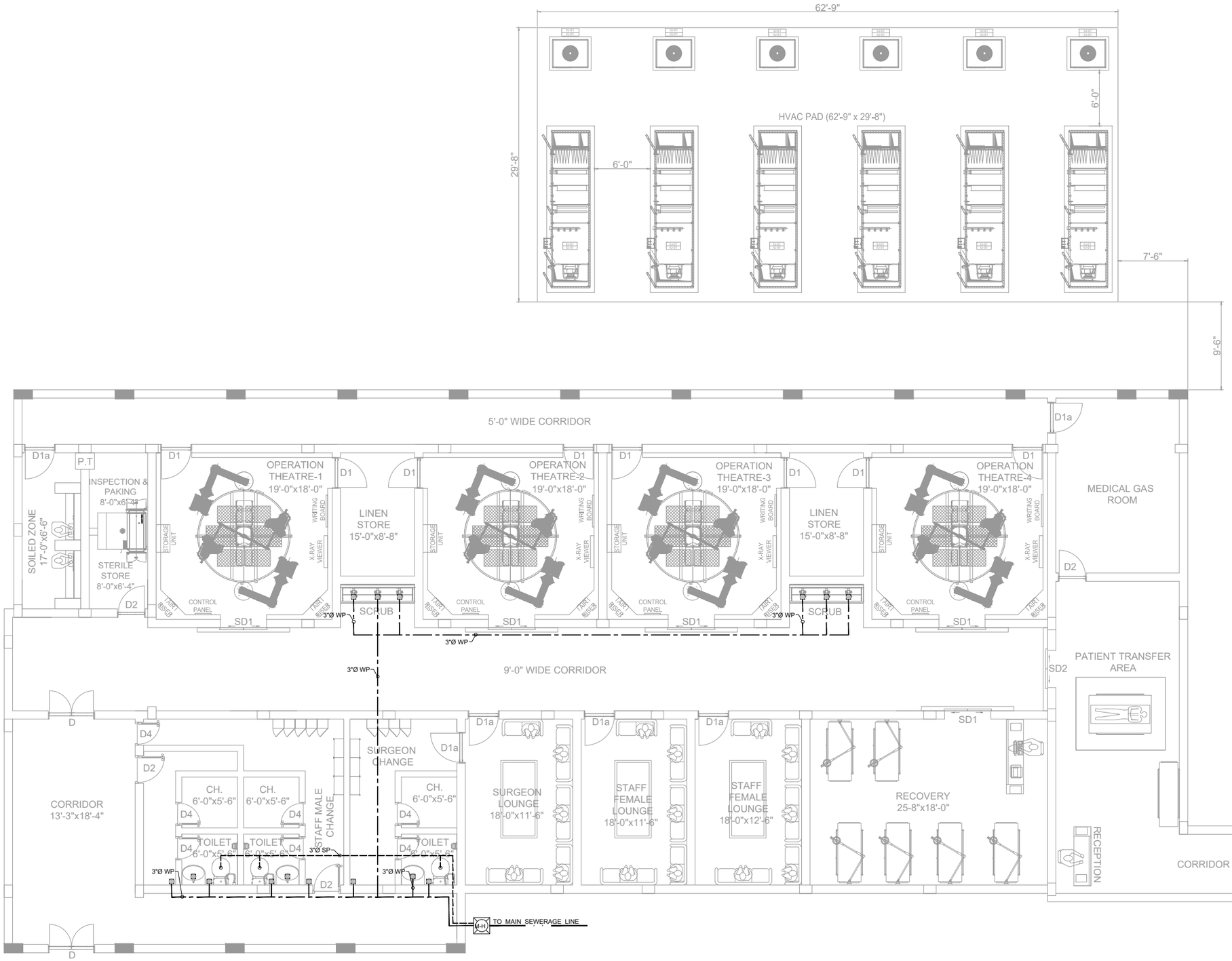
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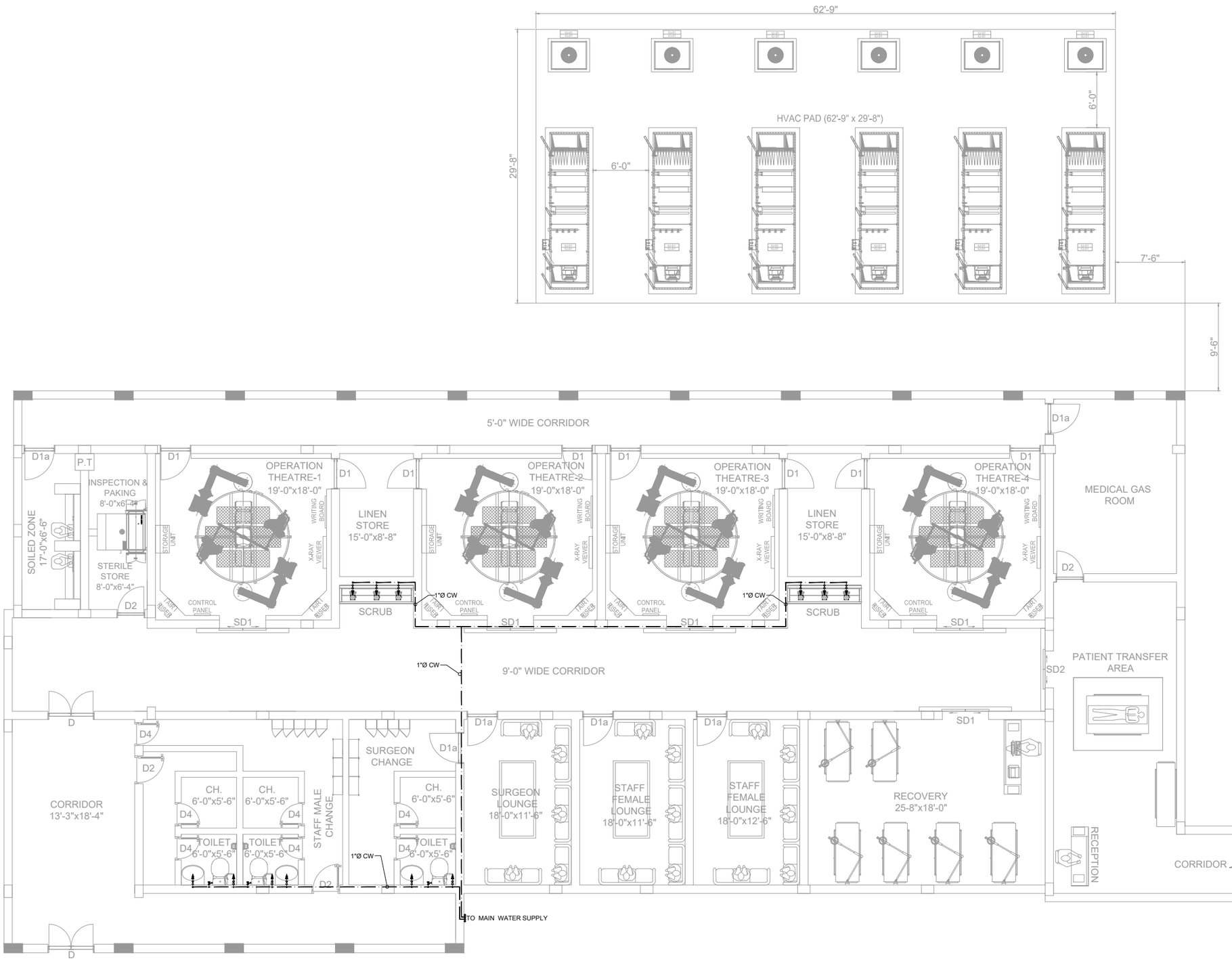
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CLIENT:- **Chandka Medical Hospital, Larkana**	CONSULTANT:	PROJECT:- RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	TITLE:- DRAINAGE LAYOUT PLAN	REV # / DATE / DESCRIPTION / CHK'D / APP'D	Project Ref: .	DATE: APRIL.2025		
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CLIENT:- **Chandka Medical Hospital, Larkana**	CONSULTANT:	PROJECT:- RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA	TITLE:- WATER SUPPLY LAYOUT PLAN	REV # / DATE / DESCRIPTION / CHK'D / APP'D		Project Ref: .	DATE: APRIL.2025	
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CHANDKA MEDICAL COLLEGE

TECHNICAL SPECIFICATIONS
VOLUME-III

RENOVATION/REPAIR/AUGMENTATION/STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL LARKANO PHASE-I

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1. GENERAL AND SITE FACILITIES

1.1 INTRODUCTION

These Specifications shall apply to all such works to be executed involving construction of a building and its allied works under the Contract or otherwise directed by the Engineer. In every case, the Work shall be carried out to the satisfaction of the Engineer and conform to the location, lines, dimensions, cross-sections, etc shown in the Drawings or in the Bill of Quantities (BOQ) or as indicated by the Engineer. The quality of materials, processing of materials as may be needed at the site, salient features of the construction work and quality of finished works shall comply with the requirements set forth in the succeeding Sections and Sub-sections. Where the Drawings and Specifications describe a portion of the work in only general terms and not in complete detail, it shall be understood that only the best general practices are to prevail, materials and workmanship of the best quality are to be employed and instructions of the Engineer are to be fully complied with.
Words importing the singular also mean the plural and vice versa where the context so demands. Similarly, words importing the male also mean female or neuter and vice versa where the context so requires. Words have their normal meaning under the English language unless specifically defined.

1.2 DEFINITIONS

The following words and expressions shall have the meaning hereby assigned to them, except where the context otherwise require. However, in the case of any conflict with the stipulations of the Conditions of the Contract, the expressions and meaning of the Conditions of Contract shall prevail.
'The Employer' is the MS Chandka Medical College as PA's Coordinator or any other representative appointed from time to time by the authority and notified in writing to the Contractor to act as the PA's representative for the purpose of this Work.
'The Engineer' shall mean the engineer designated or any other engineer appointed from time to time by the PA and notified in writing to the Contractor to act as 'the Engineer' for the purpose of the Contract.
'The Contractor' shall mean any person or corporate body who is pre-qualified under the Project/ enlisted with the PEC and whose Tender to carry out the Work has been accepted by the Employer and the legal successors in title to such person, but not (except with the consent of the Employer) any assignee of such person.
A **'Sub-Contractor'** shall mean any person or corporate body named in the Contract as a Subcontractor for a part of the Work or any person or corporate body to whom a part of the Work has been subcontracted with the consent of the Engineer and the legal successors in title to such person or corporate body, but not any assignee of any such person or corporate body.
'The Contract' is the contract between the Employer and the Contractor to execute, complete and maintain the Work.
The expression of **'Work'** or **'Works'** are what the Contract requires by the Contractor to construct, install and hand over to the Employer, as defined in the Tender Documents. Unless there be something either in the subject or context repugnant to such construction it shall be construed and taken to mean the works by or by virtue of Contract to be executed, whether temporary or permanent and whether original, altered, substituted or additional.
'Site' means the places provided by the Employer where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of the Site.
'Tender' means the Contractor's priced offer to the Employer for the execution and completion of the Work and the remedying of any defects therein in accordance with the provisions of the Contract, as accepted by the Letter of Acceptance.
'Letter of Acceptance' means the formal acceptance by the Employer of the Tender.

1.1 SCOPE OF WORK

The Work to be carried out under the Contract shall consist of the various items as generally described in

the Tender Documents as well as in the BOQ furnished in the Tender Documents.
The Work to be performed shall also include all general works preparatory to the construction of a building and all other related works. The Work shall include works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and of the Drawings, BOQ and these Specifications and further Drawings and Orders as may be issued by the Engineer from time to time. Whether specifically mentioned or not in the various Sections of this Specification, the Scope of Work shall include compliance by the Contractor with all conditions of the Contract, all materials, apparatus, plant, equipment, tools, fuel, water strutting, timbering, transport, offices, stores, workshop, staff, labor and the provision for proper and sufficient protective works, temporary fencing and lighting, etc. It shall also include safety of workers, first-aid equipment, suitable accommodation for the staff and workmen with adequate sanitary arrangements, the effecting and maintenance of all insurance, the payment of all wages, salaries, fees, royalties, duties or other charges arising from the erection of works and the regular clearance of rubbish, reinstating and clearing the site as may be required on completion of the Work, safety of the public and protection of the Work and the adjoining land.
The Contractor shall ensure that all actions are taken to have a built-in quality assurance in the planning and execution of the Work. The quality assurance shall cover all stages of works such as setting out, selection of materials, selection of construction methods, selection of equipment and plant, deployment of personnel and supervisory staff, quality control testing, etc. The work of built-in quality assurance shall be deemed to be covered in the Scope of Work.

1.2 SUBMITTAL

The submittal by the Contractor shall include construction programme, all Shop Drawings, reports, samples, test results etc. to conform with all applicable provisions of the General Conditions of the Contract and as required under the various Sections of these Specifications. The purpose of the submittal required herein is to assure that items furnished and installed are, in all matters of consequence, equivalent to the specified items and that proper records are maintained of the changes made in the Specifications, Drawings or in materials used or any deviations made in the construction process.
The Contractor shall forward all submittal to the Engineer under a cover letter stating that the submittal has been carefully reviewed by the Contractor and that on-site conditions or dimensions where necessary and correctness have been verified and checked.
The submittal shall be reviewed by the Engineer to verify that the Contractor's obligations are fulfilled as per the turn intention of the Contract. In checking and approving submittal, the Employer does not relieve the Contractor from responsibilities for construction errors or omissions, which may occur, even though executed in accordance with the approved Shop Drawings. Any such errors or omissions, as is discovered later on, should be corrected by the Contractor irrespective of any approval by the Employer at no additional cost to the Employer. This does not apply to modifications approved as specified herein.
The Contractor shall make submittal of construction requirements at least 10 days prior to actual construction of the component to allow time for checking and re-checking, if necessary. Any works fabricated or installed by the Contractor prior to approval of the Shop Drawings or other required submittal shall be done at his own risk.

1.2.1 CONSTRUCTION PROGRAM

Within 14 days of the date of the Letter of Acceptance, the Contractor shall submit to the Engineer for his approval a Bar Chart/Gantt Chart showing the program sequence in which works have been proposed to be carried out including the procurement and delivery of equipment and materials.
The Contractor shall, whenever required by the Engineer, also provide in writing a general description of the arrangements and methods, which would be adopted for the execution of the Work.
If at any time it would appear to the Engineer that the actual progress of work does not conform to the approved program, the Contractor shall be obliged to produce for the approval of the Engineer the reasons for any changes with a revised program showing the modifications to the previously approved program necessary to complete the Work on schedule. Submission to and approval by the Engineer of such

program or furnishing of such particulars shall neither relieve the Contractor from any of his duties and responsibilities under the Contract nor it shall prejudice the 'Liquidated Damages' Clause of the Contract.

1.2.2 NOTICE OF OPERATION

The Contractor shall give full and complete written notice of all the important operations, including setting out, to the Engineer sufficiently in advance (not less than 10 days) to enable the Engineer to make such arrangements as the Engineer may consider necessary for inspection and for any other purposes. The Contractor shall not start any important operation without the written approval of the Engineer.

1.2.3 AS-BUILT DRAWINGS

Before the expiry of the period of maintenance, the Contractor shall submit the full sets of As-Built Drawings of the completed works to the Employer. The sets shall comprise of all Discipline Drawings (9 copies) along with soft copies on a CD.
The As-Built Drawing shall clearly show the lines and dimensions of the permanent construction actually made based on the changes to the original design from time to time as ordered by the Engineer or proposed by the Contractor and approved by the Engineer.
The original soft copies of the Tender Drawings and Design Drawings will be provided to the contractor for producing additional copies, if the contractor requires.

1.2.4 SHOP DRAWINGS

The Contractor shall prepare the Shop Drawings at his own costs showing clearly all elements of construction that are required to assure proper shop fabrication or job ins Shop Drawings shall be clearly shown. All material quality, finishes, construction details as specifically related to the project must be shown on the Shop Drawings installation of items requiring.

1.3 TAKING OVER POSSESSION OF SITE

The Contractor shall, upon receiving the Work Order, immediately take possession of the Site and move his men and materials to prepare the Site in order to create conditions for starting the Work as per terms of the Contract, Drawings and Specifications.

1.4 MOBILIZATION

The work of mobilization shall consist of carrying out the following listed actions together with all other requirements of the Contract with regard to commencing the execution of the Work by the Contractor at his own cost.

i. Procurement, assembly, repair and make to running condition of all the contractor-owned constructional plant and equipment by the Contractor at any other site as convenient to him.

ii. Transportation of Contractor-owned constructional plant, equipment and materials from the storage site as mentioned above in (a) to the place of construction.

iii. Assembling and installation of all items of constructional plant, equipment, etc. required for the execution of the Work.

iv. Receiving all constructional plant, equipment and materials to be furnished by the Employer, if any, and collect and transport those to the Work site. All materials shall be properly stored, inventoried and protected until used in to the Work and all plant and equipment shall be tested and made ready for use.

v. Construction of a suitable Site office building or shed for storage of materials and equipment, workshop, other operational buildings and First-Aid Center attended by competent Medical Assistants.

vi. Maintenance of all temporary roads, fences and sanitary facilities, keep all areas used by the Contractor clean, neat, well-kept and in good repair and provide proper drainage to protect the area from surface run-off and flooding.

vii. Provide all the required electric power, water supply and other utility connections to temporary installations at the Site as may be necessary for the execution of the Work.

viii. Obtain all insurance policies, performance bond and payment guarantee as required under this Contract.

ix. Payment of all fees, permits, licenses, etc. as may be required covering the execution of the Contract.

1.5 MONITORING PROGRESS

The Contractor shall furnish the Engineer, without cost to the Employer, at regular monthly interval and in a form and number of copies determined by the Engineer, with the following:

i. Physical progress for the month under report and the estimated progress for the following month.

ii. Completion schedules (target and actual) based on the approved construction program.

iii. A tabulation of construction equipment listing the major items and pieces of equipment comprising the construction plant as were utilized for performance of the Work during the month under report.

iv. A tabulation of employees countersigned by the Engineer's representative, showing the supervisory staff and the number of several classes of labour employed by the Contractor in the month under report.

v. Any report which may be specifically requested by the Employer and/or by the Engineer.

1.5.1 ATTENDANCE AT SITE MEETINGS

The Contractor shall attend punctually the progress and other on-site meetings as would be requested by the Engineer.

1.5.2 RECEIVING VISITORS

The Contractor shall receive all authorized visitors of the Employer and allow them to visit the Work in the manner as would be requested by the Employer

1.6 CONTRACTOR'S SITE FACILITIES

The Contractor shall, at his own expenses, be responsible for the provision, maintenance, operation and subsequent removal of the following and all other necessary temporary facilities and services on Site those are required to accomplish the Work in a safe and orderly manner as per provisions of the Contract:

i. All temporary stores, warehouses and workshops.

ii. Adequate number of toilets necessary for all persons engaged for the Work with separate arrangements for women. All sewage from toilets shall be disposed off by means of septic tank and soak pit or by some other acceptable disposal system.

iii. To keep all sanitary facilities clean and their frequent disinfecting.

iv. Fencing, lighting and security.

v. Cranes or other appropriate ways and means for off-loading plant and equipment, placing in temporary storage and moving from storage to equipment locations.

vi. Site transport for the staff.

vii. Electric power for temporary buildings and tools.

viii. Provisions for adequate supply of water of acceptable quality at the Site for use in the Work.

ix. Raw water from Site Tube-wells and provisions for adequate potable water.

In addition to above, the Contractor shall also make available all other necessary temporary facilities and services on Site those are required to accomplish the Work in a safe and orderly manner as per provisions of the Contract.

The Contractor shall submit for the approval of the Engineer Detailed Plans and/or construction Drawings of the temporary buildings, warehouses, workshops and labour camps that he proposes to construct or arrange on lease/rent including the proposals for water and power supply and sewerage facilities. These requirements shall be fulfilled by the Contractor within 10 (ten) days from receipt of the Formal Work Order to commence work (Date of commencement of Work). All buildings and facilities shall be of standard and acceptable to the Engineer.

The labour camps shall be at a location approved by the Engineer and conform to all requirements of the local law. It shall be laid and constructed in accordance with a Drawing prepared by the Contractor and approved by the Engineer.

The Contractor shall be responsible for acquiring the land deemed necessary for the Work beyond the Employer's land and for his temporary buildings, warehouses, workshops, staff quarters, labour camps and any temporary access road. The Contractor shall maintain the Site and all working areas in a safe and hygienic condition and in all matters of health and sanitation shall comply with the requirements of the local Medical Officer of Health or other competent Authority.

1.7 MATERIALS, PLANT, EQUIPMENT AND TOOLS

The Contractor at his own expenses shall provide the materials, plant, equipment and tools products as shown on the Drawings or as specified in the Contract. Necessary haulage and safe storage of materials, supervision of works etc. shall be provided by the Contractor.

1.7.1 EQUAL PRODUCTS AND EQUIVALENTS

Except as specifically required otherwise, the mention of any proprietary materials by trade name is intended to establish a standard of quality, appearance, size and durability. The products of other manufacturers may be used subject to the conditions as stated below.

1.7.2 ADDITIONAL COSTS RELATED TO SUBSTITUTIONS

Any additional costs, or any losses or damages, arising from the substitution of any materials or methods from those originally specified shall be borne by the Contractor, unless such substitution was made at the written request or direction of the Employer.

1.7.3 FAILURE OF EQUAL PRODUCTS

Where products are accepted, based on representation of the Contractor, as approved equals, those shall

be used subject to the same installation and performance standards as required by the original specification. Approval of a request for substitution shall not modify the Contract requirements except as specifically noted. Subsequent failure of "approved equals" shall be considered first. For any evidence of improper installation or product inequality, the installation shall be repaired or corrected as directed by the Engineer at the full costs of the Contractor.

1.7.4 PLANT, EQUIPMENT AND TOOLS

The Contractor shall furnish all constructional plant, equipment and tools for the proper execution of the Work at his own expenses and keep those in proper working condition. The Contractor shall supply the Employer a list of major items of the constructional equipment and tools that he proposes to use in execution of the Work.

1.8 SUFFICIENCY OF MEANS EMPLOYED

The Contractor shall take upon himself the full and entire responsibilities for the sufficiency of his supervisory and other personnel, plant or equipment or tools, scaffolding, timbering and generally for all means used for the fulfilment of the Contract. In the event of any of these means proving insufficient, the Contractor shall remain fully and entirely responsible for the sufficiency of these means notwithstanding any previous approval or recommendation that might have been given by the Engineer.

1.9 PROTECTION AND SAFETY

1.9.1 GENERAL

The Contractor at all times shall take all necessary measures to the safety of life and property during construction of various parts of a building. International Safety Manuals used in Engineering Construction Project shall be adopted for protection and safety at the construction Site during the period of construction. Nothing stated herein shall be construed to nullify any rules, regulations, safety standards or statutes of the local authority, or those contained in the various Acts of the Government of Pakistan. The specific rules, regulations and Acts pertaining to the protection of the public or workmen from health and other hazards wherever specified by the local Authority etc. or by the Act/Ordinance of the Government shall take precedence over whatever are specified herein.

1.9.2 SAFETY OF WORKMEN

Helmets conforming to and shall be worn by the workmen and other personnel at all times while works are going on.

Safety goggles of accepted standard shall be used by individuals engaged in drilling, cutting, welding and all such works which cause hazard to the eye. The welders and gas cutters shall be equipped with proper protective equipment like gloves, safety boots, aprons and hand shields having filter glass of accepted standard and suitable to the eyes of a particular worker.

1.9.3 SITE PRECAUTIONS

In absence of boundary walls, construction Site shall be delineated by fences.

Warning signs shall be displayed, where necessary, to indicate hazardous areas like high voltage zone, area of no smoking etc. Hand lamps shall be of low voltage, preferably 24V. All electrically operated hand tools shall be provided with double earthing.

The temporary wells, which shall be provided by the Contractor at the construction Site as a part of the toilet facilities, shall be provided with proper covers. The toilet facilities shall be located at a corner of the Site so as to avoid any obstruction. Protection from bad weather and falling object and proper privacy shall be provided to the toilet users.

Temporary toilets shall be dismantled, all wells filled up, and the whole area made level, dressed and restored back to proper grade at the end of the project.

The Contractor at all times shall protect the excavation, trenches and building materials from rain water, groundwater, backing up of drains and from water of any origin. He shall provide all pumping arrangements for removal of surplus water, coverings and other materials as required.

All rubbish and debris shall be removed from the Site and disposed of at a safe distance as per direction of the Engineer so as not to create any obstruction to Work or give rise to health hazards.
The Contractor shall take all necessary precautions to ensure against fire during construction. The Contractor must make all necessary arrangements for providing adequate protection against fire hazards at the construction site during the period of execution of the Work.
Timber, coal, paints and similar combustible materials shall be separated from each other. A minimum of two dry chemical powder (DCP) type fire extinguishers shall be provided at both open and covered locations where combustible and inflammable materials are stored.
Inflammable liquids like petrol, thinner etc., shall be stored in conformity with the relevant regulations.

1.10 CARE OF WORKS

1.10.1 MOVEMENT OF TRANSPORT AND PLANT

The Contractor shall exercise diligence and care in the movement of all transports and plant within the Work area so as not to cause injury or damage to life or property. The Contractor shall be responsible for restoring any roadway, bridge, culvert etc. damaged by his transports and plant to the satisfaction of the Engineer or the appropriate Authority.

1.10.2 KEEPING WORKS FREE FROM ATMOSPHERIC CONDITION

The Contractor shall construct all temporary works and other works and supply and operate pumping plant and ensures all measures as may be found necessary for the construction of the Work under proper atmospheric condition.
Notwithstanding any approval by the Engineer of the arrangements made, the Contractor shall remain responsible for the sufficiency thereof and shall be liable for keeping the works safe at all-time regardless of the climatic condition at his own expenses. Any loss of production, additional overheads or additional costs of any kind that may result from inclement climatic conditions shall be at the Contractor’s risk

1.10.3 MATERIALS ON AND UNDER THE SITE

All soil, turf, gravel, stone, timber, or other materials obtained in the excavations, clearing of the Site of the Work and soil stripping, shall belong to the Employer and must not be removed from the Site without the written permission of the Engineer. Provided the Engineer directs the Contractor, he may use for the construction of the Work, any timber obtained from trees felled at the Site and any of the materials excavated under the Contract, which the Engineer may determine to be fit for such use.

1.11 SURVEY WORKS

1.11.1 PERMANENT BENCH MARK

Before commencing the work, the Contractor shall establish at his own cost, at least 2 (two) permanent Bench Marks (B.M) with permanent pillars at suitable positions as per direction of the Engineer. These B.Ms. shall be incorporated in the Drawings and used for controlling all levels of construction works.

1.11.2 REFERENCE LINE PILLARS

The Contractor shall establish permanent Reference Line Pillars (axis pillars, centre line pillars, etc.) at his own cost for all structures before starting of excavation of foundation pits/trenches as per standard practice and or as per direction of the Engineer. The Contractor shall remain responsible for safeguarding all Survey Monuments, Bench Marks, Beacons, etc. The Contractor, at his own expenses, shall make necessary arrangements to protect the B.M pillars against any disturbances, damages, including their maintenance.
The Engineer will provide the Contractor with the data necessary for setting out of the center line. All dimensions and levels shown on the Drawings or mentioned in the Documents forming part of or issued under the Contract shall be verified by the Contractor on the Site and he shall immediately inform the Engineer of any apparent error or discrepancy, if found by him in such dimensions or levels. The Contractor shall, after or in connection with these staking out of the center line, survey the terrain and

shall submit to the Engineer for his approval, a profile as required by the Engineer.
Instruments and equipment for surveys shall be subject to rigorous inspection by both the Contractor and the Engineer and any items found to be defective in the opinion of the Engineer, shall be promptly replaced, repaired or adjusted as per his direction. A qualified Surveyor or Engineer shall supervise all survey works. The checking of the setting-out of works by the Engineer's staff shall not relieve the Contractor of any of his liabilities or responsibilities under the Contract

1.12 FABRICATED ITEMS INCORPORATED IN THE WORK

Whenever required by the Specifications to fabricate or manufacture and furnish equipment for incorporation in the permanent works, the Contractor shall submit to the Engineer for his approval the names of the manufacturers or fabricators the Contractor proposes to use and also his detailed Shop Drawings for approval before proceeding with the Work. All such Drawings shall be adequately and properly checked before being submitted to the Engineer for approval and shall be so designated.
Any fabricating or manufacturing undertaken during or before the approval of the Drawings, will be at the Contractor's risk. The Engineer shall have the right reserved to ask the Contractor to make any changes in the Design, which may be found necessary in the opinion of the Engineer, for the equipment or component materials to fully meet the requirements and intent of these Specifications without causing any additional costs to the Employer.
Approval of the Contractor's Drawings shall not relieve the Contractor of any part of his obligation to meet all requirements of these Specifications or of the responsibilities for the correctness of his Drawings. At the time of delivery of the equipment, the Contractor, if requested to do so, shall furnish the Engineer two complete sets of the final approved Drawings.

1.13 INSPECTION AT FABRICATOR'S WORKSHOP

1.13.1 GENERAL

All equipment furnished under these Specifications and all works performed thereon will be subject to inspection by the Engineer or his authorized representative. Inspection at the manufacturer's plant, when located only in Pakistan, may be made with the intention to determine the meeting of requirements of the Specifications in respect of use of equipment and materials. The Contractor shall notify the Engineer a minimum of 15 (fifteen) days in advance of the date and place of equipment/materials to be available for inspection. No equipment or materials shall arrive at the Site until the Engineer's inspection at the manufacturer's plant or Contractor's storage place outside the actual Site has been made, the Engineer's approval has been given, final Drawings have been furnished by the Contractor and the Contractor's responsibilities for furnishing equipment and materials meeting the requirements of the Contract Document are fully complied with. All costs of the Engineer's inspection shall be borne by the Contractor.

1.13.2 TESTS AND INSPECTION RECORD

The record shall identify the Contractor and the Supervision Consultant staff (when applicable) involved, the place, the date and time when the inspection is completed, the sections of the Work and the materials tested or inspected and its state of completion. Reference shall be made to the relevant Working Drawings and the specific aspects or properties, which were checked or measured, shall be recorded.
One copy of each record of inspection shall be submitted to the Engineer and one copy of each record of inspection shall be submitted to the Supervision Consultant (when involved). The Contractor shall maintain records of inspections and tests in an orderly fashion at the Site until the issuance of the Defects Liability Certificate for the whole of the Work, or such earlier time as the Engineer may instruct. The Engineer shall have the rights of access to them at all times After the issuance of the Defects Liability Certificate for the whole of the Work, or such earlier time as the Engineer may instruct, the Contractor shall, as instructed by the Engineer, either dispose of the records or deliver them as directed.

1.13.3 NOTICE OF WORKS OFF-SITE

The Contractor shall give adequate written notices to the Engineer on the preparation or manufacture at a place not within the Site of any pre-fabricated units or parts of units or materials to be used in the Work. Such notices shall state the place and time of the preparation or manufacture, quarrying or extraction. The notice be given sufficiently in advance as to enable the Engineer to make arrangements which he may deem necessary for inspection before the start and at any stage of the Work and not only at the time when the units or parts are completed. Off-Site works shall not commence without the prior approval of the Engineer.

Any unit or parts, prepared or manufactured without giving such prior notice to the Engineer, may be rejected, if the Engineer considers that his inspection was necessary during the time of preparation or manufacture. No inspection by the Engineer shall relieve the Contractor of any of his responsibilities, duties and liabilities under the Contract.

1.13.4 STANDARDS

Except where otherwise specified or authorized by the Engineer, all materials and workmanship shall conform to the latest edition of the relevant Standard Specifications of the ASTM.

Materials meeting other internationally accepted equivalent or higher Standards may be accepted subject to review by the Engineer. The Contractor shall submit in English language any such alternative Standards proposed by him, for approval by the Engineer.

The Contractor shall provide the Engineer 3 (three) sets of each of the Standards, Codes and References to be used in the Contract within 45 (forty-five) days of the Date of Commencement of the Work. In addition, he shall supply 3 (three) copies of any other Standards or Codes subsequently specified or alternatively proposed to be used by the Engineer, the Supervision Consultant (when involved) and the Site Laboratory. All Standards shall be in English. On completion of the Contract, all copies of Standards, Codes and References, so provided, shall become the properties of the Employer.

1.13.5 PROPRIETARY PRODUCTS

Where a proprietary or brand name or the name of a supplier or manufacturer is indicated on the Drawings or in the Specifications, this would be in respect of items, which have not otherwise being adequately described by ASTM or equivalent recognized Standards. Alternative items based on recognized national Standards of the country of origin may be accepted provided that documented proof in the English language is submitted to the Engineer for his approval sufficiently in advance and showing that the alternative proposal is equal or higher in quality and performance than the specified item.

1.13.6 MATERIALS TO BE NEW

All materials used in the permanent works shall be new. No materials, incorporated in the permanent works, shall have previously been used in the temporary works.

1.13.7 ORDERS FOR MATERIALS

Before orders are placed for any materials of any description to be used in the permanent works, the Contractor shall submit to the Engineer the names and addresses of the manufacturers or suppliers proposed. Following approval by the Engineer, the Contractor shall submit to him copies of all orders placed for such materials.

1.13.8 SAMPLES

In accordance with the provisions of the Contract, the Contractor shall, in the way as directed by the Engineer, supply samples of materials to be incorporated in the Work. The Contractor shall submit the samples required for approval in labelled boxes suitable for storage and with sufficient time for testing. Due allowance shall be kept for the fact that if samples are rejected, further samples and testing will be required. The Engineer shall keep the approved samples with him and will compare the supply with the sample before acceptance. He shall reject any materials not conforming to the character and quality of the approved samples.

1.13.9 CERTIFICATES

All manufacturer's certificates of tests, proof sheets, mill sheets etc., showing that the materials have been tested in accordance with the requirements of the relevant ASTM or other approved Standard or this Specification, shall be supplied in English language by the Contractor to the Engineer free of charge.

1.14 TOLERANCES

Unless it has been specified in the different Sections otherwise, all works shall be constructed within the tolerances shown in the Table given below;

Type of Structure	Item	Tolerance
Concrete Structures	Tolerances from the specified position (Structure) Maximum departure of plan position of structure or element Tolerances from the specified dimensions (Structure) Maximum departure in thickness or cross-sectional dimensions of columns, beams, buttresses, wall footings etc., up to and including 500mm thick (except tunnel and shaft linings) Ditto – between 500mm and 1000mm thick Ditto – between 1000mm and 4000mm thick Ditto – over 4000mm thick Tolerances from specified position (Surface) Maximum departure of vertical, sloping or curved surfaces including joint surfaces Maximum departure of horizontal or near-horizontal surfaces including joint surfaces Tolerance on Straightness or Departure from Specified Curve (Surface) General Surface Maximum deviation in horizontal or vertical directions (gradual) Maximum deviation in horizontal or vertical directions (abrupt)	 25mm +6mm -3mm +10mm - 5mm +10mm -8mm +25mm -10mm 25mm 20mm 12mm in 2m 6mm
Formwork	Sectional dimension Plumb Levels (before any deflections	±5mm ±1 in 1000 of height ±3mm

	has taken place)	
Reinforcement	Length of splice Variation of protective cover Variation in indicated position or reinforcement: ▪ Starter bars ▪ Slabs and Walls ▪ One bar diameter Dimension of bent bars: ▪ Stirrups and ties ▪ Other bars	-25mm ± 1 in 1000 of ht. ± 3mm One bar dia. 0.25 times the indicated spacing. ±5mm ±5mm ±10mm
R.C.C. Piles	Pre-cast driven pile: a) Verticality for vertical pile b) Verticality for raker pile c) Deviation from position shown on the plan for vertical and raker piles after driving. Concrete piles casting tolerances: a) Maximum departure in thickness or crosssectional dimensions. b) Deviation of pile face c) Deviation of cross-section centroid from straight line connecting the centroid of the end faces of the pile. 2. Bored and Cast-in-situ pile: a) Verticality for vertical pile b) Verticality for raker pile c) Deviation from position shown on the plan for vertical and raker pile shaft	1 in 50 1 in 25 1/4th of Least dimension of 75mm whichever is greater. +6mm -0.00 6mm in 3m 10mm 1 in 75 1 in 25 Maximum 75mm in any direction
Timber Piles	Deviation of cross-sectional dimension. Deviation of cross-section centroid from straight line joining end face centroid. Level of top Pile.	-6mm 40mm + 12mm

* In addition to above, other tolerances have also been specified in the different Sections and Subsections in the relevant portion

1.15 RECORDING OF MEASUREMENT

Conditions of the Contract, Technical Specifications and Contract Drawings are to be read in conjunction with the Bill of Quantities (BOQ).

General directions and descriptions of works and materials are not necessarily be repeated nor summarized in the BOQ. References to the relevant Sections of the Contract documents shall be made before entering the Tender's rate.
The quantities given in the BOQ are only approximate and provisional and are given to provide a common basis for tendering. It does neither expressly nor by implication prescribed that the actual volume of work to be performed will exactly correspond therewith.
Any clarification regarding the BOQ and the Method of Measurement shall be adjudged by the Engineer in accordance with this Standard Specification, its Sub-sections, BOQ and other Tender Documents The works, executed fully complying the Drawings and instructions of the Engineer, will be measured for payment in accordance with the method adopted in the BOQ and the item therein set forth, notwithstanding any custom to the contrary. The net quantities of the finished works in place will always be taken except where otherwise specified.
No allowance shall be made for waste, laps, cuttings, etc. and no deduction will be made for grout nicks, joggle holes or rounded arises and sink age or for fitting iron works, etc.

1.16 PAYMENT

Full account shall be taken of all information contained in the Tender Documents and made available during the tender period as affects, inter-alia, working methods, haulage requirements and sequence of operations. Full allowance shall be made for all these provisions in the rates and sums entered against the various items in the BOQ of the Contract.
The specified payment Sections/Sub-sections of the Contract shall apply to any additional or varied works, which may be required to execute under the Contract except where specifically varied therein.
The basis of payment will be the actual quantities of works ordered and carried out, as measured by the Engineer (based on the As-Built Drawing, BOQ or otherwise as directed by the Engineer) and valued at the rates and prices of the Tender, where applicable, or otherwise at such rates and prices as (in case of non-tendered items) the Engineer may fix within the Terms of the Contract.
No payment will be made on account of the anticipated profit for work covered by the Contract, which is not performed. No adjustment will also be made in the unit rates set out in the Bill of Quantities because of an increase or decrease in the actual quantities from the Estimated quantities indicated therein, unless otherwise stated in the Conditions of Contract.
Notwithstanding any limit, which may be implied by the wording of the individual item and or the explanations in this Section, it is to be clearly understood that the Tender price is for the works finished and completed in every respect. Full account of all requirements and obligations have to be taken, whether expressed or implied covered by all parts of the Contract. The Tender price shall, therefore, include all incidental and contingent expenses (including all taxes and VATs) and risks of every kind necessary to construct, complete and maintain the whole of the Work in accordance with the Contract.
Full allowance is to be made in the Tender price for all costs involved in the following, inter- alia, which are referred to and/or specified herein:

i. All setting-out and survey works.
ii. Temporary access unless separately billed, fencing, guarding, lighting, and all temporary works including their removal on completion.
iii. Paying fees and giving notices to the Authorities.
iv. Reinstatement of the Site.
v. Safety precautions and all measures to prevent and suppress fire and other hazards.
vi. Interference to the works by persons or vehicles being legitimate users of the facilities on or in the vicinity of the Site.

vii. vii. Protection and safety of adjacent structures so far as they may be affected by the works or temporary works.

viii. viii. Supplying, maintaining and removing the Contractor's own housing for staff and labour, offices, workshop, plant yard, transport, welfare, services in connection therewith and other facilities required by the Contractor on completion of work unless separately billed.

ix. Working in the dry condition except where otherwise permitted by the Specification.

x. Supplying, inspection and testing of materials intended for use in the works including the provision and use of equipment.

xi. Maintaining public roads and footpaths.

xii. Opening quarries and borrow pits including all surveys, site investigations, removal and disposal of overburden, trimming of quarry or borrow pit faces and floors and all measures necessary to render quarries or pits safe and free for draining on completion.

xiii. Providing and transporting to Site all equipment necessary for the execution of the Work, setting to works, operating (including all fuel and consumable stores), removal from the Site all construction equipment upon completion of the Work, costs of all tests and other requirements in respect of such plant and equipment.

xiv. The requirements and all incidental costs and expenses involved to provide all necessary skilled and unskilled labors and supervision.

xv. Protection of all completed works following operations making good damages to any completed works due to any cause whatsoever, clearing all rubbish as they accumulate and leaving the Site in a tidy condition.

xvi. All costs associated with the provision and submission of Progress Reports, Records, Photographs, preparation of the necessary Shop and Working Drawings etc. except those provided in the Bill of Quantities.

xvii. Workmen's compensation and Owner's liability insurance.

xviii. Payments under the item for hiring of land (if there be any) in addition to the Employer's land for temporary works shall be made in accordance with the receipts obtained from the land owners within the limitation of quoted rate only if such provision is made in the BOQ of the Contract.

xix. Payment of royalties for fill materials obtained from privately owned land/carried earth shall remain included within the rates of the relevant items of the Contract. The volume of borrowed materials shall be calculated on the basis of pre-work and post-work measurements. Finished sections as per Drawings will be the basis for post-work measurement while the Work is complete as per Specifications.

xx. Payment shall mean gross payable amount on the rates of the BOQ including the Performance Security.

xxi. With regard to the Sub-section on 'Contractor's Site Facilities', payment will be made for hiring land for the Contractor's temporary works outside the Employer's property, only if such provisions are kept in the BOQ of the Contract.

xxii. The cost of keeping the works free from water will only be paid for, if referred to in the BOQ of the Contract Documents.

xxiii. No payment shall be made for any tests required under the Specification unless specifically referred to in the BOQ. If the Engineer requires any tests outside the BOQ, the cost of such test shall be agreed with the Engineer before execution and paid for as a supplementary item.

xxiv. No direct payment shall be made for works required under other Sub-sections. The costs for such works shall be deemed included in the related items of the BOQ.

Section 1: Civil Works

2. CONSTRUCTION MATERIALS

2.1 FIRST CLASS MACHINE MADE BRICKS

First Class Machine Made Bricks shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right-angled edges. They shall be of uniform colour (generally deep red or copper), homogeneous in texture and free from cracks, flaws and nodules of free lime. A fractured surface shall show a uniform compact structure free from limps and grits of holes. Other requirements of the First-Class Machine-Made Bricks shall comply with the following requirements:

Minimum crushing strength	210 kg/cm2.
Maximum water absorption	10% of dry weight
Efflorescence	Nil
Dimensions (+ 5mm)	200mm x 100mm x 50mm

2.2 AGGREGATES

Aggregates shall be hard, strong, durable, dense and free from injurious amount of adherent coatings, clay, lumps, dust, soft or flaky particles, shell, mica, alkali, organic matter and other deleterious substances. The various sizes of particles of which an aggregate is composed of shall be uniformly distributed throughout the mass.

Testing of aggregates shall be in accordance with BS 812 or ASTM C-136.

Approval of a source of aggregate by the Engineer shall not be construed as constituting the approval of all materials to be taken from that source and the Contractor shall be responsible for the specified quantity and quality of all such materials used in the Work. Aggregates shall not be obtained from sources, which have not been approved by the Engineer. The Contractor shall provide means of storing aggregates at each point where concrete is made such that;

i. Aggregates shall be stored on a hard and dry patch of ground covered with a 50mm thick layer of lean concrete.
ii. Each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times.
iii. Contamination of the aggregates by the ground or other foreign materials shall be effectively prevented at all times.
iv. Each heap of aggregate shall be capable of draining freely.
v. The aggregates shall be handled so as to avoid segregation.

The Contractor shall make available to the Engineer such samples of the aggregate as he may require. Such samples shall be collected at the point of discharge of aggregate to the batching plant/mixer machine. If any such sample does not conform with the Specifications, the aggregate shall promptly be removed from the Site and the Contractor shall carry out such modifications to the supply and storage arrangements as may be necessary to secure compliance with the Specifications.

2.2.1 COARSE AGGREGATE

Coarse aggregate shall be obtained from breaking hard durable rock or gravel or Picked Jhama Bricks, which conform to the requirements of AASHTO Standard Specifications M-80. Coarse aggregate shall be clean, free from dust and other deleterious materials. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce a workable concrete of maximum density.

Aggregate pieces shall be angular in shape and have granular or crystalline or smooth, but not glossy non-

powdery surfaces.
Maximum allowable limits of deleterious substances that shall not be exceeded for coarse aggregate are shown in the following table:

Material	Mass Precent
Soft fragments	2.00
Clay Lumps	0.25
Material passing the 0.075mm sieve	0.50 for clay 1.50 for fracture dust
Thin or elongated pieces: Flakiness Index (BS 8821992) less than	50 for uncrushed 40 for crushed

The Aggregate Crushing Value shall be less than 25% or the Ten percent Fine Value shall be greater than 150 kN according to BS 882-1992. Grading for nominal size coarse aggregate shall comply with the following ASTM C-33 standard gradations:
20mm nominal size Coarse Aggregate

Sieve Size (mm)	% Passing by Weight
25	100
19	90-100
12.50	20-55
9.50	0-15
4.75	0-5

40mm nominal size Coarse Aggregate

Sieve Size (mm)	% Passing by Weight
50	100
37.5	90-100
19	20-55
9.50	0-15
4.75	0-5

Coarse aggregate subject to five cycles of the Soundness Test, specified in ASTM C88, shall not show a loss exceeding 10% when magnesium sulphate solution is used except where otherwise approved.
The flakiness and elongation indices of the predominant size fractions in each single sized coarse aggregate, determined in accordance with BS 812, shall not exceed 20% and 35% by weight respectively.
Aggregate for use in concrete which is subject to abrasion and impact shall comply with the Test requirements of BS 812 and the Specification of BS 63 Part 1 and BS 63 Part 2 and BS 882 respectively.

Coarse aggregate shall be tested for drying shrinkage characteristics in accordance with BRS Digest No. 35.
Coarse aggregate shall be stored at Site in such a manner that it is not contaminated by fine aggregate, earth or other foreign matter. Adequate precautions shall be taken to prevent segregation of the coarse aggregate while it is being transported and stacked.

2.2.2 STONE AGGREGATE

The boulders to be used as coarse aggregate in concrete shall be composed of limestone, sandstone, granite, trap rock or rock of similar nature and shall have the following properties:

Minimum compressive strength	490 kg/cm2
Specific gravity	2.4-2.7
Unit-weight	2245-2566 kg/m3
Porosity	2 – 6%
Water absorption	1.5 – 5% by weight

The boulder shall be of uniform light colour as approved and shall be free from thin lamination, adherent coatings and deleterious substances. The wear loss of coarse aggregate of all types shall not exceed 35% by weight when tested by the Los Angeles Abrasion Test.
The boulders shall be supplied in sizes that can be handled manually by one person. Stock piling shall be such as to permit ready identification of the materials and shall be approved by the Engineer. Site for stockpiles shall be clean prior to storing materials. The stockpiles shall be built up in layers not to exceed 1.22m in height and each layer shall be inspected before the next layer is started. The crushed boulder chips shall be stacked in accordance with the specified sizes in different stacks as directed by the Engineer. Height of each stack should not exceed 33% of the minimum base dimension of the stack.

2.2.3 STORAGE OF COARSE AGGREGATE

Aggregate of different sizes or grades and from different sources of supply shall not be mixed. All aggregate shall be stored separately free from contact with earth and other deleterious matter. The coarse aggregate should be stockpiled in different stacks, according to the sieve sizes.
All precautions shall be taken during transport and stockpiling of coarse aggregate to prevent segregation. Segregated aggregate shall not be used until they have been thoroughly re-mixed and the resulting stack is of uniform and acceptable gradation.
Aggregate shall be stock-piled at least 7 (seven) days prior to their anticipated use to permit the Engineer to sample each stock-pile to determine the acceptability of the material for the intended use.

2.2.4 FINE AGGREGATE

Fine aggregates for use in the concrete and masonry work shall be non-saline clean natural sand and have a Specific Gravity not less than 2.6 and conform to the requirements of ASTM C 144. It shall be angular (gritty to touch), hard and durable, free from clay, mica and soft flaky pieces. All sands must be well washed and clean before use.
A well graded sand should be used for cement work as it adds to the density of the mortars and concretes. Sand required for brick work needs to be finer than that for stone work.
Sand which contains 90% of particles of size greater than 0.06mm and less than 0.2mm is fine sand. On the other hand, sand which contains 90% of particles of size greater than 0.6mm and less than 2mm is coarse sand.
Supply methods and stock piling of sand shall be such, as to permit ready identification of the material delivered and shall be approved by the Engineer.

2.2.5 IMPURITIES

Sand shall be clean and free from injurious amount of organic impurities. Deleterious substances shall not exceed the following percentage by weight.

Material Passing No. 200 sieve	2.0
Shale, coat, soft or flaky fragments	1.0

Sulphur Compounds 0.3
Clay Lumps (wet, on No. 4 sieve) 0.00
Fine aggregate subject to five cycles of the soundness test, specified in ASTM C88 shall not show a loss exceeding 10 mass percent when magnesium sulphate solution is used except where otherwise approved.

2.2.6 GRADING

Sand shall be well graded from coarse to fine within the limits given below or shall conform to the specified Fineness Modulus.

2.2.7 FINE AGGREGATE FOR CONCRETE

Sieve Size (mm)	% Passing by Weight
9.5	100
4	95-100
16	45-80
50	10-30
100	2-10

2.2.8 FINE AGGREGATE FOR MASONRY

Sieve Size (mm)	% Passing by Weight
4	100
8	95-100
16	70-100
30	40-75
50	10-35
100	2-15

2.2.9 SAND FILL

Sand for sand fill shall consist of hard, dense, durable materials free from injurious amounts of clay lumps, lightweight materials or other deleterious substances. Unless otherwise specified on the Drawings, sand fill with gunny bags shall have Fineness Modulus not less than 0.8. Sand fill for the Geo-textile bags shall, unless otherwise approved by the Engineer, comply with the following grading:
mm
d_{90} = 0.60 to 0.30
d_{86} = 0.50 to 0.25
d_{60} = 0.40 to 0.20
d_{50} = 0.35 to 0.20
d_{10} = 0.20 to 0.05

2.3 CEMENT

Cement used in the works shall be obtained from manufacturers, approved in writing by the Engineer and

shall be Ordinary Portland Cement complying with the requirements of ASTM C150 Type 1 or BS 12 or equivalent standard. Special cements shall conform to the requirements provided in writing by the Engineer.
A certificate showing the place of manufacture and the results of standard tests carried out on the bulk supply from which the cement was extracted must accompany each consignment of cement delivered to the Site.
The Engineer may make any tests, which he considers advisable or necessary to ascertain, if the cement has deteriorated in any manner during transit or storage. Any cement which, in the opinion of the Engineer, is of doubtful quality shall not be used in the Work until it has been re-tested and test result sheets, showing that it complies in all respects with the relevant standard, have been delivered to and accepted by the Engineer.
Cement that becomes lumpy or otherwise deteriorated in transit or storage shall not be used for brick masonry or concrete works. All cement, found unsuitable for use, shall be removed from the Site immediately.
The Engineer shall ask to carry out sampling, inspection and testing of all cement as may consider be necessary. Samples shall be taken as instructed from the Site store or from elsewhere on the Work or from any places where cement is used for incorporation in the Work. The compressive strength and tensile strength of standard cubes and briquettes respectively shall be not less than as follows:

Days	Compressive Strength (N/mm2)	Tensile Strength (N/mm2)
3	12.4	1.0
7	19.3	1.9
28	27.6	2.4

Initial setting time shall be not less than 45 minutes and the final setting time shall be not more than 8 hours. Cement, when tested for fineness, shall have a specific surface of not less than 160m2/kg. Cement when tested for soundness shall not have an expansion of more than 10 mm. The unit weight of cement shall be a minimum of 14.16 KN/m3.

2.3.1 WHITE CEMENT

White Cement shall be made from pure calcite lime stone and have the same physical properties as those of Portland Cement Type 1, ASTM C-150. Atypical composition of White Cement is as follows:

CaO	65%
SiO2	25.5%
Al2O3	5.9%
Fe2O3	0.6%
MgO	1.1%
SO3	0.1%

2.3.2 REJECTION OF CEMENT

The Engineer may reject any cement as the result of any tests thereof notwithstanding the manufacturer's certificate. The Engineer may also reject cement, which has deteriorated owing to inadequate protection or from other causes where the cement is not to his satisfaction. The Contractor shall remove at his cost all rejected cement from the Site without delay.

2.3.3 STORAGE OF CEMENT

Cement shall be delivered at the Site in sound and properly sealed jute/paper bags, each plainly marked with manufactures name or registered mark. Cement shall be well protected from weather by tarpaulins or other approved cover during transit. Weight of individual bag containing cement shall be 50 kg and

weight of all bags shall be uniform. Weight of cement shall be legibly marked on each bag. Bags in broken or damaged condition shall be rejected.
The Contractor shall provide waterproof and well-ventilated god owns at the specified or approved location at the Site having a floor of wood or concrete raised platform at minimum 450mm above the ground so as to protect the cement against moisture from air or from any other source. Sheds shall be large enough to allow a minimum 300mm gap between the stacked cement and the god own walls to store cement in sufficient quantity to ensure continuity of work and to permit each consignment to be stacked separately therein to permit easy access for inspection. All storage facilities shall be subject to approval by the Engineer.
Immediately upon arrival at the Site, cement shall be stored in the god owns with adequate provisions to prevent absorption of moisture. The Contractor shall use the consignments in the order in which they are received. Cement delivered to the Site in drums or bags provided by the supplier or manufacturer, shall be stored in the drums or bags until used in the Work. Any cement in drums or bags, which has been opened, shall be used immediately on opening. Cement shall not be stored in a go down for more than 3 (three) months if bagged or 6 (six) months, if in bulk or a lesser period as directed by the Engineer. After this period is over, any unused cement shall be removed from the Site.

2.4 ADMIXTURE

Admixture shall be used to provide excellent acceleration of gaining strength at early age and major increase in strength at all ages by significantly reducing water demand in a concrete mix, especially suitable for pre-cast concrete and other high early strength requirements. Admixture shall conform to BS 5075 Part 3 and ASTM C 494.

2.5 CONSTRUCTION JOINTS

Construction joints are defined as concrete surfaces upon or against which concrete is to be placed and to which new concrete is to be placed, that have become so rigid that the new concrete cannot be incorporated integrally with that previously placed. Construction joints shall be formed wherever there is a discontinuity in placing concrete in external elements of concrete structures. Formed vertical or inclined construction joints as well as unformed joints, which are due to interruption of concrete placement, shall be made only where located on the Drawings or shown in the pouring schedule or as directed by the Engineer. All exposed faces of construction joints shall be made absolutely straight, leveled or plumbed and normal to the finished surface.
Spacing of construction joints shall be in accordance with good concreting practice as defined in BS 8110 or equivalent and enabling adequate precautions to be taken against shrinkage cracking. Placing of concrete shall be carried out continuously. The joints shall be at right angle to the general direction of the member and shall take due account of shear and other stresses.
All planned reinforcing steel shall extend uninterrupted through joints. Additional reinforcing steel dowels shall be placed across the joints, if and when directed by the Engineer. Such additional steel shall be furnished and placed at the Contractor’s expenses.

2.5.1 BONDING

Unless otherwise shown on the Drawing, horizontal joints may be made without keys and vertical joints shall be constructed with shear keys. Surfaces of fresh concrete at horizontal construction joints shall be rough floated sufficiently to thoroughly consolidate the surface and intentionally left in a rough condition. Shear keys shall consist of formed depressions in the surface covering approximately one-third of the contact surface. The forms for keys shall be beveled so that removal will not damage the concrete. Surfaces of construction joints shall be prepared as early as possible after casting. The preparation shall consist of the removal of all laitance, lose or defective concrete coatings, sand and other deleterious materials. Preparation shall be carried out preferably when the concrete has set but not hardened by jetting with a fine spray of water or brushing with a stiff brush, just sufficient to remove the outer mortar skin and to expose the larger aggregate without it is being disturbed. Where this treatment is impracticable and work is resumed on a surface, which has set, the whole surface shall be thoroughly roughened or scrapped

with suitable tools so that no smooth skin of concrete that may be left from the previous work is visible. The prepared joint face shall be thoroughly cleaned by compressed air and water jets or other approved means and brushed and watered immediately before depositing concrete. The cleaned and saturated surfaces that also include vertical and inclined surfaces, shall first be thoroughly covered with a thin coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.
The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints, which are exposed to view, shall be carefully finished true to line and elevation.
Construction joints in floors shall be located 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.

2.5.2 BONDING AND DOWELING TO EXISTING STRUCTURES

When reinforcing dowels grouted into the holes drilled in the existing concrete is required at such construction joints, the holes shall be drilled by methods that will not damage the concrete around the holes. The diameters of the holes shall be 6mm larger than the nominal diameter of the dowels unless shown otherwise on the Drawings. The dowel bars shall be round mild steel bar of the diameter and length as indicated on the Drawings and/or as per the directions of the Engineer. The grout shall be a neat cement paste of Portland cement and water or an epoxy. Immediately prior to placing the dowel bars, the holes shall be cleaned off dust and other deleterious materials, shall be thoroughly saturated with water, have all free water removed and shall be dried to a saturated surface dry condition. Sufficient grout or an epoxy shall be placed inside the holes so as not to remain any void after the dowels are inserted. Grout shall be cured for a period of at least 3 (three) days or until dowel bars are encased in concrete. When an epoxy is used, the mixing and placing shall conform to the manufacturer's recommendations.

2.5.3 FORMS AT CONSTRUCTION JOINTS

When forms at construction joints overlap previously placed concrete, they shall be re-tightened before depositing new concrete. Exposed face edges of all joints shall be neatly formed with straight bulkheads or grade strips, or otherwise properly finished true to line and elevation.

2.6 EXPANSION AND CONTRACTION JOINTS

2.6.1 EXPANSION JOINTS

Expansion joints are intended to accommodate relative movement between adjoining parts of a structure. Compressible filler shall be placed between the joint faces to provide freedom for expansion for the two adjacent concrete masses. Care shall be taken to ensure that the material fills the joint completely and that no concrete or hard material is left in the joint after the second face of the joint has been cast

2.6.2 Material

One of the following specifications shall be used as pre-mould fillers:
i. Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction, ASTM 1751.
ii. Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction ASTM D 1752. Type-II (cork) shall not be used when resiliency is required.
iii. Specification for Preformed Expansion Joint Filler for Concrete, ASTM D 994. The bitumen sheet, laid on the horizontal top surface of the expansion joint keys, shall be a 10mm thick material approved by the Engineer.

2.6.3 Metal armour

Expansion joint armor assemblies shall be fabricated from steel with the following materials:
i. Steel bars, plates and shapes shall conform to the requirements of ASTM A 36.
ii. Bolts and nuts shall conform to the requirements of ASTM A 307.
iii. High strength bolts, nuts and washers shall conform to the requirements of ASTM A 325.
iv. Steel castings shall conform to the requirements of ASTM A 486 or ASTM A 27.

v. Grey iron castings shall conform to the requirements of ASTM A 48.
vi. Sheet metal shall be of commercial quality.

2.6.4 Armour assemblies

All assemblies shall be accurately fabricated and straightened at the workshop, as necessary to conform to the concrete sections. The assemblies shall be installed so that their top surface matches the plane of the adjacent finished concrete surface throughout the length of the assembly. Appropriate methods shall be followed in placing the assemblies to keep them in correct position during the placing of concrete. The opening at expansion joints shall be that designated on the Drawings at normal temperature or as directed by the Engineer for other temperatures. Cares shall be taken to avoid impairment of the clearance in any manner.

2.6.5 CONTRACTION JOINTS

General
Joints placed in structures or slabs to provide for volumetric shrinkage of monolithic unit or movement between monolithic units are defined as contraction joints. Contraction joints shall be constructed so that there will be no bond between the concrete surface forming the joints.
Material
Material placed in contraction joints shall consist of asphalt saturated felt paper or other approved bond-breaking materials

2.7 POURABLE JOINT SEALANTS

Pourable sealants shall be placed along the top edges of contraction or filled expansion joints. It shall conform to the following considerations:
i. Unless otherwise shown on the Drawings and/or ordered by the Engineer, joint sealants shall be a hot poured rubber bitumen compound for horizontal joints and either a bituminous compound or an elastomeric two parts polysulphide sealant for sloping, vertical and soffit joints.
ii. Bituminous compounds shall comply with BS 2499 for horizontal joints and BS 2499 Type A1 for sloping or vertical joints. Polysulphide compound shall comply with BS 4254.
iii. Joint sealants and the requisite priming materials shall be obtained from manufacturers approved by the Engineer. The application of joint sealant shall not be commenced without the Contractor obtains its approval by the Engineer.

2.7.1 COMPRESSIVE FILLER

Unless otherwise specified, the joint filler shall be of resin or bituminous bonded corks such as 'Hydrocor' manufactured by Expandite Ltd. The filler shall be obtained from a manufacturer approved by the Engineer and shall be stored and fixed in accordance with the manufacturer's instructions.
Types
Water stops to be used may be of the following types:

2.7.2 WATER STOPS

Water stops shall be of the type, size and shape shown on the Drawings and/or as directed by the Engineer. They shall be dense, homogeneous and without holes or other defects.

2.7.2.1 POLYVINYL CHLORIDE (PVC) WATER STOPS

Where shown on the Drawings, construction (as required and approved by the Engineer), contraction and expansion joints shall be made watertight by the provision of a continuous Water Stop strip of Poly Vinyl Chloride (PVC) manufactured by the extrusion process from an elastomeric plastic compound, the basic resin of which shall be Poly Vinyl Chloride. Unless otherwise specified or ordered, a two bulb dumbbell section PVC. Water Stop shall be used in construction joints and a three bulb section PVC Water Stop shall be used in expansion joints.
Water Stops shall be of high grade PVC, containing no filler or reclaimed or scrap material. PVC shall comply with the requirements of BS 2571 for PVC Type A, Class 1. The quality of Water Stops shall

comply with the following major requirements:
i. Specific gravity……. 1.30 (maximum)
ii. Hardness ……80 (minimum)
iii. Tensile strength…… 138 kg/cm2 (minimum)
iv. Elongation duro..……. 225% (minimum)

2.7.2.2 RUBBER WATER STOPS

Rubber Water Stops shall be manufactured with synthetic rubber made exclusively from neoprene, reinforcing carbon black, zinc oxide, polymerization agents and softeners. The quality shall conform the following major requirements:
Neoprene content…… 70% by volume (minimum)
Hardness…… 50-60 duro
Tensile strength…….. 193 kg/cm2 (minimum)
Elongation…….. 600% (minimum)
Rubber Water Stops shall be formed with an integral cross section in suitable molds so as to produce a uniform section with a permissible variation in dimension of 0.8mm plus or minus. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured in a manner such that any cross section shall be dense, homogeneous, and free from all porosity. Junctions in the special connection pieces shall be full molded. During the vulcanizing period, the joints shall be securely held by suitable clamps. The material at the splices shall be dense and homogeneous throughout the cross-section.

2.7.2.3 INSTALLATION

Open Joints
Open joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate, or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. When not protected by metal armour, open joints in slabs shall be finished with an edging tool. Upon completion of concrete finishing work, all mortars and other debris shall be removed from the open joints.
Filled Joints
When filled joints are shown on the Drawings or asked by the Engineer, pre-mold type fillers shall be used unless Poly Styrene board is specifically called for. Filler for each joint shall consist of as few pieces of material as possible. Abutting edges of filler material shall be accurately held in alignment with each other and tightly fit or taped as necessary to prevent the intrusion of grout. Joint filler material shall be anchored to one side of the joint by waterproof adhesive or other methods so as to prevent it from working out of the joint but not interfere with the compression of the material.
Sealed Joints
Prior to installation of the pourable joint sealants, all foreign materials shall be removed from the joint. The filler material shall be cut back to the depth shown or approved and the surface of the concrete, in contact with the sealant, be cleaned by light sand blasting. When required, a Poly Ethylene foam strip shall be placed in the joint to retain the sealant and isolate it from the filler material. The sealant materials shall then be mixed and installed in accordance with the manufacturer's directions. Any material that fails to bond the sides of the joint within 24 hours after placement shall be removed and replaced.
Water Stops
Water Stops shall be obtained from a manufacturer approved by the Engineer, and shall be fixed and joined according to the manufacturer's instructions. All strips shall be stored in a place as cool as practicable and shall in no case be exposed to the direct sun light.
Water Stops shall be installed with approximately half of the width of the material embedded in the concrete on either side of the joint. It shall be firmly supported by split stop-end shuttering and in no case shall Water Stop be pierced to assist in fixing. Special care shall be taken to ensure that the concrete is well worked against the embedded parts of the strips and is free from honeycomb. Precautions are to be taken to protect any projected portions of the strips from damage during the progress of the works and

from sunlight and heat.
If, after placing concrete, Water Stops are moved out of position or shape, the surrounding concrete shall be removed, the Water Stop reset, and the concrete replaced at the Contractor's own expenses. Two 9mm diameter reinforcing bars shall be provided to support the Water Stops and shall be securely held in position by the use of spacers, supporting wires, or other approved devices.
Flexible Water Stops shall be fully supported in the formwork, free from nails and clear of reinforcement and other fixtures. Damaged Water Stops shall be replaced and care shall be taken to place the concrete so that Water Stops do not bend or distort.
Splicing of Poly Vinyl Chloride Water Stop shall be performed in accordance with the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic. Splices shall develop at least 90% of the tensile strength of un-spliced materials and shall withstand bending 180o around a 50mm diameter pin without cracking or separating.
The Contractor, at least before the commencement of concrete work, shall submit to the Engineer for his approval details of the Contractor's proposals for the installation of water stops. These shall show where joints in the Water Stops are to be located and details of the intersections and changes of direction to a scale that shows the position of any joint or shape of any mould section.
As far as possible, jointing of PVC Water Stops on Site shall be confined to the making butt joints in straight runs of Water Stops. Where it is agreed with the Engineer that it is necessary to make an intersection or change of direction of any joint other than a butt joint in a straight run, a preliminary joint, intersection or change of direction piece shall be made and subjected to such tests as the Engineer may require.
Precautions shall be taken so that the Water Stops shall neither be displaced nor damaged by construction operations or other means. All surfaces of the Water Stops shall be kept free from oil, grease, dried mortar or any other foreign matters while the Water Stop is being embedded in concrete. Means shall be used to ensure that all portions of the Water Stop designed for embedding shall be tightly enclosed by dense concrete.

2.7.3 MEASUREMENT

Construction Joints shall not be measured. Expansion and Contraction joints shall be measured in linear meter of the joints considered satisfactory by the Engineer and accepted by him. There will be no additional measurement for joint fillers, sealed joints, Water Stops, miscellaneous metal devices etc.

2.7.4 PAYMENT

Payment for construction joints shall be deemed included in the items of concrete and there will be no extra payment for it. For expansion and Contraction joints the amount of completed and accepted works measured as provided above shall be paid at the Contract Unit Price per linear meter and the payment shall constitute the full compensation for furnishing and placing joint fillers, sealed joints, Water Stops, drains, vents, miscellaneous metal devices including all labour and incidentals for full completion of the Work as per Specifications.

Item of Payment	Unit
Expansion joints Linear	meter / Linear feet
Contraction joints Linear	meter / Linear feet

2.8 FAN AND MOTOR

The outdoor unit shall be equipped with DC inverter motor, capable of modulating frequency / speed as per the ambient temperature and discharge pressure / temperature.

2.9 SAFETY DEVICES

The following safety devices shall be part of the Outdoor unit; Discharge temperature sensor, Overload protector, Hot gas bypass cycle, Evaporator inlet piping sensor for anti-freeze protection, Evaporator outlet piping sensor, Return air temperature sensor, Time delay relay, reverse phase protection and phase

failure protection. The safety devises shall also contain high pressure sensor and low pressure sensor.

2.10 CONTROLS

The unit controls shall include main PCB, inverter PCB, inverter fan PCB, transformer, bridge diode, reactor. The noise filter shall also be incorporated to reduce the electrical noise.
The main PCB shall consist of 3 digit, 7 segment LED display. Automatic addressing of the indoor unit shall be possible with the help of dip switch on the main PCB.
The outdoor unit shall have Black Box Function which can record the full operation history of the units every 3 minutes which can help in precise analysis, decision and fast trouble shooting.
The main PCB shall have a refrigerant checking device which charges the appropriate amount of refrigerant automatically through cycle operation, checks for any refrigerant leakage and over charging.
Each outdoor unit should have alternate cycling of the compressors in order to equalize the run time and increase the life time of the compressor.
A serial connection port shall be available in the outdoor unit to display the cycle view, operating parameters like suction pressure, discharge pressure, voltage, current, ambient temperature, indoor unit refrigerant in/out temperature, room temperature, percentage loading of the invertors compressor, percentage opening of the EEV, and easy start up and Easy trouble shooting and fault alarm
Pump down and pump up operation of the refrigerant should be possible by changing the dip switch location on the outdoor main PCB.

2.11 OIL RECOVERY SYSTEM

Unit shall be equipped with 3 types of oil recovery procedures. i) Oil Separator for every compressor
ii) Oil balancing line (between 2 compressors in a unit).
iii) Oil recovery logic in PCB with the help of which the LEV and the compressor operation is controlled for 3 minutes to recover the oil
back to compressor at an interval of every 6 hours of partial compressor working to ensure stable operation with long refrigerant piping.

2.12 EXECUTION

Supplier shall provide support to the contractor during the commissioning process.
Installation work shall include all rigging, setting, aligning and grouting necessary to prepare equipment and its integral parts for normal continuous operation. All installation work shall be done according to best practice and recommendations of equipment manufacturer.
The technician shall attend and successfully complete the training course at the VRF manufacturer and obtain a certificate of passing the course. The technician shall have the detailed knowledge of the VRF installation, piping installation and commissioning procedures. The electric power supply to the outdoor unit shall be 380-415 V / 3 ph / 50 Hz.

RECOMMENDED COPPER PIPES MATERIAL

Seamless phosphorous deoxidized copper pipe wall thickness: comply with the relevant local and national regulations for the designed pressure 3.8mpa (551psi). We recommend the following table as the minimum wall thickness.

1. **Recommended minimum Wall thickness**

Outer diameter [mm]	6.35	9.52	12.7	15.88	19.05	22.2	25.4	28.58	31.8	34.9	38.1	41.3
Minimum thickness [mm]	0.8	0.8	0.8	0.99	0.99	0.99	0.99	0.99	1.1	1.21	1.35	1.43

Interconnecting refrigeration pipe work between the indoor and outdoor +Slave 1& 2 recommended to layout on galvanized GI tray. Pipe work sizing, layout, fittings, etc shall be in strict accordance with the

manufacturers design and installation requirements.(Refer Product data book)The pipe work shall be of refrigerant quality copper to half hard temper. Soft tempered pipe work may be used where the pipe diameter is ¼"or 3/8". Long radius bends shall be formed using pipe bender. The use of short radius pre formed bends and elbows should be avoided to minimize pressure drop and possibility of leaks. Pipe work shall be carried out manufacturer's design and installation instructions and in accordance with longest possible of copper wire shall be utilized to minimize joints on site. Appropriate refrigeration installation tools must be utilized to avoid the use of elbows, dry Nitrogen must be in the system brazing (no cold brazing will be allowed)

2. Refrigeration Pipe Insulation

Pipe Insulation thickness

Multi V insulation (EPDM) ± thickness standard
(Engineering product data management)

Multi V	Thickness (mm) (Normal condition)		Thickness (mm) (Residential) Cooling zone (CASE 1) (ex: room, living)	Non-cooling zone (CASE 2) (ex: corridor)	Thickness (mm) (Bad condition)
	Thickness (mm)	EPDM	EPDM	EPDM	EPDM
Gas	6.35	19	13	19	19
	9.52	19	13	19	25
	12.7	19	13	19	25
	15.88	19	13	19	25
	19.05	19	13	19	25
	22.22	19	13	19	32
	25.40	19	19	19	32
	28.58	19	19	19	32
	31.75	19	19	19	32
	38.1	25	19	25	32
	44.45	25	19	25	32
Liquid	6.35~9.52	9	9	9	9
	12.7~44.45	13	13	13	13

※ Normal condition : 30°C, 85%RH ※ Bad condition : 30°C, 90%RH (High humidity place: bathroom, swimming pool)

Pressure Testing, Evacuation and Commissioning

After installation of pipe work, and prior to sealing of insulation joints, pipe work shall be pressure tested for R-410A to 28 ~ 38kg/cm2(398~540 psi approx), held for

24 hrs and checked for leaks, vacuumed/dehydrated to 0.5~0.8 Torr or (-752mm Hg) and held at that setting for 1 to 4 hours depending on the pipe length.

Note: If you suddenly press the nitrogen gas to 28 or 38kg/cm2 the heat exchangers of indoor unit will be damaged.

iv) Brazing work

Dry nitrogen must be passed through the pipe work during all brazing of joints to prevent the formation of oxidization scale on the inside surface of the pipes. All pipe work shall be clean, de-hydrated and sealed. Pipe work shall be stored under dry conditions.

Any pipe work found to be stored without the end caps should be rejected. Where sections are cut from a new coil any remaining lengths must be re-sealed. During the installation if the system has to be left unattended for any purpose whatsoever, the openings in the systems must be securely sealed. Y Branch or headers joints shall be used for branching to indoor units. No other fittings are acceptable. The positioning of these joints shall be strictly in accordance to the manufacturer's specification. However the brackets must not be positioned directly on the joints or headers. On horizontal pipe work the bracketing should be over the insulation to allow pipe movement due to contraction and expansions. The vertical pipe work shall be bracketed at no more than 1000mm. The horizontal pipe work shall be bracketed at no more than 1500mm.

2.13 REINFORCEMENT

2.13.1 HIGH STRENGTH DEFORMED ROAD

Reinforcing steel under this type comprises Grade-60 Deformed re-bars. The steel shall conform to ASTM Specification A 617M or A 615M of yield strength not less than 420 MPa (N/mm2). The structural grade shall be made from billets. The ends of the bar shall be machine sheared perpendicular to

the axis of the bar. The bars shall be free from injurious defects and shall have a workman like finish.

2.13.2 CLEANING AND STORAGE

Steel reinforcement bars and structural steel shall be stored in a way to prevent distortion, corrosion, scaling and rusting. Reinforcement bars and structural steel sections shall be coated with cement wash before stacking, especially in humid areas. In the case of long time storage or storage in coastal areas, reinforcement bars and steel sections shall be stacked at least 200mm above the ground level.
Steel sections shall be stacked upon platforms, skids or any other suitable supports. Bars of different sizes and lengths and structural sections shall be stored separately to facilitate issues in required sizes and lengths without cutting from standard lengths. Ends of bars and sections of each type shall be painted with separate designated colors.
Tag line shall be used to control the load in handling reinforcing bars or structural steel when a crane is used. Heavy steel sections and bundles of reinforcing bars shall be lifted and carried with the help of slings and tackles.
All bars, prior to its use, shall be cleaned with wire brush to make them free from nail scale, loose rust, dirt, paint, oil, grease or other foreign substances.
Bars of reduced sectional area to excessive rust shall be rejected.
All reinforcing steel shall be stored properly under shed not to be contaminated by oil, grease, dirt or mud.
All stacking and storing of bars shall be the Contractor's responsibility and contingent upon his Tender.

2.13.3 PRE-STRESSING STEEL AND ANCHORAGE

Pre-stressing reinforcement shall comprise high strength seven wire strand, high strength steel wire or high strength alloy bars conforming grade and type as shown on the Drawings.
Un-coated seven-wire strand shall conform to the specifications of AASHTO M 203.
Un-coated stress-relieved steel wire shall conform to the specifications of AASHTO M 204.
Un-coated high-strength bars shall conform to the specifications of AASHTO M 275.

2.14 FORMWORK

Formwork is defined to be an enclosure or panel, which contain the fluid concrete and withstand the forces due to its placement and consolidation. Forms in turn be supported on scaffolding.
The work to be performed under this Sub-section includes the furnishing and installing and removing of forms for all cast-in-places concrete work as shown and noted on the Drawings and as specified herein or as directed by the Engineer.
Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be of sufficient rigidity to prevent objectionable distortion of the formed concrete surface due to pressure of the concrete and other loads incidental to construction operations. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be so designed as not to damage previously placed structure.
Relevant provisions of the American Concrete Institute (ACI) issue of ACI 347 on 'Recommended Practice for Concrete Formwork' or some other generally accepted Standards shall apply for the structural designing of the formwork, except as they may be modified herein.

2.14.1 MATERIALS

Formwork shall be constructed from sound materials of sufficient strength, properly braced, strutted and shored as to ensure rigidity throughout the placing and compaction of the concrete without visible deflection. The materials used to be of wood, steel or other approved materials and shall be mortartight. Formwork shall be so constructed that it can be removed without shock or vibration to the concrete. Formwork for concrete, permanently exposed to public inspection, shall be faced with plain 28/26gauge steel sheet fitted over 38mm thick wooden plank panels suitably braced or steel framing faced with minimum 12/14 BWG mild steel sheet. Formwork for cement concrete blocks shall be fabricated from M.S. sheet of sufficient thickness to prevent any distortion.

Where metal forms are used, all bolts and rivets shall be countersunk and well-grounded to provide a smooth plane surface.
Where timber is used, it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mark the surface of concrete.
Form ties shall be prefabricated rod, flat band, or wire type, or threaded internal disconnected type, of sufficient tensile capacity to resist all imposed load of freshly placed concrete and having external holding devices of adequate bearing area. Ties shall permit tightening and spreading of forms and shall leave no metal closer than 25mm from surface. Ties shall fit tight to prevent mortar leakage at holes in forms. Removable ties shall be coated with non-staining bond breaker. All ties shall be protected from rusting at all times. No wire ties or wood spreaders shall be permitted. Cutting ties back from concrete face will not be permitted. Ties for exposed Architectural Concrete shall be plastic cone snap ties.

2.14.2 CONSTRUCTION METHOD

The Contractor shall submit for the approval of the Engineer details of the methods and materials proposed for formwork to each section of the Work. Details of all proposed wrought formwork and formwork to produce special finishes are to be submitted for approval in writing to the Engineer before any material is hauled at Site. If the Engineer so requires, samples of formwork shall be constructed and concrete be placed so that the proposed methods and finish effect can be demonstrated.
All joints shall be close fitting to prevent leakage of grout. At construction joints the formwork shall be tightly secured against previously cast or hardened concrete in order to prevent stepping or ridges to exposed surfaces.
Where the Contractor proposes to make the formwork from standard sized manufactured formwork panels, the dimensions of such panels shall be approved by the Engineer before they are used for construction of the Work. The finished appearance of the entire elevation of the structure and the adjoining structures shall be considered when planning the patterns of joint lines caused by the formwork and by construction joints to ensure continuity of horizontal and vertical lines.
Formwork shall be constructed to provide the correct shape, lines and dimensions of the concrete shown on the Drawings. Due allowance shall be made for any deflection, which will occur during the placing of concrete within the formwork. Panels shall have true edges to permit accurate alignment and provide a neat line with adjacent panels and at all construction joints. All panels shall be fixed with their joints either vertical or horizontal, unless otherwise specified or approved.
Formwork shall be provided for the top surfaces of sloping work where the slope exceeds 15o with the horizontal and shall be anchored to enable the concrete to be properly compacted and prevent floating. Cares shall be taken to prevent air being entrapped. Openings for inspection of the inside of the formwork and for the removal of water used for washing shall be provided and so formed as to be easily closed before placing concrete.

2.14.3 FORMWORK FOR EXPOSED CONCRETE SURFACES

All exposed concrete surfaces are to be ‘form finish’ and shall be cast in any approved formwork and shall be free from honeycomb, fins, projections and air holes. All external angles to form finish concrete surfaces shall be chamfered as directed.
Forms for concrete surfaces exposed to view shall produce a smooth surface of uniform texture and color substantially equal to that which would be obtained with the use of plywood conforming to the National Institute of Standards and Technology Product Standard PSI for Exterior B-B Class I Plywood. Panels lining such forms shall be arranged so that the joint lines form a symmetrical pattern conforming to the general lines of the structure. The same type of form lining material shall be used throughout each element of a structure. Such forms shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 3mm when checked with a 1.5m long straight edge or template.
The Contractor shall submit shuttering Drawings and details of pattern and the method of forming joints in the exposed (form finish) concrete to the Engineer for his approval. All changes and modification made by the later shall be appropriately incorporated by the former and final approval whereof be obtained from

the Engineer.
Unless otherwise stated on the Drawings, wrought formwork shall be used for all permanently visible concrete surfaces. Wrought formwork shall be such as to produce a smooth and even surface free from perceptible irregularities. Tongues and grooved paneled boards, plywood or steel forms shall have their joints flushed with the surface. The formwork shall be formed with approved standard size panels. The panels shall be arranged in a uniform approved pattern, free from defects likely to be detected in the resulting concrete surface.
In all types of formwork to form finished exposed concrete, only non-staining mold oil shall be used as approved by the Engineer.
The respective usage of the same formwork to cast form-finished exposed concrete shall be as decided by the Engineer and in no case the formwork, not guaranteed to produce the required form-finish to the satisfaction of the Engineer, shall be used.
The exposed concrete shall have a uniform finish. The finish of the concrete when shuttering and formwork are removed will generally be without any blemish and will be such as will not require touch up. Slight touch up for a small spot or two, if necessary shall be carried out skillfully so as to be synonymous with the entire surfaces.
The finished surfaces shall be within the specified tolerances and full cover to the reinforcement steel shall be maintained.

2.14.4 FORMWORK FOR NON-EXPOSED CONCRETE SURFACES

Unless otherwise stated on the Drawings, rough formwork may be used for all surfaces, which are not permanently exposed. Rough formwork may be constructed of plain butt-joined sawn timber. But the Contractor shall ensure that all joints between boards shall be grout-tight.
The finished surfaces shall be within the specified tolerances and full cover to the reinforcement steel shall be maintained.

2.14.5 FORMED SURFACES AND FINISH

The formwork shall be lined with a material approved by the Engineer so as to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and so joined and fixed to its backing as not to impart any blemish. It shall be of the same type and obtained from only one source throughout the construction of any individual structure. The Contractor shall make good any imperfection in the finish as required by the Engineer. Internal ties and embedded metal parts will be allowed only with the specific approval of the Engineer.

2.14.6 SIZES OF TIMBER AND OTHER SECTIONS FOR FORMWORK

Scaffolds, formwork and components thereof shall be capable of supporting without failure, at least two times the maximum intended load. The following types of loading shall be considered in designing the formwork:
i. Weight of wet concrete: 20 KN/m3.
ii. Live load due to workmen and impact of ramming or vibrating: 15-40 kPa (light duty for carpenter and stone setters, medium duty for brick layers and plasterers, heavy duty for stone masons).
iii. Allowable bending stress (flexural tensile stress) in soft timbers: 8,000 kPa. The sizes for formwork elements specified in the Table given below are applicable for spans of up to 5m and height of up to 4m. In case of longer span and height, formwork and support sizes shall be determined by calculating the load and approved by the Engineer before use.
Sizes of timber and other sections for formwork

Types of Formwork	Members Size in mm
Flat sheeting for slab bottoms, columns and beam sides	25 to 50
Beam bottoms	75x100 to 150x150

Vertical posts	75x100 to 150x150
Bamboo posts	Minimum 75 dia
Timber posts	Not less than 100 dia at mid-length and 80dia at thin end
Joist and ledgers supporting sheeting of slab	50x100 to 75x200
Studs for supporting vertical wall sheeting	50x100 to 150x150
Columns yokes-horizontal cross, pieces supporting vertical sheeting	50x100 to 100x100

2.14.7 QUALITY OF SHUTTERING

The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement grout. Ply-board shuttering material shall be well seasoned free from projecting nails, splits or other defects that may mark the surface of concrete. It shall not be so dry as to absorb water from concrete and swell and bulge, nor so green or wet as to shrink after erection.
The timber shall be accurately sawn and plain on the sides and the surface coming in contact with concrete.
Wooden formwork with metal sheet lining or steel plates stiffened by steel angles shall also be permitted. Where metal forms are used, all bolts and nuts shall be countersunk and well-grounded to provide a smooth plain surface.
The chamfers, leveled edges and moldings shall be made in the formwork itself. Opening for fixture and other fittings connected with the services shall be provided in the shuttering as directed by the Engineer.
Clamps shall be used, to its practicality, to hold the forms together. Where use of nails is unavoidable, it shall be kept to minimum number and these shall be left projected so that they can easily be withdrawn. Use of double-headed nails shall be preferred.

2.14.8 TOLERANCES

The formwork shall be made so as to produce a finished concrete true to shape, lines, levels, plumb and dimensions as shown on the Drawings subject to the following tolerances unless otherwise specified in this document or Drawings or as directed by the Engineer.
i. Sectional dimension ± 5mm
ii. Plumb ± 1 in 1000 of height
iii. Levels ± 3mm before any deflection has been taken place
Tolerances given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerance for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Errors, if noticed in any lift/tilt of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

2.14.9 FIXING OF FORMWORK

The formwork shall be arranged in a manner as to readily be dismantled and removed from the cast concrete without shock, disturbance or damage. Where necessary, the formwork shall be so arranged that the soffit form, properly supported on props only, can be retained in position for such period as may be required by maturing conditions or Specification.
The surfaces of formwork shall be free from foreign matters, projecting nails and the like, splits or other defects, and all formwork shall be cleaned and made free from standing water, dirt, shavings, chippings or other foreign matter before concrete is placed.
Before placing concrete, all built-in reinforcement bars, anchoring, steel beams, cables, fixing truss, bolts, pipes or conduits or any other fixtures shall be fixed in their correct positions. The cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without the approval of the Engineer.

All exterior and interior angles on the finished concrete of 900 or less shall be given 12mm – 20mm chamfers unless otherwise shown on the Drawings or directed by the Engineer. When chamfers are to be formed, the fillets shall be accurately cut to size to provide a smooth and continuous chamfer.
No ties or bolts or other devices shall be built into the concrete for the purpose of supporting formwork without the prior approval of the Engineer. The whole or part of any such support embedded in the Reinforced Concrete shall be capable of removal so that no part, remaining embedded in the concrete, shall be nearer than 75mm from the surface. Holes left after removal of such supports shall be neatly filled with well-reamed dry-pack mortar following the procedures described in the relevant Sub-section of this Specification.
All rubbish shall be removed from the interior of the forms before the concrete is placed. After cleaning and prior to placement of reinforcing steel, the formwork in contact with the concrete shall be treated with a suitable non-staining mold oil or suitable approved release agent to prevent sticking of the concrete. Such works shall not discolor or otherwise injure the surface of the concrete. Care shall be taken to prevent the oil from coming in contact with the reinforcement or mixing with the concrete. At construction joints, surface-retarding agents shall be used only where ordered by the Engineer.
All formwork shall be inspected and approved by the Engineer before concrete is placed in it. However, this shall not relieve the Contractor from the requirements as to soundness, finish and tolerances of the concrete specified in this Specification or elsewhere acknowledged as Standard. If, at any period of the work during or after placing the concrete, the forms show signs of sagging or bulging, the concrete shall be removed to the extent directed by the Engineer, the forms brought to the proper position and new concrete placed. No allowance shall be made to the Contractor for such extra works.

2.14.10 REMOVAL OF FORMS

Forms shall not be removed without the approval of the Engineer. In the determination of the time for the removal of forms, consideration shall be given to the location and character of the structure, the weather, the materials used in the mix and other conditions influencing the early strength of the concrete. Extreme cares shall be taken to ensure that the method of removal shall not cause overstressing of the concrete or damage to its surface.
Forms shall be removed in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.
Forms shall not be removed in the cases of footing forms where the removal would endanger the safety of the cofferdams, forms from enclosed cells where access is not provided, deck forms in the cells that do not interfere with the future installation of utilities shown on the Drawings, or other works.
Except for concrete being post-tensioned, no concrete shall be subjected to loading which will induce a compressive stress in it exceeding one-third of its compressive strength at the time of loading, or one-third of the specified characteristic strength whichever is less. It may be possible to use shorter periods before striking forms by determining the strength of the concrete in the structural element.
Forms supporting cast-in-situ concrete in flexure may be struck when the strength of the concrete in the element is 10 N/mm2 or twice the stress to which it will be subjected, whichever is greater provided that striking at this time will not result in an unacceptable deflection. This strength may be assessed by test on cylinder/cube cured under the same conditions as the concrete in the element as far as possible.
Forms on upper sloping faces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any repair or treatment required on such sloping surfaces shall be performed at once.
If the floor is to be used to support construction loads, props should be retained for 28 days unless the Contractor can prove the requisite concrete strength by tests.
The form shall be removed slowly, as the sudden removal of wedges is equivalent to a shock load on the partly hardened concrete.
Materials and plants shall not be stacked on any newly constructed floor unless sufficient support is maintained to withstand such loads without damaging the floor.

The following table is a guide to the minimum periods that must elapse between the completion of the concreting operations and the removal of formwork. No formwork shall be removed without the permission of the Engineer and such permission shall not relieve the Contractor of his responsibilities regarding the safety of the structure.

Type and position of Formwork	Approximate period (days)
Side of beams, walls and columns (unloaded)	5
Slab soffits (props supporting)	14
Removal of props to slabs	21
Beam soffits (props supporting)	21
Removal of props to beams	28

Notwithstanding the foregoing, the Contractor shall be held responsible for any damages arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

2.14.11 OPENINGS

Temporary and permanent openings in concrete shall be framed neatly with provisions for keys or reinforcing steel as shown on the Drawings or as directed by the Engineer.

2.14.12 DEFECTS IN FORMED SURFACES

Workmanship in formwork along with concrete placing shall be such that concrete shall normally require no repair to surfaces being perfectly compacted and smooth. If any blemish is revealed after removal of formwork, the Contractor shall obtain immediately the Engineer's decision concerning remedial measures to be undertaken. Notwithstanding the specifications and provisions stated under the Sub-section on 'Finish and Finishing' of this Specification, such measures may include but shall not be limited to the following: i. Fins, pinholes, bubbles, surface discoloring and mirror defects may be rubbed down with sacks immediately on removal of the form.
ii. Abrupt and gradual irregularities may be rubbed down with carborundum stone and water after concrete has been fully cured.
iii. Deep honeycombed concrete shall be repaired within 24 hours of striking the formwork by cutting back to sound concrete. The concrete shall be cut back at least 50mm behind face reinforcement. Cut edges shall be regular and not feathered. Recasting shall be with the same concrete as the original casting. The Engineer shall approve the formwork and its method of placing in this case also. iv. Under some circumstances, abrupt and gradual irregularities of shallow honeycombed concrete may be repaired by cutting back and reforming with an approved epoxy resin or mortar in accordance with the manufacturer's instructions.
Regardless of the above repairing measures, any structure containing excessive honeycomb, as would be termed by the Engineer, shall be subject to rejection by the Engineer. The Contractor, on receipt of written orders from the Engineer, shall remove and rebuild such portions of the structure at his own expenses.

2.14.13 HOLES TO BE FILLED

Holes on the concrete surfaces formed by formwork supports or the like shall be filled with dry pack mortar made from one part by weight of ordinary Portland cement and three parts of specified fine aggregate approved by the Engineer. The mortar shall be mixed with sufficient water only to make the materials stick together when being molded in the hands. All construction materials shall conform to the requirements as described previously and under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification.
The Contractor shall thoroughly clean any hole that is to be filled and break out any loose, broken or cracked concrete or aggregate and remove any dry cement from the hole. The surrounding concrete shall be soaked until the whole surface that will come into contact with the dry pack mortar has been covered

and darkened by absorption of the free water by the cement. The surface shall then be dried so as to leave a small amount of free water on it.
The dry pack material shall then be placed and packed in layers having a compacted thickness of not more than 10mm. Compaction shall be carried out by using a hardwood stick and a hammer and shall extend over the full area of the layer. Special cares should be taken to compact the dry pack against the sides of the holes.
After compaction, the surface of each layer shall be scratched before further loose material is added. The holes shall be slightly overfilled. The surface shall be finished by laying a hardwood block against the dry pack fill and striking the block several times.

2.14.14 APPROVAL OF SCAFFOLDINGS AND FORM

Plans, Drawings and structural calculations shall be submitted to the Engineer on time so that no construction of such scaffoldings and forms shall take place before the Engineer's approval is accorded in writing. Such approval shall not relieve the Contractor of his responsibilities for the involved structure. The Engineer shall have reasonable time for his examination of the Contractor's plans and calculations, if scaffoldings are introducing temporary loading on new structures in particular. For this purpose, the Contractor shall not be allowed any extension of time beyond the stipulated period of the Contract.
Before concrete is placed, the Engineer shall inspect all formworks and scaffoldings. No concrete shall be placed until inspection is made and approval is given by the Engineer. Such approval shall not relieve the Contractor of any of his responsibilities under the Contract for the successful completion and the soundness of the structure.

2.14.15 MEASUREMENT

Formwork and false work shall not be measured separately but shall be deemed to be an integral part of the concrete items.

2.14.16 PAYMENT

The Contractor's rates for concrete work, inter-alia, shall be inclusive of all costs of all formwork, false work and centering and for their subsequent removal. No additional payment will be made to the Contractor for these works.

2.15 CEMENT CONCRETE BLOCK MASONRY

2.15.1 SCOPE

The work covered by this section of the Specifications consists of furnishing all labour, tools scaffolding, hoisting equipment and masonry materials of every kind; and in performing all operations in connection with procurement, transportation and delivery, erection and building in of all work classified as masonry work and/or included as such herein, i.e., concrete masonry units; masonry mortars; and all related items and appurtenances, including all items supplied by other trades and customarily built-in and/or installed under mason work or required to complete mason work, in strict accordance with the requirements of the Drawings and Schedules, as specified herein, and subject to the Terms and Conditions of the CONTRACT Documents.

2.15.2 CODES AND STANDARDS

Unless otherwise specified or shown, the following codes and standards shall apply:

ASTM C31	Making and curing concrete test specimen in the field.
ASTM C39	Compressive Strength of cylindrical concrete specimen.
ASTM C90	Hollow load bearing concrete masonry units.
ASTM C144	Aggregate for masonry mortar
ASTM C270	Mortar for unit masonry
ASTM C404	Aggregate for masonry grout
ASTM E119	Fire tests of building construction and materials
UBC UL-618	Concrete masonry units, fire resistance index

ACI 531 Building code requirements for concrete masonry structure

2.15.3 SUBMITTALS

- Samples: Submit three samples of each type of block required, and the full range of exposed texture to be used in the completed works. The review will be for texture only.
- Test Reports: Reports for compressive strengths of masonry units, grout and mortar

2.15.4 SUCTION RATE

The CONTRACTOR shall, at his own cost, satisfy the ENGINEER that the suction rate of the block when determined in accordance with Appendix `A' of BS 3921 does not exceed 20g/cm.sq/min., or that the CONTRACTOR is able to adjust it so that it does not exceed this value on SITE.

2.15.5 SOLUBLE SALT CONTENT

For exposed block work, the contents by weight percent of soluble sulfate, calcium, magnesium, potassium and sodium radicals, shall not exceed 0.30, 0.10, 0.03 and 0.03 percent respectively, when ascertained in accordance with BS 3921 at the cost of the CONTRACTOR.

2.15.6 PRODUCTS

2.15.6.1 MATERIALS FOR BLOCKS

Cement, aggregate and water for concrete blocks shall conform to the requirements as specified in the section for Plain and Reinforced Concrete

2.15.6.2 CONCRETE BLOCK MAKING

- The blocks shall be machine molded. The block making machines shall be of the standard approved by the ENGINEER. They shall be operated according to the instructions laid down by the manufacturers.
- The blocks shall be continuously water cured by sprinkling for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After 10 days' water-curing period the blocks shall be air dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surface of the block will be allowed to dry.
- Cured concrete blocks shall be stored off the ground, stacked on level platforms, which allow air circulation under stacked units. Units shall be covered and protected against wetting.
- Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work.
- The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they are cast

2.15.6.3 PROPERTIES OF BLOCKS

i. Block sizes, unless otherwise indicated on drawings, shall be 16" by 8" by 4", 6", & 8" thickness (Approximately 400 by 200 by 100, 150 & 200 mm). Physical requirements shall comply with relevant ASTM or equivalent approved standards.

ii. For non-load bearing wall the cement, sand and coarse aggregate shall be volume batched in the minimum ratio of one-part cement, three parts sand and six parts coarse aggregate and shall be mixed in a concrete mixer.

iii. For load bearing Hollow/Solid block wall the mix unless otherwise stated shall be proportioned to meet the following strength requirements:

- Solid Load Bearing Concrete Masonry Units shall have a 28 days' compressive strength of not less than 1500 psi (106 kg/cm. sq.) average of 3 units tested or 1200 psi (85 kg/cm. sq.) per individual unit tested.
- Hollow Load Bearing Concrete Masonry Units shall comply with ASTM C90, grade N-1 (moisture controlled), and shall have a 28-days compressive strength of 1350 psi (96 kg/cm. sq.) average of 3 units tested and 800 psi (57 kg/cm. sq.) on individual unit tested. The compressive strengths shall be verified by tests in accordance with UBC section 2404, para 2
- The CONTRACTOR shall provide test results proving the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test results shall be provided as required by the ENGINEER, to ensure that all batches of blocks have the minimum specified crushing strength.
- The test shall be carried out by an authority approved by the ENGINEER. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The ENGINEER will require to periodically test samples of blocks, and the CONTRACTOR shall make any necessary arrangements.
- Hollow concrete block units wherever specified shall have cores with cross sectional area at least equal to the percent of gross area of block given below:

8 in. (200 mm)	38 percent
6 in. (150 mm.)	30 percent
4 in. (100 mm)	No requirement

- Minimum shell wall thickness be 1-1/4 in. (32 mm).
- Permissible tolerance in size of block shall be 1/8 in (3 mm) each way.
- Special shapes for lintels, corners, jambs, sash, cleanouts, control joints and headers, bonding and other particular needs shall be provided where required.

2.15.6.4 MORTAR CONSTITUENTS

- Cement: Cement shall conform to ASTM C-150, type II low alkali non-staining without air entrainment

- Sand (Aggregate): Sand and its grading shall comply with the requirements of ASTM C-144, 100% passing the U.S. equivalent No. 16 sieve. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the ENGINEER.
- Water: Water shall conform to the specifications set forth in Section of Plain and Reinforced Concrete.
- Lime: Hydrate lime shall conform to ASTM C-207 type S. If it is not available, use quick lime according to ASTM C-5.

2.15.6.5 MORTAR PROPORTIONS AND MIXING

- Cement, Lime and Sand shall be mixed in proportion, by volume, as follows:
- Type (1) 1:1:6 (Cement: Lime: Sand)
- Type (2) Alternatively use 1:4 (Cement: sand) mix subject to the prior approval of the ENGINEER.
- Mix only as much mortar in a mortar mixer as can be used in one hour for Type-1 and 30 minutes for Type-II after water has been first mixed into the batch.
- Do not re-temper the mortar.
- Where cement lime mortar is used, sand and lime shall be mixed first and cement to be added later on.
- Compressive strength of mortar specimen tested in accordance with ASTM C39 shall not be less than 2500 psi (210 Kg/cm sq.)

2.15.6.6 REINFORCING AND ANCHORS

i. All masonry walls shall be reinforced. At least one vertical and one horizontal reinforcing member shall be provided for every 16 sq.ft of wall elevation or as per structural drawings.

ii. Block masonry anchors and ties required to connect masonry with structural member unless shown otherwise on drawings, shall be 3/8” dia. (10-mm dia) bars every 4-5th course, anchored 6" in each jointing element.

iii. Additional details of anchors, if any, are shown on drawings.

iv. Alternate compatible anchoring system may be used subject to the approval of the ENGINEER. v. All reinforcing steel shall conform to ASTM A 615 grade 40 deformed bars as specified in section 3310 plain and reinforced concrete.

2.15.6.7 ERECTION / WORKMANSHIP

Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at center of units in alternate courses below. Each course shall be properly bonded at corners and intersections of walls. Courses of block shall be kept plumb throughout, and

corners reveals shall be true and in plumb.
Standard width of mortar joints for both horizontal and vertical joints shall be 1/2" (12.5 mm) maximum. Mortar joints in walls shall have full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools. Block terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joint shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Expansion joints shall be kept free from mortar or other debris. Unless otherwise shown on the drawings or specified by the ENGINEER, the spaces around door frames and other material or built in items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with 3 ksi concrete. Work required to be built in with masonry including door frame anchors, wall plugs, dovetail anchors and accessories shall be built in as the erection progresses. The block work shall be carried up in uniform manner and no portion shall be carried more than 3. ft (1 meter) above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled round each floor.
Sleeves, chases and holes etc. shall be built in as construction proceeds. Chasing of completed walls or the formation of holes shall only be carried out with the approval of the ENGINEER.
Walls of blocks indicated as being non-load bearing shall not be constructed on the in-situ concrete floor slab unit until the floor shuttering is struck and the concrete has obtained sufficient strength to support their weight. Toothing into load bearing walls shall not be permitted.

2.15.7 CURING

Masonry wall shall be cured by keeping it moist with water for at least 10 days after its construction. ENGINEER may direct additional curing if required.

2.15.8 SCAFFOLDING

CONTRACTOR shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the ENGINEER shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the CONTRACTOR in the unit rate for masonry items.
Damage to masonry from scaffolding or from any other object shall be repaired by the CONTRACTOR at his own cost.

2.15.9 TOLERANCES

All block work shall be erected plumb and true to line and level with the maximum variation in any story height or any length of wall being 1/8" (3 mm) in 10 feet (3 meter). The maximum tolerance in the length, height or width of any single masonry unit shall be +/- 1/8" (3 mm).

2.15.10 MEASUREMENT & PAYMENT

Unless otherwise specifically stated in the Bill of Quantities or herein, all items shall be deemed to be inclusive of, but not limited to the following:

i. Labor and all costs in connection therewith.
ii. Materials, goods and all costs in connection therewith e.g. conveyance; delivery; unloading; storing; returning packing; handling; hoisting; lowering; making curing etc.
iii. All fixtures and all costs in connection therewith for precast works.
iv. Fitting and fixing materials and goods in position.
v. Use of plant and scaffolding.
vi. Cutting and patching work required for installation of built-in-work.
vii. Waste of materials.

viii. Square cutting.

ix. Establishment charges, overhead charges and profit.

x. All other expenses, charges and taxes specified in Conditions of Contract

Works shall be measured net as fixed in position as per Drawings and instructions of the ENGINEER. Each measurement shall be taken to the nearest 1/2" (12.5 mm). This rule shall not apply to any dimensions stated in descriptions.
Masonry work will be paid for according to the actual net area of masonry work in square feet (Sq. m.) for the required thickness or the actual net volume of masonry work in cubic feet (C.M.) as described in the Bill of Quantities. All the openings left in the masonry walls will be deducted.
Providing and fixing all joint reinforcing bars, reinforcing bar anchors and dovetail anchors shall be deemed to be included in the unit rate for masonry work.
Due to different thickness of the slab in different areas or rooms or for any other reason whatsoever, if the chiseling of the masonry is required the CONTRACTOR shall do so at his own cost. Where for any reason whatsoever, the height of the wall is short of ceiling height, the remaining height shall be made good with (f'c = 3000 psi) concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of masonry of the walls. In case where lintel heights are such that the CONTRACTOR has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate for masonry.

2.16 CONCRETE WORK

2.16.1 CONCRETE FOR STRUCTURES

2.16.1.1 DESCRIPTION

This work shall consist of construction of all Portland Cement Concrete in structures, with or without reinforcement, which shall involve furnishing, placing, finishing and curing of concrete. All items of concrete work shall include elements of structures constructed by cast-in-place and pre-cast methods using either plain or reinforced concrete or any combination thereof and shall conform to the specifications and requirements of the different Sub-sections of this item of work. All structures shall be built in a workman like manner to the lines, grades and dimensions shown on the Drawings or as directed by the Engineer.
All concrete works shall be carried out in accordance with BS 8110 or ASTM C-685 and as specified by the Engineer.
All sampling and testing of constituent materials shall be carried out in accordance with the provisions of the appropriate British or American Standard and all sampling and testing of fresh and hardened concrete shall be carried out in accordance with the provisions of BS 1881 “Method of Testing Concrete” or similar under ASTM C 39.

2.16.2 REINFORCEMENT FOR RCC

2.16.2.1 DESCRIPTION

Works covered by this item shall consist of supplying and placing of steel reinforcement in different types of concrete structures including board cast-in-situ piles and pre-cast concrete piles but not includes reinforcement for pre-stressed concrete. The works shall conform to the specifications, the types, sizes and positions of reinforcement requirements shown on the Drawings and this specification.

2.16.2.2 MATERIALS REINFORCEMENT

Reinforcing bars discussed under this Section shall be made of Mild Steel or High yield Steel, plain or deformed, for all Reinforced Concrete Works but excluding Pre-stressing Concrete.
Bars shall be rolled and produced from steel in the form of new and clean billets directly reduced from

ingot of properly identified heats of open hearth, basic oxygen or electric arc furnace steel or lots of acid besmear steel.
Reference Standards
Deformed reinforcement
Deformed and Plain Billet Steel Bars for Concrete Reinforcement – ASTM A 615
Rail Steel Deformed and Plain Bars for Concrete Reinforcement – ASTM A 616
Axle Steel Deformed and Plain Bars for Concrete Reinforcement – ASTM A 617
Low Alloy Steel Deformed Bars for Concrete Reinforcement – ASTM A 706
Deformed Steel Wire – ASTM A 496
Welded Deformed Steel Wire Fabric – ASTM A 497
Zinc Coated (Galvanized) Steel Bars – ASTM A 767
Epoxy – Coated Reinforcing Steel – ASTM A 775
Plain reinforcement
ASTM A 615 M, ASTM A 616 M, ASTM A 617 M, ASTM A 185
Smooth steel wire
Cold – Drawn Steel Wire - ASTM A 82
Cold – worked steel reinforcement
IS 1786: 1985, BS 4461: 1978
Mild steel plain round bar
This is a type of bar plain and round in shape of a structural or intermediate grade with yield strength of not less than 280 MPa (N/mm2) i.e. 40 grade.
Deformed bars
Reinforcing steel under this type comprises Mild Steel Grade 40 and High Strength Grade 60 Deformed re-bars with yield strength of not less than 280 MPa (N/mm2) in case of Grade 40 and with yield strength of not less than 410 MPa (N/mm2) in case of Grade 60.
Other bars
Steel welded wire, fabric plain reinforcement conforming to ASTM A 185 may be used, except that for wire with specified yield strength fy exceeding 410 MPa (N/mm2), fy will be the stress corresponding to a strain of 0.35 percent.
Smooth steel wire conforming to ASTM A 82 may be used in concrete except that for a wire with a specified yield strength fy exceeding 410 MPa (N/mm2), fy will be the stress corresponding to a strain of 0.35 percent.
Fabricated deformed steel bar mats conforming to ASTM A 184 and deformed steel wire complying with ASTM A 496 may be used. Deformed wire for concrete reinforcement shall not be smaller than a nominal diameter of 5.72mm, and for a wire with specified yield strength (fy) exceeding 410 MPa (N/mm2), fy shall be the stress corresponding to a strain of 0.35 percent.
Welded deformed steel wire fabric conforming ASTM A 497 may be used for a wire with specified yield strength exceeding (fy) 410 MPa (N/mm2), fy will be the stress corresponding to a strain of 0.35 percent.

2.16.2.3 CHEMICAL COMPOSITION

The structural grade shall be made from billets. The ends of the bar shall be machine sheared perpendicular to the axis of the bar. The bars shall be free from injurious defects and shall have a workman like finish.
The chemical composition should conform to the requirements of ASTM 706-82

2.16.2.4 PROCESS

The steel shall have been made by one or more of the following processes:

i. open-hearth
ii. basic oxygen
iii. electric furnace

iv. acid besmear

2.16.2.5 DIMENSIONAL REQUIREMENTS

The nominal diameter, cross sectional areas and perimeter of a deformed bar are equivalent to that of a plain bar having the same standard weight per unit length. Dimensional requirements of such bars have been shown in the Table given below:

Bar Designation No.*	Nominal Dimensions**			Nominal weight, lb/ft [Nominal mass, kg/m]
	Diameter, in. [mm]	Cross Sectional Area, in.^{2} [mm^2]	Perimeter, in. [mm]	
3 [10]	0.375 [9.5]	0.11 [71]	1.178 [29.9]	0.376 [0.560]
4 [13]	0.500 [12.7]	0.20 [129]	1.571 [39.9]	0.668 [0.994]
5 [16]	0.625 [15.9]	0.31 [199]	1.963 [49.9]	1.043 [1.552]
6 [19]	0.750 [19.1]	0.44 [284]	2.356 [59.8]	1.502 [2.235]
7 [22]	0.875 [22.2]	0.60 [387]	2.749 [69.8]	2.044 [3.042]
8 [25]	1.000 [25.4]	0.79 [510]	3.142 [79.8]	2.670 [3.973]
9 [29]	1.128 [28.7]	1.00 [645]	3.544 [90.0]	3.400 [5.060]
10 [32]	1.270 [32.3]	1.27 [819]	3.990 [101.3]	4.303 [6.404]
11 [36]	1.410 [35.8]	1.56 [1006]	4.430 [112.5]	5.313 [7.907]
14 [43]	1.693 [43.0]	2.25 [1452]	5.32 [135.1]	7.65 [11.38]
18 [57]	2.257 [57.3]	4.00 [2581]	7.09 [180.1]	13.60 [20.24]

*Bar numbers are based on the number of eighths of an inch including in the nominal diameter of the bars [bar numbers approximate the number of millimeters of the nominal diameter of the bar]

** The nominal dimension of a deformed bar are equivalent to those of a plain round bar having the same weight [mass] per foot [meter] as the deformed bar.

2.16.2.6 TENSILE PROPERTIES

The tensile properties of the Grade 40 and Grade 60 steel have been shown in the Table given below:

Item	Requirements	
	Grade 40 [300]*	Grade 60 [420]
Tensile strength, min, psi [MPa]	70,000 [500]	90,000 [620]
Yield strength, min, psi [MPa]	40,000 [300]	60,000 [420]
Elongation in 8 in. [203.2 mm], min, %		
Bar Designation No.		
3 [10]	11	9
4, 5 [13, 16]	12	9
6 [19]	12	9
7, 8 [22, 25]	-	8
9, 10, 11 [29, 32, 36]	-	7
14, 18 [43, 57]	-	7

* Grade 40 [300] bars are furnished only in sizes 3 through 6 [10 through 19].

2.16.2.7 BEND TEST REQUIREMENT

The pin diameter required for performing bend tests shall conform to ASTM A 615. The following table contains such requirements:

Bar Designation No.	Pin Diameter for Bend Tests *	
	Grade 40 [300]	Grade 60 [420]
3, 4, 5 [10, 13, 16]	3.5d	3.5d
6 [19]	5d	5d
7, 8 [22, 25]	-	5d
9, 10, 11 [29, 32, 36]	-	7d
14, 18 [43, 57] (90°)	-	9d

* Test bends 1800 unless noted otherwise.

d = Nominal diameter of specimen

Permissible variation

For lots from standard weights + 5% for 6mm dia

+ 3.5% for 10mm dia and above

Individual Length + 6% for all sizes

Length of the bar shall be maximum possible, but each bar shall not be less than 12m in length or 45.36 kg in weight whichever is greater.

2.16.2.8 ASTM CODE REQUIREMENTS FOR DEFORMATIONS

Deformations shall be spaced along the bar at substantially uniform distances. The deformations on the opposite sides of the bar shall be similar in size and shape.

The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45°. Where the line of deformation forms an included angle with the axis of the bar from 45° to 70° inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformation is over 70°, a reversal in direction is not required.

Average spacing or distance between deformations on each side of the bar shall not exceed 17 (seventeen) times of the nominal diameter of the bar.

Overall length of deformations shall be such that the gap between the ends of the deformations on the opposite sides of the bar shall not exceed 12.5% of the nominal perimeter of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered as the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25% of the nominal perimeter of the bar. Furthermore, the summation of gaps shall not exceed 25% of the nominal perimeter of the bar. Nominal perimeter of the bar shall be 3.14 times the nominal diameter (db).

Spacing, height and gap of deformations as to be conformed have been shown in the following table:

Deformation requirements, in. [mm]

Bar designation	Maximum average spacing	Minimum average height	Maximum gap (Chord of 12.5% of Nominal Perimeter)
3 [10]	0.262 [6.7]	0.015 [0.38]	0.143 [3.6]
4 [13]	0.350 [8.9]	0.020 [0.51]	0.191 [4.9]
5 [16]	0.437 [11.1]	0.028 [0.71]	0.239 [6.1]
6 [19]	0.525 [13.3]	0.038 [0.97]	0.286 [7.3]
7 [22]	0.612 [15.5]	0.044 [1.12]	0.334 [8.5]
8 [25]	0.700 [17.8]	0.050 [1.27]	0.383 [9.7]
9 [29]	0.790 [20.1]	0.056 [1.42]	0.431 [10.9]
10 [32]	0.889 [22.6]	0.064 [1.63]	0.487 [12.4]
11 [36]	0.987 [25.1]	0.071 [1.80]	0.540 [13.7]
14 [43]	1.185 [30.1]	0.085 [2.16]	0.648 [16.5]
18 [57]	1.58 [40.1]	0.102 [2.59]	0.864 [21.9]

Note: Any bar that fails to satisfy the aforementioned all requirements is to be treated as plain reinforcement

2.16.3 BINDING WIRE

Reinforcement binding wire shall be the best black annealed mild steel wire and not less than 1.6mm in diameter in approximation/18 - 22 BWG or 26 BWG galvanized iron wire.

2.16.4 WIRE MESH

Wire mesh shall conform to the requirements of AASHTO Standard Specification M 55 Welded Steel Wire Fabric for Concrete Reinforcement.

2.16.5 ORDERING MATERIAL

The name of the proposed supplier of the reinforcement shall be submitted as soon possible to the Engineer for his approval. The Contractor shall submit necessary information concerning the supplier as requested by the Engineer.

Copies of orders placed shall be submitted to the Engineer.

The manufacturer shall submit all requested relevant data on the steel, i.e. breaking strength, yield strength, characteristics on elongation, chemical composition etc., to the Engineer for his approval.

No steel shall be delivered without a certificate guaranteeing the yield stress.

The steel shall be stored and marked in a way that it enables identification of the steel corresponding to each certificate later on.

2.16.6 TESTS

Test results in addition to those to be submitted by the Contractor and specified above shall be required. The Contractor shall cut out samples as directed by the Engineer.
The samples shall be tested according to the Engineer's instructions by an approved Testing Institution. Approximately three samples shall be tested from each 10 tons of reinforcement delivered at the Site. Expenses incurred in connection with cutting, carrying and testing the samples shall be borne by the Contractor at his own costs.

2.16.7 CONSTRUCTION METHODS OF REINFORCING BAR

Storage and care
All reinforcing steel when received at the Site, prior to its use, shall be stacked off the ground on platforms, skids or any other support and shall be kept free from dirt, oil and grease. All cares shall be taken to prevent the steel reinforcement from any mechanical injury and surface loss resulting from its exposition to weather conditions that produce rust. It shall be clean and kept free from loose rust and loose mill scale at the time of fixing in position and subsequent pouring of concrete. However, reinforcement steel may not be rejected on the ground of bonded rust, surface seams, surface irregularities and mill scale so long minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meet the specified physical requirements for the size and grade of steel.
Reinforcement shall be handled and stored in a manner that will prevent bending out of the desired shape and any accumulation of dirt, oil and paint. When placed in the works, it shall be free from dirt, oil, grease, paint, mill scale and loose or thick rust.
Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Codes of Practice of the Concrete Reinforcing Steel Institute.
Fabrication
All bars shall be fabricated following Specifications, methods and procedures stated below. Fabrication tolerances shall be in accordance with ACI 315.
Cutting and bending
All reinforcement bars shall be cut and bent cold to the specified shape and pertinent dimensions shown on the Drawings using a proper bar bender, operated by hand or power to attain proper radii of bends. The equipment used and methods followed for this purpose shall get the approval of the Engineer.
Bars shall not be bent or straightened in a manner that will injure the material.
Bars partially embedded in concrete shall not be field bent unless otherwise shown on the Drawings or directed by the Engineer.
Errors in alignment of reinforcement partially embedded in hardened concrete shall not be corrected by bending in place, except as permitted by the Engineer.
Bars bent during transportation or handling shall be straightened before being used in work. It shall not be heated to facilitate bending.
Fabrication tolerances shall be in accordance with ACI 315.
All plain bars shall have standard hooks at the end, which shall meet the following requirements unless otherwise specified on the Drawings. When the dimensions of hooks or the diameter of bends are not prescribed, they shall be in accordance with ACI 318 'Building Code requirements for Reinforced Concrete'. Some of the standard requirements have been specified below:

i. 180° turn plus an extension of at least 4 bar diameters but not less than 60mm at the free end of the bar.
ii. 90° turn plus an extension of at least 12 bar diameters at the free end of the bar.
iii. For stirrup and the anchorage only:

Technical Specifications

- For 16 mm dia bar and smaller : 90° bend plus an extension of at least 6 bar diameters or 75mm whichever is greater at the free end of the bar.
- For 20mm and 25mm dia bar : 90° bend plus an extension of at least 12 bar diameters or 150mm whichever is greater at the free end of the bar.
- For 25mm dia bar and smaller : 135° bend plus an extension of at least 6 bar diameters at the free end of the bar.
- For closed ties and continuously wounded ties : 135° bend plus an extension of at least 6 bar diameters, but not less than 75mm.

The minimum diameter of bend measured on the inside of the bar, for standard hooks other than for stirrups and ties in sizes 10mm Φ thorough 16mm Φ, shall not be less than the values shown in the table given below.

Minimum diameters of Bend

Bar size	Minimum diameter of bend
$10mm \le d_b \le 25mm$	$6d_b$
$25mm \le d_b \le 40mm$	$8d_b$
$40mm \le d_b \le 55mm$	$10d_b$

* db is the nominal diameter of bar, mm

For stirrups and tie hooks, inside diameter of bend shall not be less than 4 bar diameters for 16mm Φ bar and smaller. For bars larger than 16mm Φ, diameter of bend shall be in accordance with the specifications shown in the above table.

Bends for other bars, where full tension in the bar may occur, shall be made around a pin having a diameter not less than 20 bar diameters. Hooks shall conform to American Concrete Institute Standard. Building Code Requirements for reinforced concrete ACI 316-89, or as shown on the Drawings or as directed by the Engineer.

Placing, supporting and fastening

All bar reinforcement shall be accurately placed, supported and secured in position as shown on the Drawings using approved spacer blocks and chairs prior to any concrete pouring. Displacement tolerance may be allowed within the permissible tolerance limit as shown in the table given below unless otherwise specified by the Engineer. The reinforcement shall be checked and approved by the Engineer before pouring of concrete.

Tolerance for Placing Reinforcement

	Tolerance for depth (d)	Tolerance for Minimum Concrete Cover
$d \le 200mm$	± 10mm	- 10mm
$d \le 200mm$	± 12mm	- 12mm

Notwithstanding the above provisions, tolerance for the clear distance to formed soffits shall be minus 6mm and tolerance for cover shall not exceed minus one-third the minimum concrete cover required in the design Drawings or specifications.

Tolerance for longitudinal location of bends and ends of reinforcement shall be ± 50mm, except at discontinuous ends of members where tolerance shall be ± 12mm.

Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the Engineer.

The Contractor shall be responsible for the accuracy of cutting, bending and placing of the reinforcement. Reinforcement will be inspected for compliance with the requirements as to grade, size, shape, length, splicing locations, overlapping length and position after it has been placed.
Before the reinforcement is placed, the surfaces of the bars and the surfaces of any metal bar supports shall be cleaned of heavy rust, loose mill scale, dirt, grease and other objectionable foreign substances. Heavy flaky rust, which can be removed in firm rubbing with hessian or equivalent treatment, shall be considered objectionable. After being placed, the reinforcing bars shall be maintained in a clean condition until they are completely embedded in the concrete.
Reinforcement shall be accurately placed in the position shown on the Drawings and/or as directed by the Engineer and shall be securely held by blocking against the forms, by supporting on concrete or approved metal or plastic chairs or by using metal hangers and by wiring together at intersections using annealed wire of specified diameter with the ends turned in to the main body of concrete. Bars shall be tied at all intersections except where spacing is less than 300mm in any direction when alternate intersections shall be tied. Wire ties shall be securely tied and folded so that they do not project beyond the planes formed by the reinforcing bars. The adequacy of the supports and ties to secure the reinforcement properly shall be subject to the approval of the Engineer.
Reinforcement supports shall be strong enough to withstand the imposed loads without movement of the reinforcement. They shall be positively attached to the reinforcement and of such size and number as to maintain the specified cover.
There shall be a clear distance of at least 25mm between the bars and any adjacent embedded metal works. The Contractor shall ensure that there is no disturbance of the reinforcing bars in concrete that has already been placed.
Reinforcement binding wire shall be best black annealed mild steel wire and not less than approximately 1.6mm in diameter/18 - 22 BWG galvanized iron wire.
Cover blocks required for ensuring that the reinforcement is correctly positioned shall be as small as possible, consistent with their purpose, or a shape and material acceptable to the Engineer and designated so that they will not overturn when the concrete is placed. The concrete cover blocks or space blocks shall be made of concrete having 1 part cement, 1 part sand and 2 part coarse aggregate. The coarse aggregate would be 6mm downgraded. The blocks would be cast in mould and continuously cured for 21 days before use. Wire shall be cast in the block for the purpose of tying it to the reinforcement. The wire must not be closer than 30mm from the concrete surface. The use of small stones or wood blocks shall not be permitted.
If concrete cylinder blocks are used for proper spacing of vertical bars in column, the height shall be 2.54cm and radius shall be equal to the distance of the centre line of the bar from column face.
Top reinforcement in slabs shall be maintained in position by means of chairs made out of ferrous metal and shall conform to industry practice as described in the Manual on ‘Standard Practice of the Concrete Reinforcing Steel Institute’. The diameter and quantity being sufficient to ensure security of the reinforcement shall be used to support access ways, working platforms, or the placing equipment or for conducting of an electric current.
Platforms for the support of workers and equipment and machines shall be placed directly on the forms without any disturbance of the reinforcing steel during concrete placement.
Before any steel reinforcement is embedded in the concrete, any loose mill scale, loose rust and any oil, grease or other deleterious matter shall be removed. Partially set concrete, which may adhere to the exposed bars during concrete placing operations, shall also be removed.

2.16.8 LATERAL REINFORCEMENT FOR COLUMNS

Spirals
Spiral reinforcement for columns shall conform to the following:

i. Spirals shall consist of evenly spaced continuous bar or wire of such size and so assembled as to permit handling and placing without distortion from designed dimensions.

ii. Size of spirals shall not be less than 10mm diameter for cast-in-place construction.

iii. The minimum and maximum clear spacing between spirals shall be 25mm and 75mm respectively.

iv. Anchorage of spiral reinforcement shall be provided by 1.5 extra turns of spiral bar or wire at each end of a spiral unit.

v. Splices in spiral reinforcement shall be lap splices of 48 spiral diameter, but not less than 300mm.

vi. Spirals shall extend from the top of footing or slab in any story to the level of the lowest horizontal reinforcement in members supported above.

vii. Spirals shall extend above termination of spiral to bottom of slab or drop panel, where beams or brackets do not frame in to all sides of a column.

viii. Spirals shall extend to a level at which the diameter or width of capital is 2 times that of the column, in case of columns with capitals.

ix. Spirals shall be held firmly in place and true to line.

Ties

Tie reinforcement for compression members shall conform to the following: i. All bars shall be enclosed by lateral ties, at least 10mm diameter in size for longitudinal bars 30mm diameter or smaller, and at least 12mm diameter in size for 35mm diameter to 55mm diameter and bundled longitudinal bars. ii. Vertical spacing of ties shall not exceed 16 longitudinal bar diameters or 48 tie diameters, or the least dimension of the compression members.

iii. Ties shall be arranged such that every corner and alternate longitudinal bar shall have lateral support provided by the corner of a tie with an included angle of not more than 135°. No vertical bar shall be farther than 150mm clear on each side along the tie from such a laterally supported bar. Where longitudinal bars are located around the perimeter of a circle, a complete circular tie is allowed.

iv. The lowest tie in any story shall be placed within one-half the required tie spacing from the top most horizontal reinforcement in the slab or footing below. The uppermost tie in any story shall be within one-half the required tie spacing from the lowest horizontal reinforcement in the slab or drop panel above.

v. Where beams or brackets provide concrete confinement at the top of the column on all (four) sides, the top tie shall be within 75mm of the lowest horizontal reinforcement in the shallowest of such beams or brackets.

Lateral reinforcement for beams

Compression reinforcement in beams shall be enclosed by ties or stirrups satisfying the size and spacing limitations as stated above. Such ties or stirrups shall be provided throughout the distance where compression reinforcement is required.

Lateral reinforcement for flexural framing members subject to stress reversals or to torsion at supports shall consist of closed ties, closed stirrups, or spirals extending around the flexural reinforcement.

Closed ties or stirrups shall be formed in one piece by overlapping standard stirrup or tie end hooks around a longitudinal bar, or formed in one or two pieces laps, spliced with a lap of development length

2.16.9 SPACING OF REINFORCEMENT

The minimum clear spacing between parallel bars in a layer shall be equal to one bar diameter, but not less than 25mm.

Where parallel reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above those in the bottom layer with clear distance between layers not less than 25mm.

For compression members, the clear distance between longitudinal bars shall be not less than 1.5 bar diameters or 35mm.

Clear distance limitation between bars shall apply also to the clear distance between a contact lap splice and adjacent splices or bars.
In walls and one-way slabs, the maximum bar spacing shall be three times the wall or slab thickness (h) but not more than 450mm.
For two-way slabs, maximum spacing of bars shall be 2h but not more than 450mm.
For temperature steel only, maximum spacing shall be 5h but not more than 450mm.

2.16.10 SPLICING

General
All reinforcement shall be furnished in the full lengths indicated on the Drawings unless otherwise permitted by the Engineer. Except for splices shown on the Drawings and splices for No. 5 or smaller bars, splicing of bars shall not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible.
Where the Drawings do not detail laps that will be necessary, the Contractor shall furnish working Drawings to the Engineer for his approval.
If such additional lap splices are approved, the extra weight occasioned by such lap splices shall not be included in the measurement of reinforcement for payment unless provided for in these Specifications.
Lapped splices
All splices for high yield strength steel bars shall have a lap length as shown on the Drawings or if not shown therein shall be in accordance with the American Concrete Institute Building Code Requirements for Reinforced Concrete (ACI 318-89).
All splices for mild steel shall have a lap length as shown on the Drawings or if not shown therein, of not less than 40 diameters of the smaller bar when hooks are used and 50 diameters for bars without hooks.
Lap splices shall not be used for 35mm diameter bars and larger, except when bars of different diameters are lap spliced in compression, the splice length shall be the larger development length of the larger bar, or the splice length of the smaller bar.
Lap splices of bundled bars shall be based on the lap splice length required for individual bars within the bundle, increased in accordance with development of bundled bars. Individual bar splices within a bundle shall not overlap. Entire bundles shall not be lap spliced.
Bars spliced by non-contact lap splices in flexural members shall not be spaced transversely farther apart than one-fifth the required lap splice length, nor 150mm.
Lap splices shall generally be located at points of minimum tension in bars. Except where otherwise shown on the Drawings, lap splices shall be made with the bars placed in contact and securely wired together.
Welded splices
Welding on Site shall be avoided wherever possible, but where suitable safeguards and techniques are employed and provided that the types of steel including high-yield steels to SS 2 have the required welding properties, it may be undertaken with the acceptance of the Engineer. Before welding any reinforcement, the Contractor shall supply to the Engineer a Welding Procedure Specification (WPS) and an example of the weld for the type of steel, connection and weld being proposed. If suchevidence is not available, the Contractor shall demonstrate satisfactory performance by means of testing as agreed by the Engineer. Unless satisfactory performance of the proposed welded connection is established by either of the two methods described above, approval for use of the welded connection shall not be given.
In addition, and as required by the Engineer, the competence of the operators shall be demonstrated prior to and periodically during welding operations by submission of independent Welder Qualification Records (WQR) for each welder to be used on Site.
Welding may be used in fixing reinforcement in position, for example, by welding between crossing or lapping reinforcement, or between bars and other steel members.
Welded intersections shall not be spaced farther apart than 300mm in the direction of calculated stress, except for wire fabric used as stirrups.
Structural welding shall not be carried out unless specifically shown on the Drawings.

Notwithstanding the above, the Engineer will not permit tack welding of bars, which will be subject to fluctuating stresses in the completed structure.
Welding shall conform to the Structural Welding Code, Reinforcing Steel, AWS D 1.4 of the American Welding Society and applicable special provisions.
Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength fy of the bar. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength fy of the bar. Welded splices and mechanical connections not meeting the above requirements are allowed where area of reinforcement is at least twice that required by analysis shall meet the following: i. Splices shall be staggered at least 600mm and in such manner as to develop at every section at least twice the calculated tensile force at the section but not less than 140 N/mm2 for total area of reinforcement provided.
ii. Spliced reinforcement may be rated at the specified splice strength, in computing tensile force developed at each section. Non-spliced reinforcement shall be rated at that fraction of fy defined by the ratio of the shorter actual development required to develop the specified yield strength (fy).
Splices of deformed bars in tension
The minimum length of lap for tension splices shall be as required for Class A or B splice, but not less than 300mm, where the classification shall be as follows:
Class A splice……. 1.0Ld
Class B splice……. 1.3Ld
* Ld is the development length
Lap splices of deformed bars in tension, shall be Class-B splices except that Class-A splices are allowed when the area of reinforcement provided is at least twice that required by analysis over the entire length of the splice, and one-half or less of the total reinforcement is spliced within the required lap length. Where area of reinforcement provided is less than twice that required by analysis, welded splices or mechanical connections used shall meet the following requirements. This is also applicable in case of splices in tension tie members those shall be made with a full welded splice or full mechanical connection. i. Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength fy of the bar.
ii. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yeild strength fy of the bar.
Welded splices or mechanical connections used where area of reinforcement provided is at least twice that required by analysis shall meet the following: i. Splices shall be staggered at least 600mm and in such manner as to develop at every section at least twice the calculated tensile force at the section but not less than 140 N/mm2 for total area of reinforcement provided. ii. Spliced reinforcement may be rated at the specified splice strength, in computing tensile force developed at each section. Non-spliced reinforcement shall be rated at that fraction of fy defined by the ratio of the shorter actual development length to ld required to develop the specified yield strength fy.
Splices in adjacent bars shall be staggered at least 750mm.
Splices of deformed bars in compression The minimum length of lap for compression splice shall be 0.07 fy.db for fy equal to 410 N/mm2 or less or (0.13 fy – 24)db for fy greater than 410 N/mm2, but not less than 300mm. For f'c (specified compressive strength of concrete, N/mm2) less than 20 N/mm2, length of lap shall be increased by one-third.
When bars of different diameters are lap spliced in compression, the splice length shall be the larger of the development length of the larger bar, or the splice length of the smaller bar. Welded splices or mechanical connections used in compression shall also satisfy the following requirements: i. Welded splices shall be butted and welded to develop in tension at least 125 percent of the specified yield strength fy of the bar.
ii. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of the specified yield strength fy of the bar.
End bearing splices
i. Compression splices for bars required to transmit compressive stress only, may consist of end bearing

of square cut ends held in concentric contact by a suitable device.
ii. Bar ends shall terminate in flat surfaces within 1.5° of a right angle to the axis of the bars, and shall be fitted within 3° of full bearing after assembly.
iii. End bearing splices shall be used only in members containing closed ties, closed stirrups or spirals.
Special splice requirements for columns.
Lap splices, butt-welded splices, mechanical connections, or end-bearing splices shall be used with the limitations as stated below. A splice shall satisfy the requirements for all load combinations for the column.
Lap splices in columns
i. Lap splices shall conform to the first two requirements stated above under the Sub-section on 'Splices of Deformed Bars in Compression' and where applicable to (d) or (e) below where the bar stress due to factored loads is compressive.
ii. Where the bar stress due to factored loads is tensile and does not exceed 0.5fy in tension, lap splices shall be Class B tension lap splices, if more than one half of the bars are spliced at any section, or Class A tension lap splices, if half or fewer of the bars are spliced at any section and alternate lap splices are staggered by ld (development length).
iii. Where the bar stress due to factored loads is greater than 0.5fy in tension, lap splices shall be Class B tension lap splices.
iv. If spiral reinforcement confines the splice, the lengths required may be multiplied by 0.75, but lap length shall not be less than 300mm.
Welded splices or mechanical connectors in columns
Welded splices or mechanical connectors in columns shall also meet the following requirements. i. Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength fy of the bar. ii. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength fy of the bar.
End bearing splices in columns
End bearing splices complying with the requirements stated above under Sub-section on "End Bearing Splices' may be used for column bars stressed in compression provided that the splices are staggered or additional bars are provided at splice locations. The continuing bars in each face of the column shall have a tensile strength at least 0.25fy times the area of the vertical reinforcement in that face.
Splices of plain bars
For plain bars, the minimum length of lap shall be twice that of deformed bars.
Mechanical anchorage
Any mechanical device capable of developing the strength of reinforcement without damage to concrete is allowed as anchorage.
Mechanical device may be used only when its adequacy can be proven by test results to the satisfaction of the Engineer.
Development of reinforcement may consist of a combination of mechanical anchorage plus additional embedded length of reinforcement between the point of maximum bar stress and the mechanical anchorage.

2.16.11 SUBSTITUTIONS

Substitutions of different size bars shall be permitted only with specific authorization by the Engineer and at no additional cost to the Employer. If bars are substituted, they shall have a cross sectional area equivalent to the design area or larger.
The Contractor shall also provide, also in the case of substitutions, at his own expenses and to the approval of the Engineer, such necessary detailing of the reinforcement as he requires for the execution of the work to the Engineer's satisfaction.

2.16.12 CONCRETE COVER TO REINFORCEMENT

Unless specified on the Drawings, the clear concrete cover to reinforcement shall be as tabulated below:

Description of Concrete Element	Clear Cover (mm)	
	Normal Exposure	Saline Water
Wall and footing		
a) Contact with earth	60	75
b) Expose to weather and water	50	60
Piles		
a) Cast-in-place	75	100
b) Pre-cast	40	50
Beam, Girder, Column	40	50
Building roof and floor slab	25	25

2.16.13 PROTECTIVE COATING

All exposed reinforcing steel at construction joints shall be protected with a brush coat of neat cement mixed to a consistency of thick paint within one week after the placing of the initial concrete, unless it is definitely known that the steel will be embedded within 30 days. This coating shall be entirely removed, by light tapping with a hammer or other tools, not more than one week before the placing of the final pour.

2.16.14 BUNDLED BARS

i. Groups of parallel reinforcing bars bundled in contact to act as one unit, shall be limited to four in any one bundle.
ii. Bundled bars shall be enclosed within stirrups or ties.
iii. Bars larger than 35mm diameter shall not be bundled in beams.
iv. Individual bars within a bundle terminated within the span of flexural members shall terminate at different points with at least 40 times the nominal diameter of bar staggered.
v. Where spacing limitations and minimum concrete cover are based on nominal bar diameter, a unit of bundled bars shall be treated as a single bar of a diameter derived from the equivalent total area.
vi. Minimum concrete cover shall be equal to the equivalent diameter of the bundle, but need not be greater than 50mm.

2.16.15 INSPECTION

The Contractor shall notify the Engineer when the steel has been placed in position and ready for concrete placing. No concrete shall be placed until the Engineer inspected the steel and given his approval in writing.

2.16.16 MEASUREMENT

The quantity of reinforcement to be measured under this Section shall be the computed weight in kilogram of material used and accepted as shown on the Drawings provided that the quantity shall not include the reinforcement in any item of works. In computing the weight to be measured, the theoretical weights of bars of the cross section shown in this Specification shall be used.
The computed weight shall not include the extra materials incurred, when bars larger than those specified are used or the extra materials necessary for splices, when bars shorter than those specified are used even with the permission of the Engineer. It shall not also include the weight of any devices used to support or fasten the reinforcement in correct position.

2.16.17 PAYMENT

This work measured as provided above, shall be paid for at the Contract unit price per kilogram of reinforcement for the particular Bill of Item. The payment shall be considered to be the full compensation for furnishing, fabricating, splicing and placing of the reinforcing steel, supports and binding wire, cutting

and bending, all labours, equipment, tools and incidentals necessary to complete the works prescribed in this Section.
No separate payment shall be allowed for chairs, laps, splices, separators etc. The costs of these shall be considered included in the unit rate.

Item of Payment	Unit
Mild steel reinforcing bars	Kilogram
High yield steel reinforcing bars	Kilogram

2.17 WELDING

2.17.1 GENERAL

All welding shall be performed by certified welders and in accordance with the American Welding Society (AWS) D1.1 'Structural Welding Code' or similar approved standard.
The principal forms of welding metals are as follows:

i. Electric arc welding

ii. Gas welding

The electric arc welding process is the most important and is most extensively used for mild steels ranging from light articles with a wall or thickness of 16 gauge to heavy fabrications. This is a process whereby the metal of the two members to be welded is fused together through hit generated by an electric arc. Fusion should be complete over the whole area of the joint surface.
Gas welding is done using oxy-acetylene flame and is not adapted to structural steel works, but is generally used for small jobs. The flame produced by burning oxy-acetylene is fed through a blowpipe, which is ignited at its tip. The flame is played on the two pieces to be welded until the metal becomes hot enough to fuse together adding additional metal to the joint as necessary by melting in to it a suitable electrode.
Unless otherwise specified, all welding shall be performed following the Shielded Metal Arc Process with low hydrogen electrodes for manual welding.
The Contractor shall be responsible for the quality of the welding performed by his welding organization.
All welding by the Contractor shall be carried out by the electric arc method using coated electrodes or other means whereby the air is excluded from the molten metal and where applicable, automatic machines with correct procedure control shall be used.

2.17.2 WORKMANSHIP AND VISUAL QUALITY REQUIREMENTS

In addition to conforming with the procedural and quality requirements set forth in the Structural Welding Code and/or these Specifications, all manual welding shall meet the following requirements for workmanship and visual quality.
i. Each weld shall be uniform in width and size throughout its full length and each layer of welding shall be smooth, free of slag, cracks, pinholes and undercut and shall be completely fused to the adjacent weld beads and base metal. In addition, the cover pass shall be free of coarse ripples, irregular surface, non-uniform bead pattern, high crown, deep ridges or valleys between beads and shall blend smoothly and gradually into the surface of the base metal.
ii. Butt Welds shall be slightly convex, of uniform height and shall have full penetration.
iii. Fillet Welds shall be of specified size with full throat and with each leg of uniform length.
iv. Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thickness.

2.17.3 WELDING REPAIRS

All weld defects which are determined unacceptable, shall be removed by chipping, grinding, arc or flame gouging, following which the area shall be properly prepared for welding, repaired by an approved qualified welding procedure and re-tested as necessary. The Contractor shall establish the cause of all

defects and show that such defects have been corrected before welding will be permitted. All repairing shall be done by and at the expenses of the Contractor.

2.17.4 PEENING

The Contractor shall not be allowed to peen welds without prior approval of the Engineer.

2.17.5 ELECTRODES

All electrodes shall be purchased in sealed containers and shall be thoroughly dry when used. Electrodes, taken from sealed containers, shall be used within four hours. Electrodes not used within four hours shall be stored in electrode storage ovens. The electrode storage oven temperature shall be in accordance with the electrode manufacturer's recommendations. Electrodes with wet or damaged coatings shall not be used.

A simple test indicates the quality of an electrode or welding or welding wire can be made by laying the wire flat on a clean surface and applying the welding flame to it for a distance of about 8 - 10cm by moving the flame backward and forward until the wire becomes red and then slowly melting the wire, moving the flame in such a manner so that the wire melts only half-way through its diameter. If the flame is withdrawn as soon as the rod metal begins to melt, the impurities can readily be seen being thrown off in the form of sparks, or a boiling action in the case of inferior metal. When cold, an inferior metal will contain numerous spongy, volcano-like irregularities. A good metal welding rod will melt and flow evenly without any disturbing actions.

Cracks may occur in welding alloy steels owing to the rapidity with which these harden. This may largely be avoided by preheating the parent metal at 300oC or above in advance of welding to lower the normal cooling rate.

The maximum diameters of electrodes for welding have been shown in the following table:

Average thickness of plate or section	Maximum gauge or diameter of electrode to be used
Less than 5mm	3.2mm – 10 SWG
5mm to Less than 8mm	4mm – 8 SWG
8mm to Less than 10mm	5mm – 6 SWG
10mm to Less than 16mm	6mm – 4 SWG
16mm to Less than 25mm	9mm
25mm and over	9mm

The maximum width of any bead of welding, other than a cover pass, shall not exceed 3 times the diameter of the electrode being used.

Subject to the approval of the Engineer, electrodes shall be carefully selected in order to provide metal welds with mechanical properties similar to those of the metal being welded, except that for welding higher strength steel to lower strength steel, the electrodes shall be chosen to provide metal welds with mechanical properties comparable to those of the lower strength material.

2.17.6 CUTTING AND EDGE PREPARATION

Members of structural steel and miscellaneous metal works, which are to be joined by welding shall be cut accurately to size and where required, shall be rolled or pressed to the proper curvature in accordance with dimensions shown. The edges of these members shall be sheared, flame-cut or machined to suit the required type of welding and to allow thorough penetration. The cut surfaces shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations, or other injurious defects. The surface to be welded shall be free from rust, grease, paint and other foreign matter for a distance of at least 150mm back from the edge of the weld.

2.17.7 GRINDING WHEELS

Grinding wheels, which leave a deposit detrimental to subsequent welding will not be permitted. Grinding wheels, which are determined by the Engineer to be detrimental to welding shall not be used.

2.17.8 QUALIFICATION OF WELDERS AND WELDING OPERATORS

All welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified in the AWS Structural Welding Code. If, as determined by the Engineer, the work of any welder appears questionable, such welder will be required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Such additional qualification tests for welders and the physical tests of the welded specimens shall be made in the presence of the Engineer. If required, the Contractor shall furnish to the Engineer a certified copy of reports of the results of physical tests of specimens welded in the qualification tests. Fulfillment of such qualification shall be at the expenses of the Contractor.

2.17.9 WELDING METHODS

General

Methods which are essentially required to be followed while welding are as follows:

i. Welds should be made in the flat position as far as practicable.

ii. Freedom of movement of one member should be allowed as far as possible.

iii. The work should be securely held in position by means of spot welds, service bolts, clamps or jigs before commencing welding so as to prevent any relative movement due to distortion, wind or other causes.

iv. The parts to be welded must be thoroughly cleaned and proper flux used. Any paint or rust and loose mill scales, etc. should be removed from the surfaces to be welded and surrounding materials for a distance of at least 12mm from the weld. A coating of boiled linseed oil may be permitted. Steel to be welded should not be painted or oiled until after erection, unless all ends to be welded are left bare.

v. The sequence of welding should be such that when possible the members, offering the highest resistance to compression, are welded first.

Extreme care shall be taken to ensure that correct welding sequences and procedures are observed to avoid any strains and internal stresses arising in welding.

Welding of stainless steel

Unless otherwise specified, all welding shall conform with AWD D1.1. Electrodes used for welding of stainless steel shall be Series E308 and electrodes used for welding of stainless steel to carbon steel shall be Series E309.

Welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified above under ‘Qualification of Welders and Welding Operators’ of this Sub-section.

Welding of reinforcement

Electric Arc Butt-welding is most suitable for bars of diameter greater than 20mm and lap welding for smaller diameters and lap welding with longitudinal beads for 6mm to 40mm diameters. However, reinforcement, specified to be welded, shall be welded by any process the Contractor can demonstrate by bend and tensile tests, which will ensure that the strength of the parent metal is not reduced and that the weld possesses a strength no less than that of the parent metal. The welding procedure established by the successful weld tests shall be maintained and no departure from this procedure shall be permitted.

Following the establishment of a satisfactory welding procedures, each welder to be employed on the work shall carry out welder performance qualification tests on reinforcing bars of the same metal and size as those on the works.
Welds in positions other than those shown on the Drawings and/or as directed by the Engineer shall not be permitted.

2.17.10 DEFECTS IN WELDED JOINTS

The usual defects in welded joints are:

i. Lack of penetration or fusion of the metal to the bottom of the joint or welded members

ii. Laps in the metal of the weld not properly fused together. Defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effects in reducing the strength of the weld.

2.17.11 INSPECTION AND TESTING OF WELDS

The metal in a good weld when cold should show its original color. If the metal has a rusty or dull red color or appears crystallized, it is an indication that the heat has become too high and the metal has been burnt. A good weld will show an evenness of ripples or waves and well-formed beads with good fusion along the edges of the welds. There should be no unfilled cavities, small pockets of slags or burnt metal and small air or gas pockets. The strength of a welded joint may be taken only about 75 per cent of the stress usually allowed for common works, although tests have shown that if the welding is properly done it is possible to develop the full strength of the members jointed. The following tests shall be carried out on the procedure, qualification, test plates and production test plates:

i. Tensile and bend tests: all welds shall be subject to visual inspection.

ii. The procedures of visual examination shall conform to the requirements of the ASME Boiler and Pressure Vessels Code.

The following defects are unacceptable unless otherwise noted:

i. Dimensional defects such as insufficient throat or leg length, excess convexity, excess or insufficient reinforcement.

ii. Undercuts, overlap, blowholes, slag inclusion, seams and excess weave.

iii. Any crack or liner indication. Plates with laminations discovered during gas cutting, welding or any other time shall be rejected, unless approval to repair the plate is obtained from the Engineer. Welds may also be subject to anyone or a combination of the examinations as may be required to establish the soundness of welds. The inspection procedures for testing of all welds shall be prepared on the above basis by the Contractor and submitted to the Engineer for approval before any fabrication work is started.

2.17.12 MEASUREMENT AND PAYMENT

Welding shall not be measured and no direct payment shall be made. All costs of welding shall be deemed included in the related items of the Bill of Quantities unless otherwise it has been specifically mentioned in the BOQ.

2.18 EXCAVATION AND BACK-FILL FOR STRUCTURES

2.18.1 DESCRIPTION

2.18.2 MATERIALS

This item of work shall consist of excavation in any type of soil/material for the foundation of structures, disposal of excavated materials, construction and removal of cofferdams, sheeting and other temporary works in protecting the stability and safety of the excavated foundations, pumping, de-watering/bailing water from foundations, back-filling of completed structures with suitable backfill.
No separate payment shall be made for the excavation and back-fill for structures when the works will involve use of cofferdams. The costs of this temporary work shall be deemed included as part of the Tender sum.
The Work shall be carried out at the locations and according to the lines, levels, grades and dimensions shown on the Drawings, stated in the BOQ and/or as directed by the Engineer.

2.18.3 EXCAVATED MATERIAL

The Engineer shall classify all excavated materials either as suitable for fill or as waste.
Approved suitable excavated materials free from large lumps, wood or other objectionable materials shall be placed as back-fill above the level of pile except where other materials are shown on the Drawings, stated in the BOQ and/or required by the Engineer

2.18.4 ORDINARY FILL

Ordinary fill consists of earth having Liquid Limit not exceeding 50 and Plasticity Index not exceeding 20, as determined by AASHTO T89 & T90, and shall be used as back-fill material above the level of pile caps and areas except where other materials are shown on the Drawings, stated in the BOQ and/or required by the Engineer.

2.18.5 SAND

Unless otherwise stated on the Drawings or in the BOQ or ordered by the Engineer, back-fill material below the top level of pile caps shall consist of sand free from chemical contamination with not more than 10% of the material passing the No. 200 sieve (U.S. size). All other specifications should conform to what have been illustrated under the relevant Sub-section of this Specification. The sand to be used shall be approved by the Engineer prior to placing.

2.19 BLINDING CONCRETE

Blinding concrete shall be placed as backfill as shown on the Drawings, stated in the BOQ and/or ordered by the Engineer. The material shall conform to the specifications stated below:

2.19.1 CEMENT

Cement shall conform to the requirements of ASTM specification C 150 Type 1 or similar approved standard for normal Portland cement.
Cement shall be free from any hardened lumps and foreign matter. It shall have a minimum of 90% of particles by weight passing the 75-micron sieve, an initial setting time in excess of 45 minutes and a final setting time of not more than 375 minutes.
All other specifications should conform to what have been illustrated under the relevant Sub- sections of this Specification.

2.19.2 COARSE AGGREGATE

Except otherwise stated, coarse aggregate shall consist of hard, durable angular fragments of crushed stone and/or crushed natural gravel conforming all other specifications illustrated under the relevant Sub-section of this Specification.

2.19.3 FINE AGGREGATE

All specifications should conform to what have been illustrated under the relevant Sub-section of this Specification.

2.19.4 WATER

Water shall be subject to the approval of the Engineer and shall be reasonably clear, free from oil, alkali, salts, acid and organic substances and other deleterious materials or objectionable quantities of suspended materials. All other specifications shall be in accordance with the requirements illustrated under the relevant Sub-section of this Specification

2.19.5 CONSTRUCTION METHODS

2.19.5.1 EXCAVATION

The Contractor shall notify the Engineer before commencing excavation of the foundation trenches so that the cross-section, elevations and measurements of the undisturbed ground may be taken. The natural ground adjacent to the structure shall not be disturbed without taking any permission from the Engineer. Trenches and foundation pits for structures shall be excavated to the lines, grades and elevations as shown on the Drawings or as directed by the Engineer. The elevations of the bottom of the foundations shown on the Drawings are approximate only and the Engineer may order such changes as deemed necessary to provide a secured foundation.

Where unstable soil is encountered at the bed level, it should be brought to the notice of the Engineer and all such unstable soil shall be removed as directed and replaced with suitable materials to provide adequate support for the structure.

On acceptance of the materials forming the bottom of any excavation by the Engineer subsequently becoming unacceptable to him due to exposure to weather condition or due to flooding or have become puddled, soft or loose during the work process, the Contractor shall remove such damaged, soft, or loose materials and make additional excavation as per requirement. Such additional excavation shall be held as excess excavation and the cost of the excess excavation and subsequent replacement with a suitable back-fill shall be at the expenses of the Contractor.

Any erroneous excavation or excess excavation for the conveniences of the Contractor, or over excavation performed by the Contractor for any purpose or reasons shall be at the expenses of the Contractor. If the excavation for foundations exceeds the depths specified, the Contractor shall bring it back to the specified levels with sand, mass concrete or other approved materials conforming Standard Specifications at the Contractor's own expenses.

Excavation shall be sufficiently large to provide necessary working space, shuttering and any other Temporary Works required during construction.

Boulders, roots and any other objectionable materials encountered in excavation, shall be removed. The excavated foundation shall be cleared of all loose materials and cut to a firm surface.

When the footing is to rest on the ground and not on piles, special cares shall be taken not to disturb the bottom of the excavation and excavation to final grade shall be deferred until immediately before the footing is placed. If foundation fill material is required, it shall be placed and compacted in layers not more than 150mm thick or as directed by the Engineer. The dry density on compaction within 300mm below the top level shall not be less than 100% maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

In excavating foundation trenches, the last 150mm layer shall not be excavated until immediately before commencing the construction work except that the Engineer shall instruct otherwise. Any damages to the work due to the Contractor's operation shall be repaired at the expenses of the Contractor.

The Contractor shall be solely responsible for the safety and stability of the excavation and shall provide all protective supports, bracing, sheet piles, shoring etc. as required. Shoring should be adequate to provide enough safety to all the adjacent structures and land.

Excavated materials, classified as suitable for fill, shall be stockpiled. Waste materials and suitable fill

materials in excess of requirement, shall be disposed of by the Contractor outside the limits of the Site.
The foundation material shall be cleared of all loose and displaced materials and cut to a firm surface, either leveled, stepped or serrated, as specified or shown on the Drawing or directed by the Engineer leaving a smooth solid bed to receive foundation.
No footing, bedding material or structure shall be placed on any foundation until the Engineer has inspected and approved the depth of excavation and the foundation materials.

2.19.5.2 POOR FOUNDATION MATERIAL

When, in the opinion of the Engineer, the bottom of any excavated foundation is of soft or otherwise unsuitable material, the Contractor shall remove the unsuitable material and fill with sand or blinding concrete at the direction of the Engineer. The sand or concrete shall be placed following the procedures specified for back-filling. Sand shall be clear, all passing a No.4 sieve (U.S. size).
When the ground between the piles is too soft to support the green concrete, the Contractor shall submit his proposal for a bottom form to the Engineer for his approval. Extra excavation and foundation-fill or concrete-fill in such case will not be paid separately.
If the bottom form is carried out by strengthening the ground in the aforementioned way, the Contractor shall, if requested, submit calculations showing that the pile cap will not be harmed during hardening due to differential settlement between the piles and the strengthened ground.

2.19.5.3 DISPOSAL OF EXCAVATED MATERIAL

All excavated materials, so far accepted by the Engineer as suitable, shall be utilized as back-fill or embankment-fill. The surplus materials shall be termed as waste.
Excavated materials, suitable for use as back-fill, shall be deposited by the Contractor in spoil heaps at points convenient for re-handling of the materials during the back-filling operations.
Excavated materials shall be deposited in such places and in such a manner as not to cause damage to roads, services or properties either within or outside the project area and so as to cause no impediment to the drainage of the Site or surrounding areas. The location of spoil heaps shall be subject to the approval of the Engineer.
Waste materials shall be disposed of in accordance with the instruction of the Engineer.

2.19.5.4 PUMPING AND BAILING

The foundation shall be kept free from water at all times during the construction period. The ground water level shall be maintained at a minimum of 0.9m below the lowest designed excavation level.
Pumping and bailing from any foundation shall be done so as to preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of concrete and for at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or from well points.
The Contractor shall be solely responsible and include in his rates all costs in designing the de-watering system, providing all equipment and accessories required for de-watering. The rates shall also include cost for transportation, furnishing, installation, safe operation and maintaining of the system including operators, mechanics, the supply of power, fuel, lubricants, spares, repairing, etc. throughout and the removal of the equipment at the end of the construction period under this Contract.
Excavations shall be as dry as possible prior to and during placing concrete. Placing of concrete under water will only be permitted if indicated on the Drawings or approved by the Engineer.

2.19.5.5 BACK-FILLING

All excavated spaces shall be back-filled around the permanent structure to original ground level. Prior to placing back-fill, all trash, metal, debris, lumber, bricks, soft materials and similar objectionable foreign materials shall be removed from the area to be back-filled. No back-fill shall be placed against any structure without the prior permission of the Engineer.
Any protective support, bracing or shoring shall be removed, as the back-filling progresses in such a manner as to prevent caving-in.

Back-fill shall be of approved materials that will produce a dense and well-compacted filling. The material shall be free from large lumps, organic or extraneous materials.
Ordinary fill placed as back-fill shall be laid and compacted. The moisture content of the fill materials, before compaction, shall be within + 5% of the Optimum Moisture Content. Each layer of materials shall be compacted uniformly using approved compaction equipment and procedures. The materials shall be compacted to achieve not less than 90% Maximum Dry Density (STD) beneath the bottom level. The dry density, after compaction within 300mm below the top level, shall not be less than 95% Maximum Dry Density as determined in accordance with AASHTO T99 or ASTM D698 and soaked CBR (4 days) should be greater than 4% at 95% Maximum Dry Density. The compacted layer shall be approved by the Engineer before the Contractor can commence a new layer.
Sand back-fill shall be placed and thoroughly compacted in layers of not more than 150mm. Sand should be clear, all passing a No. 4 U.S. Standard Sieve and conforming generally to ASTM C 144 for fine aggregate with F.M. not less than 1.2 or as required by the Engineer.
Layers of filling shall be tested as directed by the Engineer. Each compacted layer shall not be covered until the Engineer is satisfied that the specified degree of compaction has been achieved.
In placing back-fill, the materials shall be placed in, as far as possible, to approximately the same height on each side of the structure. If conditions require appreciable higher back-filling on one side, the additional materials shall not be placed until permission is given by the Engineer on being satisfied by himself that the structure has enough strength to withstand any created pressure.
In general, no structure shall be subject to the pressure of back-filling until 3 (three) days on expiry of the period designated for removal of forms. This period shall be extended if abnormal curing conditions exist
Adequate provisions shall be made for drainage during placing back-fill.

2.19.5.6 COFFERDAM

The term “cofferdam” denotes any temporary or removable structure, constructed to hold the surrounding earth, water or both, out of the excavation whether such structure is constructed of earth, timber, steel, concrete or any combination of these. The term includes earth dikes, timber cribs, sheet piling, removable steel shells and all bracings and it shall be understood to include excavation enclosed by pumping wells and well points.
Cofferdams shall be constructed so as to control water to preclude sliding and caving-in of the walls of the excavation.
The interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction and removal of any required forms and the inspection of the interior and to permit pumping.
If possible, cofferdams shall be so designed that no cross bracing shall be left in place. If this is not possible, bracing left in place shall be of structural steel. The end of such structural members that would be exposed when the structure is completed shall be boxed back at least 50mm behind the face. The resulting holes shall be completely filled with concrete.
In general, sheet-piling cofferdams shall extend well below the bottom of the footings and shall be well braced and made maximum watertight.
When conditions are encountered which, in the opinion of the Engineer, render it impossible to dewater the foundation before placing of brickwork or concrete, the Engineer may require the construction of a concrete foundation or seal. This shall be placed as directed by the Engineer. The foundation shall then be de-watered and the footing placed.
When foundation piles are to be driven inside a cofferdam and it is judged impossible to de-water the cofferdam before placing concrete, the excavation may be extended below the design level to a depth sufficient to allow for swell of the materials during pile driving operations. Any materials that rise above the design level shall be removed.
Where it is possible to de-water the cofferdam, the foundation materials shall be removed to exact grade after the foundation piles are driven.
The natural streambed adjacent to the cofferdam shall not be disturbed without the permission of the Engineer. Any excavation adjacent to the cofferdam shall be back-filled to the original ground level to the

satisfaction of the Engineer.
Unless otherwise provided, cofferdams shall be removed on completion of the structure without disturbing or marring the finished work. The Engineer may order the Contractor to leave any part or the whole of the cofferdam in place and this shall not entitle the Contractor to claim for any additional payments.
The Contractor shall submit Drawings showing his proposed methods of cofferdam construction. However, the Contractor shall remain fully responsible for the adequacy of the design for strength and stability and for the safety of the people working therein.

2.19.6 MEASUREMENT

The volume of excavation and back-fill shall be measured in cubic meter.
The quantity of excavation for structures to be measured for payment shall include excavation for all structures. Back-filling with previously excavated materials shall not be measured or paid for separately but shall be deemed included within the rate for excavation.
Volumes to be excavated for blinding concrete shall not be measured and the price for the excavation thereof shall be included in the above measured item for excavation and back-fill.
Back-fill with concrete or sand, where directed by the Engineer, including concrete seals shall be measured separately as the volume within the plan outline and top and bottom surfaces. Concrete or sand, placed to back-fill excavation beyond the excavation required, will not be measured for payment.
If sand fill is ordered over top level of pile cap, the fill shall be the specified filling volume measured on the Drawings up to the profiles agreed upon in writing by the Engineer.
Removal of cofferdams, slides, silting or filling, if required, shall neither be measured nor paid for

2.19.7 PAYMENT

The work measured shall be paid for at the Contract unit prices per cubic meter as shown in the Bill of Quantities. The payment shall be the full compensation for all excavations and back-filling for structures including supply of all materials, labor, equipment, tools and incidentals necessary to the successful completion of the work.
The payment shall also be the full compensation for excavation and subsequent back-filling of working space around the foundation structure for shoring and other protective supports, for construction and removal of cofferdams, for de-watering and for disposal of surplus excavated materials by hauling to any distance at approved locations.
Should it be necessary, in the opinion of the Engineer, to lower the footings to an elevation below the level shown on the Drawings, payment for the excavation and backfill for structures required below plan level down to and including an elevation 1.5m below plan level for any individual footing will be made at a unit price equal to 115% of the Contract unit price and payment for the excavation from an elevation greater than 1.5m below plan level down to and including an elevation 3m below plan level will be made at a unit price equal to 125% of the Contract unit price for “Excavation and Back-filling for Structures”. No additional extra compensation will be allowed for any required cofferdam adjustments arising from such lowering of footings.
In case where the extra depth required for any footing or footings exceeds 3m, a supplementary agreement shall be made covering the quantities recovered from depths in excess of 3m below the plan grade.
Payment for Back-filling shall be included in the pay item for “Excavation and Back fill for Structures” except for sand fill and concrete fill. These fill types shall be measured as provided above and paid for at the concerned Contract unit prices. However, no compensation shall be made for less Back-filling with excavated materials or more surplus to waste in the pay item of “Excavation and Back-filling for Structures”.
All payments for the Back-filling and compaction of those areas, which were removed as structural excavation shall be included in the appropriate unit rates as shown below:

Item of Payment	Unit

Excavation and back-fill for structures	Cubic meter / Cubic feet
Concrete back-fill for structures	Cubic meter / Cubic feet
Sand back-fill for structures	Cubic meter/ Cubic feet

2.20 EARTH FILLING AND SAND FILLING

EARTH FILLING

2.20.1 DESCRIPTION

This work shall consist of filling any place by furnishing, placing, compacting and shaping suitable earth material of acceptable quality obtained from approved sources to make up levels to the lines, levels, grades, dimensions and cross sections in accordance with these specifications and as shown on the Drawings and/or as instructed by the Engineer.

2.20.2 MATERIALS

All fill materials shall be free from roots, sods or other deleterious materials. All fill materials shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer. The selected fill so stockpiled, shall satisfy the following criteria:

i. Liquid limit of fraction passing 425-micron sieve shall not exceed 50% as determined by AASHTO T89.

ii. Plasticity index of fraction passing 425-micron sieve shall not exceed 20% as determined by AASHTO T90.

iii. The dry density after compaction in layers more than 300mm below top level shall not be less than 90% of the maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

iv. The dry density after compaction within 300mm below the top level (or such greater depth if shown on the plans and drawings) shall not be less than 95% maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

v. Soaked (4 day) CBR greater than 4% at 95% MDD. The moisture content at the time of compaction shall be the optimum moisture content ± 5%. Sampling to be carried out as per ASTM D 75 and D 3665.

2.20.3 CONSTRUCTION METHODS

Prior to placing any fill upon any area, all clearing and grubbing operations shall be completed following the procedures stated below.

The original ground surface should be prepared by scarifying, watering, aerating and compacting. The dry density after compaction shall not be less than 90% of MDD (STD).

Filling in swamps or water shall be carried out as indicated on the Drawings and as described in these Specifications. The Contractor shall, when ordered by the Engineer, excavate or displace swampy ground and backfill with suitable materials. Such backfill shall be river or beach sand unless otherwise directed by the Engineer.

The materials that are borrowed from canals or other waterlogged areas for use as fill material, being saturated, shall initially be stockpiled to drain the excess water before placing it in the designated areas

CLEARING

Clearing shall consist of the removal and disposal of everything above foundation level except those the Engineer directs are to be left undisturbed. The materials to be cleared shall include but not necessarily be

limited to trees, stumps, logs, bush, undergrowth, grass, crops, loose vegetable matter and structures unless provided elsewhere.
All tree stumps shall completely be removed within the limits of earthwork.
Clearing shall also include the removal of existing fences, remnants of buildings, etc

GRUBBING

Grubbing shall be confined to major roots beneath the excavations. In agricultural areas where the ground has been formed into ridges of dikes, the ground shall be roughly leveled or graded to form a surface suitable for filling and to the satisfaction of the Engineer.

OWNERSHIP OF CLEARED MATERIALS

All cleared materials shall, unless otherwise provided for in the Contract, be the property of the Department.

SPREADING AND COMPACTION OF EARTH FILL

Earth carried from outside shall be placed on the land to be developed in horizontal layers and each layer shall not exceed a loose thickness that is required to obtain a compacted thickness of 150mm. The earth of each basket is to be placed near to the earth placed before it and spread systematically. The Contractor shall not be allowed to throw earth in heaps.
The materials to be compacted shall be deposited in horizontal layers on the land to be developed with a loose thickness as stated above. The clods of earth shall be broken down to a maximum size of 25mm by striking the clods with the back of a spade or by using wooden drag or ladder or by any other suitable means before the next basket of earth is thrown close to it. Distribution of materials shall be made in such a way that the compacted materials will become homogeneous and free from lenses, pockets, streaks or other imperfections. Excavating and placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability and for this purpose the preceding compacted layer shall be scarified before placing a new layer.
All fill materials shall generally be compacted mechanically. However, under some special circumstance and when specifically allowed under the BOQ, the fill may be allowed to be compacted manually.
If the density measurement checks fall below the specified density level, re-compacting shall be required irrespective of the field compaction trial results. The Contractor shall be carried out such works
Earth fill materials, which does not contain sufficient moisture requirement for compaction in accordance with the requirements of this Sub-section shall be reworked and watered as per direction of the Engineer. The Contractor shall carry out this work at his own expenses.
Earth fill materials containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet materials shall be performed by methods proposed by the Contractor and approved by the Engineer at the expenses of the Contractor.
Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

MANUALLY COMPACTED FILL

Fill shall be placed and compacted in layers for 150mm maximum compacted thickness, uniformly spread and compacted over the fill area of each layer. If for any reason, progress in compaction of the fill is interrupted for any unreasonable time, the surface area of the fill shall be scarified or ploughed before compaction continues. Each layer shall be compacted, using controlled manual compaction methods to achieve at least 85% of the Standard Proctor maximum dry density.
Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.
Under special circumstances and if directed by the Engineer, the Contractor shall excavate 5 to 10 trial pits each of size 2m long, 1m wide and 2m depth or to a depth of the improved land (whichever is less) at random spacing to test the degree of compaction. The size of voids encountered shall not exceed 5 cm in

diameter and the number of voids shall be less than 10 per square meter.

PROCEDURES FOR MANUAL COMPACTION

The earth shall be compacted manually using concrete drop hammers each weighing 6 kg to 7 kg, fitted with a shaft of about 1.5m long. Ramming shall reduce the voids and shall continue until no further shrinkage of earth is possible by ramming.

Before commencing ramming, the moisture content of the soil shall be increased or decreased as per requirement by sprinkling the soil with water or by allowing natural drying of the soil as applicable so as to ensure that the materials shall have a moisture content of not less than 5% or greater than 5% dry of the optimum moisture required for the purpose of compaction. Both wetting and drying may be aided by furrowing the fill and then re-spreading when the moisture content is suitable.

If the moisture content exceeds the aforementioned tolerance, the compaction operations shall not proceed until the material is wetted or allowed to dry out, as the case may be to obtain optimum moisture content within the permitted tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor related to wetting or drying the materials or on account of any delays occasioned thereby.

The preceding operations shall continue layer after layer until the top of the filling is reached.

MECHANICAL COMPACTION

In the case of mechanical compaction, area of development, designated on the Drawings or by the Engineer, shall be compacted to the lines and grades shown on the Drawings or established by the Engineer. The Contractor's operations in importing materials, designated for use, shall be such as will result in an acceptable gradation of material when placed as determined by the Engineer.

Just prior to and during placement operations, the materials shall have a moisture content of not greater than 5% wet or less than 5% dry of the optimum moisture required for the purpose of compaction, as determined by Test No. 12 of BS 1337 and approved by the Engineer. The materials shall be so worked as to have uniform moisture content throughout the entire layer.

If the moisture content exceeds the aforementioned tolerance, the compaction operations shall not proceed until the materials are wetted or allowed to dry out, as the case may be to obtain the optimum moisture content within the permissible tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any
operations of the Contractor related to wetting or drying the materials or on account of any delays occasioned thereby.

When the material has been conditioned and placed as specified or directed, it shall be compacted with appropriate motorized vibratory compaction equipment or tampers of adequate weight and size as approved by the Engineer. Each layer shall be compacted to obtain at least 98% compaction of the maximum dry density. If the test results show that the density has not met the requirement, the Contractor shall have to carry out further compaction until the required density is achieved. The insitu dry density of the compacted fill shall be determined by the Sand Replacement Method described in Test No. 15 of BS 1377 or by other similar approved tests at locations as ordered by the Engineer.

2.20.4 MEASUREMENT

Measurements for earth filling works shall be taken for payment in cubic meters on cross sections compacted and accepted in place. The volume to be measured will be the net volume of required and accepted filling, actually constructed and completed in accordance with the Specifications, to the lines, levels and cross sections required as per the Drawings or such other dimensions as directed by the Engineer. This stipulation of volume determination will be regardless of the method of excavation, filling, re-sectioning and backfilling at structures or type of materials.

The cross sections to be used shall be measured by pre-work (after clearing and stripping) and post- work field surveyed sections. Pre-work sections of the portion of the work allotted to the Contractor, computed through survey works, shall be signed by the Contractor before executing the works for retention by the Engineer.

2.20.5 PAYMENT

The unit rate paid per cubic meter for earth filling shall be in accordance with the Contract unit price, which payment shall constitute the full compensation for furnishing all materials and providing all labor, tools and equipment and works as specified. The rate shall also include costs of all other items related therewith and all incidentals, which may need to be completed to execute the work strictly in accordance with the Specifications and/or as per the directions of the Engineer.
Costs of all works and the cost of lead, lift or carriage shall be included in the unit rates for the relevant item of earth filling works of the BOQ of the Contract. Unless otherwise specified, no royalties will be paid for the purchase of earth from a private land regardless of its distance from the Site. No additional payment shall be made for purchasing a land and excavating the fill outside the rate agreed in the Contract for the item of earth filling works.
No direct or separate payment shall be made for works required under the other sub-items of this item. Costs for such works shall be deemed to have included in the related items of the BOQ.
Payment shall only be made when all works have been completed in accordance with the designed sections satisfying all specifications and accepted by the Engineer.

Item of Payment	Unit
Earth filling	Cubic meter/ Cubic feet

SAND FILLING

2.20.6 DESCRIPTION

This work shall consist of filling in foundation trenches, inside plinth or at any other places by furnishing, placing, compacting and shaping suitable sand of acceptable quality and F.M. to make up levels to the lines, levels, grades, dimensions and cross sections in accordance with these specifications and as shown on the Drawings or BOQ and/or as instructed by the Engineer

2.20.7 MATERIALS

Materials shall be of natural sand free from vegetable matters, from soft particles and from clay. F.M. of sand shall be in accordance with the stipulations of the BOQ or as per the direction of the Engineer.
All fill materials shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer. The selected sand fill so stockpiled, shall satisfy the following criteria:

i. The fraction passing the 425-micron sieve shall have a Plasticity Index not greater than 10 (AASHTO, Soil Classification A-2-4).
ii. The material shall have a soaked CBR value not less than 8% when compacted to 98% of maximum dry density as to be determined by AASHTO T-99.

2.20.8 CONSTRUCTION METHODS

GENERAL
Prior to placing any sand fill upon any area, all clearing and grubbing operations shall be completed. Within the limits of sand filling, tree stumps shall completely be removed.
The original ground surface should be prepared by scarifying, watering, aerating and compacting.
SPREADING AND COMPACTION OF SAND FILL
Sand fill shall be placed on the desired place in horizontal layers and each layer shall not exceed a loose thickness that will be required to obtain a compacted thickness of 150mm. Sand in each basket is to be placed near to the sand placed before it and spread systematically. The Contractor shall not be allowed to throw sand in heaps.
The compacted materials should become homogeneous and free from lenses, pockets, streaks or other imperfections. Placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability and for this

purpose the preceding compacted layer shall be scarified before placing a new layer.
All fill materials shall generally be compacted mechanically. However, under some special circumstance and when specifically allowed under the BOQ, the fill may be allowed to be compacted manually.
If the density measurement checks fall below the specified density level, re-compacting shall be required irrespective of the field compaction trial results The Contractor shall carry out such works at his own expenses.
Sand fill materials not containing sufficient moisture requirement for compaction in accordance with the requirements of this Sub-section, shall be reworked and watered as per the direction of the Engineer. The Contractor shall carry out this work at his own expenses.
Sand fill materials containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet materials shall be performed by methods proposed by the Contractor and approved by the Engineer at the expenses of the Contractor.
Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.
PROCEDURE FOR MANUAL COMPACTION
Sand shall be compacted manually by using concrete drop hammers each weighing 6 kg to 7 kg, fitted with a shaft of about 1.5m long. Ramming shall reduce the voids and shall continue until no further shrinkage of sand is possible by ramming.
Before commencing ramming, the moisture content of sand shall be increased or decreased as per requirement by sprinkling water or by allowing natural drying of sand as applicable so as to ensure that the materials shall have a moisture content of not less than 3% or greater than 3% dry of the optimum moisture required for the purpose of compaction respectively.
The compaction operations shall not proceed until the material is wetted or allowed to dry out, as may be required, to obtain optimum moisture content within the tolerances as permitted above. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.
The preceding operations shall continue layer after layer until the top of the filling is reached.
MECHANICAL COMPACTION
In the case of mechanical compaction, area of filling, designated on the Drawings or by the Engineer, shall be compacted to the lines and grades shown on the Drawings or established by the Engineer. The Contractor’s operations in importing materials, designated for use, shall be such as will result the desired F.M.
Just prior to and during compacting operations, the materials shall have a moisture content of not greater than 3% wet or less than 3% dry of the optimum moisture required for the purpose of compaction, as determined by Test No. 12 of BS 1337 and approved by the Engineer. The materials shall be so worked as to have uniform moisture content throughout the entire layer.
If the moisture content is less than optimum by more than 3% or is greater than optimum by more than 3%, the compaction operations shall not proceed until the material is wetted or allowed to dry out, as may be required, to bring the optimum moisture content within the tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.
When the material has been conditioned and placed as specified or directed, it shall be compacted with appropriate motorized vibratory compaction equipment or tampers of adequate weight and size as approved by the Engineer. Each layer shall be compacted to obtain at least 98% compaction of the maximum dry density (STD). If the test results show that the density has not met the requirement, the Contractor shall have to carry out further compaction until the required density is achieved.

2.20.9 MEASUREMENT

Measurement shall be taken for payment on the compacted volume of completed and accepted works in cubic meter. The cross sections to be used will be the areas bound by the original ground (existing) shaped or leveled, the sides and the bottom of the foundation or the floor.

2.20.10 PAYMENT

Payment for sand filling shall be made at the Contract unit price per cubic meter measured as provided above which price shall constitute the full compensation for furnishing all materials with their storage, placing, leveling and shaping, wetting or drying, compacting the fill materials and providing all equipment, tools and all incidentals necessary to complete the work true to the Specifications and/or as per the directions of the Engineer.
Payment shall only be made when all works have been completed in accordance with the designed sections satisfying all Specifications and accepted by the Engineer.

Item of Payment	Unit
Sand filling	Cubic meter / Cubic feet

2.21 RUSTLESS TYING WIRE

Rustles tying wire of 18 SWG shall be obtained from approved manufacturers and shall, as regards strength, comply with the requirements specified. The Contractor shall, at his own costs, provide binding wires of required specifications.

2.22 GUNNY BAGS

The gunny bags used in the permanent works shall be new, 50/75 kg capacity bags similar to those normally used. The Contractor shall submit sample bags to the Engineer for his approval

2.23 WIRE GAUGE

2.23.1 WIRE GAUGE GENERAL

Gauge for fly proofing shall be of the quality uniformly woven webbing of 23 meshes per square centimeter. The wire for the gauge shall be of best quality 22 SWG brass or copper wire or any other approved materials.

2.23.2 OTHER MATERIALS

Gauge known as “plastic gauge” may also be used as and when required by the Engineer.

SECTION 2: FINISHING WORKS

3. FINISHING MATERIALS

3.1 FLOOR

3.1.1 NON-SKID FLOOR TILES

3.1.1.1 DESCRIPTION

Works covered under this item shall consist of supplying, fitting and fixing approved foreign/local made homogeneous quartz/embossed, non-skid floor tiles or special quality fibrous floor tiles laid on cement mortar base of proportion in accordance with the applicable Drawings, requirements of the BOQ, and these Specifications and/or as directed by the Engineer.

3.1.1.2 MATERIALS

Tiles
Tiles shall be either homogeneous quartz/embossed non-skid or special quality fibrous. The tiles shall be local/foreign made and of the sizes as shown on the Drawings, described in the Schedule of Works and/or as directed by the Engineer. They should be free from all warpage blemishes and dimensional defects.
Mortar
Mortar for installation shall consist of 1-part cement and 2 parts sand (FM 1.2). The specification for cement and sand shall conform to those stated under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification and/or as directed by the Engineer.
Grout
All grout for tile joints be prepared with white cement or colored with inert pigments as and where specified. The specification for white cement shall conform to those stated under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification and/or as directed by the Engineer.
Water
Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other deleterious substances and shall not contain any visibly solid materials. All requirements shall be similar to what have been stated under the relevant Sub-section of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification. The Contractor shall get the water tested by comparing with water of known satisfactory quality, if requested by the Engineer.

3.1.2 CONSTRUCTION METHODS

The Contractor shall submit three sets of samples of all types of tiles to the Engineer for his approval before procuring the materials. One set will be kept in the office of the Engineer, one set at the Site office and the remaining set will be returned to the Contractor.
The Contractor shall prepare sample tile work and he should obtain its approval from the Engineer. Before such approval is received, no full-scale work shall start. The design of the floor layout shall conform to what have been shown on the Drawing and/or as directed by the Engineer.
The tiles shall be laid over previously roughened and wetted patent stone floor. The panels shall be of the size as shown on the Drawings and/or as indicated in the relevant item of the BOQ and/or as directed by the Engineer.
The sub-floor on which the tiles will be laid, shall be prepared in the same way as have been stated under the Sub-section on 'Patent Stone Floor' of this Section, but it will exclude the portion of neat cement finishing.
The tiles are to be fitted and fixed on the floor on a base of 20mm thick cement mortar prepared with 1 part ordinary Portland cement and 2 parts sand of FM 1.2. The mortar bed shall be cut through horizontally and vertically every 425mm to 600mm.
If the surface needs leveling, a scratch cost of plaster shall be applied, leveled and scratched for key and be allowed to dry out for 12 hours before installing tiles. The setting mortar shall be applied evenly and a

neat cement paste to a thickness of about 2mm shall be troweled to the back of the tiles. The tiles will then be set on firmly tapped into place to ensure full contact. The joints shall be in specified pattern and shall not exceed 2mm in width. The joints shall be raked with grout prepared with white cement and colored pigment and damp-cured for at least 3 days.
The tiles shall be soaked in water for at least 6 hours before laying. Installation shall be controlled by strings, pages, spacers, levels or other suitable methods so as to ensure their correct laying and uniform leveled joints.

3.1.3 MEASUREMENT

Measurement shall be taken for payment in square meter of finished tiled surface in place completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.1.4 PAYMENT

The amount of completed and accepted works measured as provided above shall be paid at the Contract unit price per square meter, which shall constitute the full compensation for furnishing all materials, equipment and labor, including transport, storage and handling of materials, cleaning, preparing and laying bed with cement mortar and cutting and laying the tiles with neat cement paste, grouting and curing tiles ranking our joints, high quality finishing and all other works and all incidentals necessary to complete the Work as per requirements described under this item of work, the requirements of the BOQ, as shown on the Drawings and as directed by the Engineer. However, this item shall not include the costs for the item on Artificial Stone Floor.

Item of Payment	Unit
Non-skid floor tiles	Square meter / Square feet

3.1.5 CERAMIC TILES

3.1.5.1 GENERAL

RELATED DOCUMENTS

i. Related Drawing and Detail.

SUMMARY

ii. This Section includes the following:

- Ceramic Tiles.

DEFINITIONS

iii. **Module Size:** Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

iv. **Facial Dimension**: Actual tile size (minor facial dimension as measured per ASTM C 499).

v. Facial Dimension: Nominal tile size as defined in ANSI A137.1

3.1.5.2 PERFORMANCE REQUIREMENTS

i. Static Co-efficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

- Level Surfaces: Minimum 0.6.

ii. Load-Bearing Performance: Provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:

- Heavy: Passes cycles 1 through 12. Use where indicated in finishing Schedules.
- Moderate: Passes cycles 1 through 10. Use for other applications indicated on Schedule where heavy duty is not indicated.

3.1.5.3 SUBMITTALS

I. Product Data: For each type of tile, mortar, grout, and other products specified.

II. Shop Drawings: For the following:

- Tile patterns and locations.
- Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

III. Locate precisely each joint and crack in tile substrates, record measurements on shop drawings, and coordinate them with tile joint locations, as approved by Consultant.

IV. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

V. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.Each type and composition of tile and for each color and texture required, at least 400 mm square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Consultant.

❑ Full-size units of each type of trim and accessory for each color required.

❑ Stone thresholds in 150-mm lengths.

Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

VI. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.

VII. Installer Experience: List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product.

VIII. Installer Experience: List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product Qualification Data: For firms and persons specified in the

"Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of Consultants and Employers, and other any information required by Consultant.

IX. Test Reports: Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.

X. Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

3.1.6 QUALITY ASSURANCE

i.Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.
ii. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
iii. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
iv. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

4. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
5. Stone thresholds. Waterproofing. Cementitious backer units. Joint sealants.
6. Mockups: Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.

- Locate mockups in the location and of the size indicated or, if not indicated, as directed by Consultant.
- Notify Consultant 7 days in advance of the dates and times when mockups will be constructed.
- Demonstrate the proposed range of aesthetic effects and workmanship.
- Obtain Consultant's approval of mockups before proceeding with final unit of Work
- Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

Approved mockups in an undisturbed condition as judged solely by the Consultant at the time of Substantial Completion may become part of the completed Work, otherwise demolish mockups, remove rubbles from site and install permanent works.

Pre-installation Conference: Conduct conference at Project site to comply with requirements of Project Management and Coordination.

3.1.7 DELIVERY, STORAGE, AND HANDLING

i. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

ii. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

iii. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

3.1.8 PROJECT CONDITIONS

Environmental Limitations: Do no install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

3.1.9 EXTRA MATERIALS

Deliver extra materials to Employer. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

- Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

3.1.10 PRODUCTS GENERAL

GENERAL

- Provide tile complying with Standard Grade requirements, unless otherwise indicated.
- Retain below with appropriate definitions in referenced part 1 article.
- For facial dimensions of tile, comply with standard requirements unless otherwise indicated.
- Tiles are to be highest grade of production in manufacturer’s quality grading system. Iv

ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

Colors, Textures, and Patterns: Where manufacturer’s standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

- Provide Consultant’s selections from manufacturer’s full range of colors, textures, and patterns for products of type indicated.

Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

3.1.11 TILE PRODUCTS

Wall Tile: Provide flat tile complying with the following requirements:
Module Size: As indicated on Drawings.
Water Absorption: Less than 6% to ASTM C373.

- Thickness: minimum 3 mm to 5 mm.
- Face: Plain with modified square edges or cushion edges. Background/Base: 15mm thick 1:4 cement/sand render on concrete or concrete blockworks.

Bedding: Thin cement based adhesive to be approved
Grouting material: Epoxy grout Nitotile 489 as supplied by Fosroc or equal approved to be used in accordance with manufacturer recommendations. Colour to architects approval.
Movement joints: All internal corners; Width: 6mrn.

3.1.12 MISCELLANEOUS MATERIALS

i. Trowel able Underlayment's and Patching Compounds: Latex-modified, Portland-cementbased formulation provided or approved by manufacturer of tile- setting materials for installations indicated.

ii. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile. ❑ Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 49 to 60 deg C per ASTM D 87.

iii. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

3.1.13 MIXING MORTARS AND GROUT

i. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

ii. Add materials, water, and additives in accurate proportions.

iii. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

3.1.14 EXECUTION EXAMINATION

Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

- Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.

3.2 PORCELAIN

3.2.7 GENERAL

RELATED DOCUMENTS: Related Drawing and Detail.
SUMMARY: This Section includes the following:

- Porcelain Tiles.

DEFINITIONS

i. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
ii. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).
iii. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

3.2.8 PERFORMANCE REQUIREMENTS

Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

- Level Surfaces: Minimum 0.6.

Load-Bearing Performance: Provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
Heavy: Passes cycles 1 through 12. Use where indicated in finishing Schedules.
Moderate: Passes cycles 1 through 10. Use for other applications indicated on Schedule where heavy duty is not indicated.

3.2.9 SUBMITTALS

Product Data: For each type of tile, mortar, grout, and other products specified.
Shop Drawings: For the following:

- Tile patterns and locations.
- Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- Locate precisely each joint and crack in tile substrates, record measurements on shop drawings, and coordinate them with tile joint locations, as approved by Consultant.

Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.
Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

- Each type and composition of tile and for each color and texture required, at least 400 mm square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Consultant.
- Full-size units of each type of trim and accessory for each color required.
- Stone thresholds in 150-mm lengths. v. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.
Installer Experience: List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product.
Installer Experience: List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of Consultants and Employers, and other any information required by Consultant.
Test Reports: Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.
Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

3.2.10 QUALITY ASSURANCE

Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.
Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

- Stone thresholds.
- Waterproofing.
- Cementitious backer units.
- Joint sealants.

Mockups: Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed Work.

- Locate mockups in the location and of the size indicated or, if not indicated, as directed by Consultant.
- Notify Consultant 7 days in advance of the dates and times when mockups will be constructed.
- Demonstrate the proposed range of aesthetic effects and workmanship.
- Obtain Consultant's approval of mockups before proceeding with final unit of Work.
- Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work. 1) Approved mockups in an undisturbed condition as judged solely by the Consultant at the time of Substantial Completion may become part of the completed Work, otherwise demolish mockups, remove rubbles from site and install permanent works.

Pre-installation Conference: Conduct conference at Project site to comply with requirements of Project Management and Coordination.

3.2.11 DELIVERY, STORAGE, AND HANDLING

i. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

ii. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

iii. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

3.2.12 EXTRA MATERIALS

Deliver extra materials to Employer. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

- Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

3.2.13 PRODUCTS GENERAL

- Provide tile complying with Standard Grade requirements, unless otherwise indicated.
- Retain below with appropriate definitions in referenced part 1 article.
- For facial dimensions of tile, comply with standard requirements unless otherwise indicated.
- Tiles are to be highest grade of production in manufacturer’s quality grading system.

ii. **ANSI Standards for Tile Installation Materials**: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

iii. **Colors, Textures, and Patterns**: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements: ❑ Provide Consultant's selections from manufacturer's full range of colors, textures, and patterns for

products of type indicated.
iv. **Factory Blending**: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.
v. **Mounting:** Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.
vi. **Factory-Applied Temporary Protective Coating**: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

3.2.14 TILE PRODUCTS

i. **General Characteristics**: Tiles are to comply with the following general requirements:

Floor Tiles:

1) **Abrasive Hardness**: Minimum Index 253 to ASTM C 501 (unglazed tiles), unless otherwise specified.
2) **Bending Strength**: Minimum 35 Kg/cm2 to ASTM C 648.
3) Water Absorption: As specified.
4) Chemical Resistance: Unaffected with moderate acids.
5) **Tile Rating**: For heavy duty floor by a rating system acceptable to the Consultant.
6) **Background/Base**: 15mm thick 1:4 cement/sand render on concrete or concrete block works.
7) **Bedding:** Thin cement based adhesive to be approved
8) **Grouting material**: Epoxy grout Nitotile 489 as supplied by Fosroc or equal approved to be used in accordance with manufacturer recommendations. Colour to architects approval.
9) **Movement joints**: All internal corners; Width: 6mrn.
10) **Accessories**: all exposed edges and corners to have preformed rounded edges.

3.2.15 FLOOR TILING

Background/Base: screed 1 in-situ concrete
Screed: 1:3:6 cement/sand/aggregate semi-dry screed laid to falls and towards floor drain outlets, overall thickness of flooring to be 75mm Bedding: Waterproof adhesive on cement 1 sand bed Adhesive: to be approved
Waterproofing: 2 coats Fosroc Nitoproof 10, or equal, to B.S. Standard. laid to manufacturer's recommendations, with necessary accessories
Grouting material: Epoxy grout Nitotile 489 as supplied by Fosroc or equal approved to be used in accordance with manufacturer recommendations. Colour to architects approval.
Joint width: 2 mm
Movement joints:
Location: At all perimeters including door thresholds;
Width: 2 mm
Accessories: Skirting: Coved skirting tiles, 100mm high to match ceramic floor tiles, set flush with render, to be fixed on plastered walls, grouted with epoxy grout Nitotile 489 as supplied by Fosroc or equal approved, applied in accordance with manufacturer's recommendations.

3.2.16 GROUTING MATERIALS

i. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
ii. Chemical-Resistant Epoxy Grout: ANSI A 118.3, color as indicated.
❑ Provide product capable of resisting continuous and intermittent exposure to temperatures of up to 60 deg C and 100 deg C, respectively, as certified by mortar manufacturer for intended use.
iii. Grout Colors: Provide colors as selected by the Consultant from manufacturer's full range of standard and custom colors. Finish shall be smooth, unless otherwise specified or directed by the Consultant

3.2.17 ELASTOMERIC SEALANTS

i. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Joint Sealants.
ii. Colors: Provide colours of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

3.2.18 MISCELLANEOUS MATERIALS

i. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile- setting materials for installations indicated.
ii. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.
❑ Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 49 to 60 deg C per ASTM D 87.
iii. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers

3.2.19 MIXING MORTARS AND GROUT

i. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
ii. Add materials, water, and additives in accurate proportions.
iii. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

3.2.20 EXECUTION EXAMINATION

Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

- Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.

DOORS, WINDOWS AND CEILINGS

3.3 WOOD WORK FOR DOOR/ WINDOW FRAMES AND SHUTTERS

3.3.7 DESCRIPTION

Works covered under this item shall consist of furnishing, finishing and installing of wooden door/ window frames and shutters of the size and shape shown on the Drawings and/or as specified in the Bill of Quantities and/or as directed by the Engineer including supplying and fixing of all finished hardware and glazing.

3.3.8 GENERAL REQUIREMENTS

Design drawings

Design Drawings shall be thoroughly studied by the Contractor before the Work is commenced. Detail of joints as shown on the Drawings must be specifically checked. If any detail description or specification is found missing or in the opinion of the Contractor inadequate, inconsistent or otherwise, the Contractor shall draw the same to the attention of the Engineer who may make necessary arrangements as deemed fit. On no account, the Contractor shall use his own judgement when any discrepancy is noticed in the Drawings, details and descriptions.

Shop drawings

Detailed Shop Drawings of doors and windows and other wooden works including glazing and installation details, when required, shall be submitted to the Engineer for approval.

Shop Drawings shall include the submission of manufacturer's literature, brochures and delivery date for all finish hardware and manufacturer's literature or specification for glass.

Fabrication of wooden doors/windows shall not start until the Engineer approves the Shop Drawings.

Samples

Within 35 days (or as may be specified otherwise) following the Contract is awarded, the Contractor shall furnish the Engineer, for his approval, a complete list in 4 copies of all hardware proposed for use under the Contract, scheduling all hardware for every door/window.

The Contractor shall submit to the Engineer two pieces of wood specimens, each of size 150mm x 250mm x 25mm, for his approval. The Contractor shall submit to the Engineer one sample of each type of finished hardware for doors and windows for his approval. However, the hardware shall be of the quality equal to or better than the samples, if available in the Engineer's office.

The Contractor shall submit to the Engineer two pieces of glass sample, each of size 150mm x 200mm and of required thickness proposed for glazing for his approval. The samples shall bear the name of the manufacturer, thickness and the type of glass.

All approved samples may be kept at Site for comparing the materials supplied by the Contractor.

The works of this Sub-section shall not commence until the samples get approval of the Engineer.

3.3.9 OTHER REQUIREMENTS

Dimensions shown on the Drawings are finished dimensions. In sizing rough components, necessary allowance, therefore, must be kept for the working loss arising from planning, smoothening and finishing.

Requisite precautionary measures against fire, denting, breakage or loss must be ensured while the articles are in transit and till the supply is completed.

Polishing or painting, as the case may be, shall be done at Site on receiving approval of the woodwork, carpentry etc. by the Engineer. The working area shall be cleaned properly before the finishing works start and subsequently before each day's work to ensure reasonably dust-free surroundings.

Particulars of the workshop, working area and storage space must be furnished to the Engineer, which shall be checked by him. If required, modifications shall be made as instructed by the Engineer to ensure proper atmosphere and amenities.

The Contractor shall provide adequate locked-up storage space. The Contractor shall replenish all lost or damaged hardware at his own expenses.

In case of inflicting injury to any part of the building/other works while installing, the Contractor shall

rectify the same employing proper workers of the trade and furnishing all requisite materials at his own expenses.
The Contractor shall keep the Employer indemnified against all charges, which may arise out of this Contract in case of procurement of timbers from local sources.

3.3.10 MATERIALS

Timber
General
Timber, only as specified on the Drawings and Bill of Quantities, shall be used. Timber used for woodwork shall be well seasoned, kiln dry containing not more than 8% to 12% moisture so as to ensure minimum tendency towards warping, shrinking and swellings. It shall be free from all defects, such as large or loose knots, saps, shakes, upsets, wane edge and twisted fibre. It shall also be free from all diseases such as decay, wet rot, dry rot, woodworms and white ant. Timber shall be finished to the exact dimensions shown on the Drawings or as directed by the Engineer. The pieces of wood shall be properly finished by planer and other tools before joining and the completed wood works shall be accepted by the Engineer before fixing those in position.
Wood for frame
High quality, well-seasoned Garjan, Jarul, Local Sal, Shilkarai/Chikrashi, Telsu and Teak Chambol or any other equivalent type of wood as approved by the Engineer, shall be used for frame work or any other related works required.
Wood veneered flash door shutter
Jack wood, Gamari and Chapalish wood, Teak Chambol wood and Chittagong Teak wood veneered flash door shall be used for door shutter or sash or any other related works required. Any other equivalent type of wood may be used when it is required by the Engineer.
Wood for solid door shutter
High quality Jack wood, Chittagong Teak wood, Gammari and Chapalish wood and Teak Chambol wood or any other equivalent type of wood, as approved by the Engineer, shall be used for solid door shutter or any other related works required.
Wood for panel door shutter
High quality Jack wood, Chittagong Teak wood Gammari and Chapalish wood and Teak Chambol wood or any other equivalent type of wood, as approved by the Engineer, shall be used for solid door shutter or any other related works required.

3.3.11 FINISH HARDWARE

3.3.12 MATERIALS AND FINISH

Two sets of complete list indicating the manufacturer's name, brand name, type, size and location of all hardware to be installed shall be submitted to the Engineer for his approval. No hardware shall be ordered until the Engineer has approved this list.
Unless otherwise specified on the Drawings and in the Bill of Quantities or directed by the Engineer, specifications of the finish hardware shall be as follows:
Door hinges
Hinges shall be locally available, best quality iron or brass hinge of 100mm size and attached with No. 8 steel screw 32mm long, as approved by the Engineer or as directed by him.
Door stopper
Door stopper shall be made of timber as specified previously in the relevant portion of this Sub-section and shall be 100mm long to act as a stopper to keep the door in open position. Cleat with 65mm steel hinge, "Lion" brand or approved equal shall be fixed with No. 6 steel screws 20mm long, "Diamond" or "Star" brand or equal standard approved by the Engineer or as directed by him. One cleat to be furnished for each leaf as approved by the Engineer.
PVC buffer block
PVC buffer block shall be locally available best quality PVC block 38mm diameter and attached to wall

with No.8 steel screw 50mm long, “Diamond” or “Star” brand or approved equal or as directed by the Engineer. One block to be furnished for each leaf as approved by the Engineer.

Door handle

Door handle shall be locally available best quality chromium or nickel plated 150mm long, attached with No.7 steel screw 25mm long or as directed by the Engineer. Two handles to be furnished for each door, one inside and one outside as approved by the Engineer.

Door tower bolts

Door tower bolts shall be locally available best quality 250mm and 200mm brass or iron bolts fitted on the interior side of the door leaf. 250mm long bolts shall be fitted at the top of the leaf vertically and the 200mm long bolts shall be fitted at the bottom of the door leaf horizontally. The 250mm and 200mm tower bolts shall be fitted with No. 6 brass screw 20mm long and as approved by the Engineer.

Hatch bolt

Hatch bolt shall be locally available best quality brass or iron bolt 300mm long fixed with approved bolts and nuts fitted on the outside of the door for locking arrangement as per direction of the Engineer.

Window hinge

Window hinge shall be locally available best quality 100mm iron hinge, “Lion” brand or approved equal, 75mm x 50mm in size and fixed with No. 7 steel screw 25mm long “Diamond” or “Star” brand or approved equal or as directed by the Engineer. Three hinges shall be furnished per window.

Window handles

Window handles shall be locally available best quality Chromium plated 100mm long, “Lion” brand or approved equal or as directed by the Engineer. One handle shall be furnished for each leaf at the centre on the inside.

Windows catch hook

Window catch hook shall be locally available best quality, “Diamond” brand or approved equal, galvanized iron 225mm long or as directed by the Engineer. One catch hook shall be furnished for each leaf.

Window tower bolt

Window tower bolt shall be locally available best quality iron, “Diamond” brand or approved equal. Tower bolts 150mm long be fitted on the interior side of the window leaf. Tower bolts shall be fixed with No. 5 steel screw 20mm long, “Diamond” or “Star” brand or approved equal or as directed by the Engineer and fixed vertically one each at the top and bottom on the interior side of the leaf to close the window from inside.

Glass

All glass shall be the approved best quality locally available sheet glass unless otherwise specified and shall be of the various sizes and thickness as shown on the Drawings and Bill of Quantities. All glass shall be free from bubbles, distortion and flaws of every kind with even surface and free from all other imperfections. Each piece of glass shall bear a label indicating the name of the manufacturer, the thickness and the type of glass. Label shall remain on the glass till they are cleaned finally on completion of work.

Lock sets

All Lock sets shall be of the best quality ‘Yale’ brand door lock or approved equal in perfect operating conditions or as directed by the Engineer, if not shown on the Drawings or mentioned elsewhere. Strikes shall be used where required to protect trim from being marred by hatch bolt. Three keys shall be furnished with proper identification for each lock set.

3.3.13 JOINERY

Joints shall be made according to the sizes and profiles as shown on the Drawings.

No extra nails or screws, other than those used in the approved samples, shall be used. Nails and screws to be used on finished surfaces shall be fitted slightly below the surface. Polyvinyl acetate adhesive of ‘Aica Aibon’ brand or other equivalent brand shall be used where use of adhesive is required or instructed. Wooden pins, where required or instructed, shall be of the same specimen, perfectly round and pressure

fitted in the holes which shall be circular.
All joints shall be of such true-fit that they will not be discernible from a distance of one meter.
Layout of the joints shall be made by using accurate instruments. A knife can be used whenever a line is to be cut. A sharp pencil can be used for all layouts and specially when part of the area is to be cut away.
All measurements shall be made from a common starting point, edge or surface. All identical joints shall be laid out at the same time. Two members of each joint shall always be identified with a pencil mark for quick identification during assembling.
Right instrument or machine shall be used for each cut. The cut shall always be made just inside or outside the layout line. The joints shall be trimmed out with a router plane or chisel when necessary.
Proper type of clamping devices shall be used for assembling the joint. A trial assembly shall be made to make sure that each joint shall fit properly. A correct method of fastening shall have to be determined. The same shall be completely square and aligned when properly assembled.

3.3.14 GLUING UP

The stock shall be glued together where necessary. The glue shall be of 'Aica Aibon' brand Polyvinyl-acetate emulsion adhesive or its equivalent quality. The grain of all the pieces shall run in the same direction. The edge of gluing stock shall be of the same maturity and strength.
Good glue must develop the full strength of the wood under all condition stress. To obtain this result, it is necessary to control the gluing operation as well as the condition of the material. The moisture content before gluing shall not be too low or too high.
The average moisture content of wood is about twelve percent. High quality glue joints can not be made on wet wood. The moisture content of timber shall be checked through each step of manufacturing preferably with an electrical Moisture Meter. The following points must be checked in order to ensure proper gluing:

i. Parts of the assembly are at proper moisture content and temperature.
ii. Gluing surfaces have been made smooth, free from irregularities and even as much as possible.
iii. All joints have been placed under equal pressure.
iv. Excess glue has been removed before machining.

3.3.15 FABRICATION AND INSTALLATION

All materials and finish shall get the approval of the Engineer before they are installed. All hardware and accessories shall be purchased in the manufacturer's original packages complete with all required trimmings. They shall conform to the requirements of the specifications and no substitution shall be made for the samples submitted without prior approval of the Engineer. Required templates shall be submitted for proper installation.
All wood works shall be fabricated and installed in a way to conform to the details and dimensions indicated on the Drawings in the Bill of Quantities and as directed by the Engineer.
All hardware and accessories shall be of best stainless and non-corroding variety of screws, bolts, nuts and other fastenings and approved by the Engineer before attaching them. These shall be of the same finish as the material, which they attach and shall be of the type and standard of the manufacturer.
All items of finish hardware and accessories shall be carefully fitted and adjusted to ensure smooth operation. All items of finish hardware and accessories shall be in perfect operating condition and undamaged while installing.
Door/window frames shall be properly cut, housed together and jointed with 'mortice' and 'tenon' joints. The frames shall be rabbeted on one side by a cut measuring 13mm in one direction and the full thickness of the shutter in the other. Frames shall be plumbed and leveled with corners at right angles. All exposed surfaces shall be smoothened with sandpaper. Back faces of wood, remaining in contact with or against concrete or masonry, shall be treated with a minimum of two coats of wood preservation paint, such as creosote or solignum. Wood preservatives, to be used, shall be approved by the Engineer.

The frame shall be fitted vertically in position true and plumb and fixed with clamps made with M.S. angle iron of size 375mm x 40mm x 6mm set in cement concrete within the masonry wall. There shall be six clamps for door frames and four clamps for window frames in general. However, the number and the size of the clamps shall conform to the requirements of the Drawings and as specified in the Bill of Quantities. The clamps shall be fitted by filling the recess properly so as to fit the frame nicely with the wall.

Door sash shall be of panel design and made as shown on the Drawings. Panel-sash frame shall be housed and jointed with mortise and 'tenon' joints. Panels for doors shall be solid wood, placed properly in retaining grooves with 4mm gap between adjacent panels on all sides or as indicated/shown on the Drawings.

Door/window frames and door sash shall be approved by the Engineer on assembling and before installing in position.

All hardware shall be installed and all door/window assemblies shall be fitted properly with minimum clearances. Hinges shall be recessed flush with surrounding wood surfaces. All sash shall be tested for proper and smooth operation without hinge bind.

On completion of door/window installation, all wood surfaces shall be French polished or painted.

3.3.16 GLAZING

General requirements

All glazing work shall be performed in accordance with the typical glazing details shown on the Drawings. Joints and spaces, to be sealed, shall be thoroughly dried and made free from dust and other foreign materials before glazing. All glass shall be set with proper clearance as recommended by the manufacturer at all edges. Glass with nipped or damaged edges shall not be installed. Adjacent materials, which are solid, shall be cleaned immediately before the sealant and compound harden or stain the adjoining surfaces.

Glazing process

Glass to be cut to provide a clearance of 1.7mm to 3mm on all sides. A thin layer of sealant made of chalk, double boiled linseed oil and resin is to be applied to the frame surfaces coming in contact with the glass. The glass panes shall be fitted in to the rabbet not less than 20mm wide taking care to centre with equal clearance of jambs between glass and frame. The glass is next to be pressed firmly in to the place against the sealant. A bead of sealant is then to be laid in to the spaces between the glass and the frame. Sufficient sealant shall be applied so that when the stop is put in place, the sealant will be forced in to the gap between the glass and the stop and completely fill the space between the frame, glass and stop. The removal stop is then to be installed. The remaining space between the face of glass and stop shall be completely filled with sealant.

Cleaning

No glazing shall be considered complete until and unless paints and other stains have been removed from the surface of the glass. Glass must be cleaned and polished with pads of damp cloth and then with clean dry soft cloths. It will have to be finally finished with appropriate glass cleaning fluid and made absolutely free of foreign particles.

Defects and breakage

The Contractor shall replace any glass not conforming these specifications or having defects not admissible under the manufacturer's grading rules. The Contractor shall replace all glass, broken, cracked or chipped by his workers or by faulty installation or from any other cause. All glasses shall remain in perfect condition at the time of handing over of the building to the Employer.

3.3.17 MEASUREMENT

All wood door/window frames and assemblies completed, including all hardware installed in place, shall be measured in cubic meter for the specified section of the installed frame and accepted by the Engineer.

All wood door/window leaf and assemblies completed, including glass panes and all hardware installed in place shall be measured in square meter of the installed area and accepted by the Engineer.

3.3.18 PAYMENT

For all wood door/window frames, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per linear meter, which payment shall constitute the full compensation for furnishing all materials and assemblies, fitting and fixing the frames, filling the recess, painting, all tools and appliances and labour including storage, transport, providing scaffolding and other works as well as all incidentals necessary for completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.
For all wood door/window shutters including window glass panes, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials, hardware and assemblies, fitting and fixing the shutters/panes, all tools and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Subsection the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Wood door/window frame	Cubic meter / Cubic feet
Wood door/window shutters/panes	Square meter / Square feet

3.4 VENEERED PARTEX FIXED PANEL DOOR/WINDOW

3.4.7 DESCRIPTION

Works covered by this item shall consist of supplying and fitting fixing Gammari Veneered Partex Panel of the size and shape as shown on the Drawing or as directed by the Engineer including supplying and fixing of all necessary hardware and meeting all requirements as described under the Sub-section on the 'Wood Work for Door/Window Frames and Shutters'.

3.4.8 GENERAL REQUIREMENTS

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

3.4.9 OTHER REQUIREMENTS

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

3.4.10 MATERIALS

Gammari Veneered Partex door/window panel.

3.4.11 JOINERY

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

3.4.12 GLUING UP

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

3.4.13 FINISH HARDWARE

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

3.4.14 FABRICATION AND INSTALLATION

Same as stated under the Sub-section on 'Wood Work for Door/Window Frames and Shutters'.

3.4.15 MEASUREMENT

All Veneered Partex panel door/window and assemblies completed and all hardware installed in place shall be measured in square meter of the installed area. Only the works completed in accordance with the provisions of the BOQ, and/or as shown on the Drawings and/or as directed by the Engineer and accepted by the Engineer will be eligible for payment.

3.4.16 PAYMENT

For all Veneered Partex panel door/window and assemblies, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials, hardware and assemblies, fitting and fixing the panel, all tools and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Veneered Partex fixed panel door/window	Square meter / Square fee

3.5 ALUMINIUM DOORS, WINDOWS AND CURTAIN WALLS

3.5.7 DESCRIPTION

Works covered under this item shall consist of supplying and fixing aluminum products of various types and uses such as doors, windows, curtain wall, curtain rail, cladding/flushing of sills, window grills, etc. fitted with necessary hardware, glass (where required) and finished in accordance with applicable Drawings and specifications.

3.5.8 MATERIALS AND PRODUCTS

Doors, windows and curtain walls

Doors, windows, curtain walls etc. shall be of approved standard conforming to the U.S. Architectural Aluminium Manufacturing Association (AAMA) or approved equivalent specifications. The frames and such members shall be of extruded shape made of 6063-T5 high quality aluminum alloy having a minimum section thickness of 1.8mm unless otherwise shown on the Drawings or indicated in the Bill of Quantities and shall conform to the U.S. Architectural Aluminum Manufacturing Association or approved equivalent standard.

Fasteners, hardware and anchors

Fasteners, hardware and anchors shall be of aluminum or non-magnetic, non-corrosive material compatible with aluminum. All windows shall be provided with non-jamming latches of rocker type designed to be locked from inside. Window locks shall be ‘flush type’ as manufactured by the Adams Rite Manufacturing Company of Glendale, California or any approved equivalent. The doors shall be provided with cylinder lock and suitable built-in-non-jamming latches and bolts.

Security locks shall be pin type ‘Mortice’ lock, 6 or 7 pins and adaptable to Master, Grand Master and Great Grand Master keys. Sliding windows and doors shall be fitted with adjustable sealed bearing sheaves of durable hydrated nylons or approved equivalent. Closer, push/pull and kick plates shall have to match with the frames. Any other necessary hardware to be incorporated in the works shall also match with the frame. Assembly and installation screws shall be of stainless steel. Doors, windows, curtain walls etc., to be installed with ‘Teflon’ injected expanding bolts and sills, shall contain adequate provisions for drainage. Head, sills and jamb members shall be comprised as single unit. Aluminum to aluminum contact between hardware parts or moving members shall not be permitted. Such contacts shall be properly insulated.

Glazing beads

Glazing beads shall be aluminum shape-in-interchangeable type.

Weather stripping

Weather stripping shall be of neoprene or silicon treated woven wood or any approved equivalent.

Joints

All joints shall be mechanically done square (telescopic) joints. No ‘Mitral’ joints and forced fitting shall be accepted. All units shall be fabricated at the factory with high dimensional accuracy. It shall be rigid and designed to permit complete weather stripping. In principle, the parts should be put together by self-tapping screws.

Surface finish
All exposed surfaces of aluminum members shall be factory finish and of substantially uniform appearance maintaining the "Architectural" standard.
All exposed surfaces shall be given a natural Anodic Oxide Hardcore coating of 15 micron in thickness and a density of 4 mg per square centimeter and a uniform colour tone conforming to the U.S. Architectural Aluminum Manufacturing Association or any other approved equivalent standard. The colour spectrum shall be an-lock. Finish of hardware shall match closely with the door/window/curtain wall finish.
Accessories
All accessories necessary for proper fixing and operation such as anchors, clips, fins, sub-frames, metal sills, mullion, covers, other trim, cleaning anchors, glazing beads, weathering and glazing strips, hardware and mechanical operators, etc. shall be supplied ready to set in place with the door, window, curtain wall units.
Steel or wood sub-frames shall be painted with Zinc Chromatic primer incase of steel and with wood preservative in case wood. Steel anchor shall be properly insulated from aluminum frame.
Sealant
Sealant shall be one part elastic compound of "Architectural" grade caulk and shall be in matching colour.

3.5.9 SHOP DRAWINGS

The Contractor shall prepare detailed design of all works involved in line with the Employers design and prepare Shop Drawings for the total works and submit to the Engineer for approval before factory fabrication starts. All exterior doors, windows and curtain walls shall be designed to withstand a wind pressure of 180 kg/cm2.

3.5.10 INSTALLATION

All units shall be assembled at Site under proper conditions, erected, fixed and glazed in place in strict conformity with the manufacturer's instruction. All cut-out operations for hardware preparation shall be made accurately and reinforced as required.
All doors, windows, curtain walls, etc. shall be set plumb, square, level and in exact alignment with surrounding works and shall be securely anchored ready for operation. All joints between the masonry opening and frames shall be caulked and sealed after installation of the frames. All installation works shall be done and finished in such a way as to ensure a free and smooth operation.
Abrasion or other injuries to the finished surfaces shall be carefully avoided. Cleaning should be accomplished with plain water or a petroleum type cleaning agent or with the manufacturer's recommended cleaning reagent. No corrosive reagent shall be used

3.5.11 MEASUREMENT

All aluminium door and window frame shutter with glass assemblies complex including all hardware, installed in place shall be measured in square meter of the installed frame. Only the works completed in accordance with the provisions of the BOQ, and/or as shown on the Drawings and/or as directed by the Engineer and accepted by the Engineer will be eligible for payment.

3.5.12 PAYMENT

For all aluminium door and window frame shutter with glass, the amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter, which payment shall constitute the full compensation for furnishing all materials and assemblies and hardware, fitting and fixing, all tools, accessories and appliances and labour including storage, transport, and providing scaffolding and all other works as well as all incidentals necessary for satisfactory completion of all works as per specifications and requirements described under this Subsection the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Aluminium door, windows and curtain walls	Square meter / Square feet

3.6 LIME

Lime shall be stone lime of good quality high calcium lime containing calcium oxide from 95% upwards. The impurities, insoluble in acids, should not exceed 3% for the quick lime and 1% for the hydrated lime. Limes shall conform to the requirements of ASTM C 5 for quick lime and ASTM C 207 for hydrated lime.

3.6.7 STORAGE AND HANDLING OF LIME

Quicklime shall be slaked as soon as possible. If not possible, it may be stored in compact heaps having only the minimum of exposed area. The heaps shall be stored on a suitable platform under a roof protected from rain and wind. A minimum space of 300mm shall be provided all round the heaps to avoid bulging of walls.
Un-slaked lime shall be stored in a watertight place and shall be separated from combustible materials. Hydrated lime shall be supplied either in containers or sacks, such as jute bags lined with polyethylene or high density polyethylene woven bags lined with polyethylene or craft paper bags. It shall be stored in a dry room to protect the lime from dampness and to minimize warehouse deterioration.
When dry slaked lime is to be used within a few days, it shall be stored on a covered platform and protected from rain and wind. It shall be kept in a dry airtight god own when immediate use is not required. However, it shall never be stored for more than two months.
Workmen, handling bulk lime, shall wear protective clothing, respirators and goggles. They shall be instructed for cleanliness as a preventive measure against dermatitis and shall be provided with hand cream, petroleum jelly or similar protectors.

3.6.8 WATER

Water shall be clean, fresh and free from organic or inorganic matter in solution or suspension in such amount that may impair the strength or durability of the concrete. Water shall be obtained from a supply, where possible. However, it may be taken from any other sources, only if approved. No water from excavation shall be used. Only water of approved quality shall be used for washing shuttering, curing of concrete and similar other purposes.
Water to be used in construction shall be stored in tanks, bottom and the sides of which shall be constructed with brick or concrete. Contact with any organic impurities shall be prevented.
The tank shall be so located as to facilitate easy storage and filling in, and supply for construction works and other purposes.

3.6.9 FILL

Materials for filling shall be uniform in character throughout and free from substances that by decay or otherwise may cause the formation of hollows or cavities or otherwise affect the stability of the filling. Earth filling shall be of selected materials obtained from the excavation or carted fine sand as approved by the Engineer. No soft chalk or clay or earth with a predominating clay content shall be used. Hard core shall be selected hard clean gravel, broken brick, broken concrete, broken or crushed stone, quarry waste or similar approved materials. Concrete for filling shall be to the proportions specified.

3.7 TIMBER

3.7.7 GENERAL

All timbers for temporary or permanent works shall be of best quality, sound, straight and wellseasoned. They shall be free from sap, defects, radial cracks, cup-shakes, large/loose/dead knots, or other imperfections and shall show a clean surface with cut.
Timber shall be stored in stacks on well treated and even surfaced beams, sleepers or brick pillars so as to be at least 200mm above the ground level. Members shall be stored separately in layers according to the lengths.
A space of 25mm shall be kept between the members. The longer pieces shall be placed in the bottom layers and the shorter pieces in the top layers. At least one end of the stack shall be in true vertical

alignment.
The recommended width and height of a stack are 1.5m and 2.0m respectively. Minimum distance between two stacks shall be 800mm.
The stacks of the timbers shall be protected from hot dry wind, direct sun and rain. Weights may be placed on top of the stacks to prevent wrapping of timber. Nails, metal straps, etc. attached to used timber shall be removed before stacking.

3.7.8 INSPECTION

All timbers shall be subject to inspection at Site piece by piece and shall be to the approval of the Engineer who may reject such timber as is considered by him to be under-specified. In the case of timber specified to be creosoted, the Engineer may reject such timber before or after creosoting, if specifications are not correctly followed. The Contractor shall provide all necessary labour for handling the timber during inspection free of charge.

3.7.9 WROUGHT FACES AND ALLOWANCES ON JOINER'S WORK

All joiner's works shall be wrought and finished with a clean, even and smooth face. Thickness shall be given to include 2mm for each wrought face in soft- wood and 1.5mm for hard wood.

3.8 MARBLE

3.8.7 MARBLE STONE

Marble shall be of Italian origin or equivalent and size as per Drawing having approved color and texture.

3.8.8 MARBLE CHIPS

Marble chips shall be white in approved color and shall be of size # 2-3 (retained on screens 6mm and 19mm mesh). The chips shall be of uniform color and texture and shall be made from white marble stone, a calcareous metamorphic rock, which is capable of being polished and have following properties:

compressive strength	562 - 844 kg/cm2
Specific gravity	2.72
Unit-weight	2563-2724 kg/m3

3.8.9 MARBLE DUST

Marble dust shall consist of finely grounded white marble stone and 90% shall pass sieve # 100.

3.10 FALSE WORK AND FORMS

SCAFFOLDING (FALSE WORK)
Scaffolding is defined to be any temporary structure required to support structural elements of concrete, steel, masonry, or other materials at the time of their construction or erection.
Plans, Drawings and structural calculations in details shall be submitted to the Engineer for approval, but in no case shall the Contractor be relieved of his responsibilities for results obtained by using this Document.
All scaffolding shall be designed and constructed to provide the necessary rigidity and strength to safely support all loads imposed and produced in the finished structure, the lines and grades indicated on the Drawings. The supports shall be designed to withstand the worst combination of self-weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads, together with all incidental dynamic effects caused by placing, vibrating and compacting the concrete. No harmful cracking should occur in the placed concrete. The Engineer may require the Contractor to employ screw jacks or hardwood wedges to take up any settlement in the formwork either before or during the placing of concrete.
All scaffolding, exceeding 20m or six storeys in height, shall be constructed of noncombustible or fire-retardant materials.
Scaffolding shall be founded on a solid base, which is safe against undermining, protected from softening and capable of supporting the loads imposed on it. Scaffolding which cannot be founded on a satisfactory

footing shall be supported on piling, which shall be spaced, driven and removed in a manner approved by the Engineer.
Horizontal and inclined bracings shall be provided for posts higher than 3m. Spans of beam bottoms shall be supported by posts with maximum 1m apart when steel is used and instructions from the manufacturer/supplier shall be strictly followed. Spacing of the props under beams shall consider the increased load and shall be posted closer than those under the floor slab.
Scaffolding can, in certain cases, be supported on structures already constructed. In that case, the Contractor shall submit in due time to the Engineer in writing all information on the loading from the scaffolding as requested. The Engineer shall consider the loading and submit his approval in writing.
Scaffolding shall be set to give the finished structure the camber shown on the Drawings or specified by the Engineer. If any weakness develops or the scaffolding shows undue settlement or distortion during construction, the work shall be stopped and any structure affected thereby shall be removed and the scaffolding shall be further strengthened before work is resumed. Suitable screw jacks, pairs of wages or other devices shall be used at each post to adjust scaffolding to grade.
All materials used in the construction of the scaffolding shall conform to the corresponding ASTM or BS Standards or any other equivalent International Standards. Material tests and certificates may be required by the Engineer. Examinations of welding may also be requested. Test loading of the scaffoldings may be requested for the determination of the flexibility and the strength. All expenses of the tests and examinations of scaffoldings shall be borne by the Contractor on non-reimbursable basis.
Scaffolds shall be made from strong bamboo poles, wooden posts, steel pipes or any other suitable materials. They shall be adequately tied to vertical members resting on firm floor. Strong ropes shall be used to tie up bamboo poles. In addition, cross-bracing with bamboo or wooden posts shall be provided along with ties or guys of steel wire or rod not less than 6mm in diameter.
Good, sound and uniform bamboo shall be collected in sufficient quantities for providing scaffolding, propping, temporary staging, ramp etc. The bamboos shall be free from any defects, firmly ties to each other and joints made smooth. Joining members only with nails shall be prohibited. Bamboos for vertical support shall not be less than 75mm in diameter and shall be straight as far as possible. Bamboos may be used as vertical support for up to a height of 4m, if horizontal bracings are provided at the centre. Splicing shall be prohibited.
After stripping the formwork, the bamboo posts shall be cleaned and stacked vertically in shade protected from rain and sun. Defective or damaged bamboo posts shall be removed from the Site.
Timber posts shall be used in supporting formwork upto a height of 6m. The posts shall not be less than 80mm in diameter at any place and shall spread to at least 150mm in diameter at the top. The timber posts shall be supported on timber planks at the bottom. Either the bottom or the top of the posts shall be wedged with a piece of triangular wood peg for easy removal. Adequate horizontal and inclined braces shall be used for all timber centering. All timber posts shall be carefully inspected before use and members with cracks and excessive knots and crookedness shall be discarded. The joints shall normally be made with bolts and nuts. No rusted or spoilt threaded bolts and nuts shall be used.
When steel scaffoldings are used, it shall be painted in a manner that no mark of corrosion shall appear on the permanent concrete structures.
The Engineer shall only select the type of scaffolding. Bamboo scaffolding will only be used, if agreed and allowed by the Engineer. All scaffoldings shall remain in place for a period, which shall be determined by the Engineer.
Scaffold shall be dismantled after use piece by piece. Holes in the wall shall be filled up with the same materials as that of the wall. Filled up holes shall have uniformity in texture and colour with the surrounding surface. Crash striking shall not be allowed.
Triangular wooden wedges shall be put under the posts for easy dismantling of the members. Timber planks or steel sheets shall be placed at a time below the vertical or inclined posts covering several posts.
Materials and joints in scaffolding shall be inspected from time to time both before and after erection for the soundness, strength, damage due to weathering etc. Inspections shall be made for spillage of material or liquids, loose material lying on the gangways and proper access to the platform.

The scaffold shall be secured to the building at enough places; no ties shall be removed. Warning sign, prohibiting the use of any defective or incomplete scaffold and working in bad weather and high wind, shall be posted in a prominent place. Inspections shall be made for the observance of these requirements.

3.11 DAMP PROOF COURSE

3.11.1 DESCRIPTION

Works covered under this item shall consist of constructing a layer of cement concrete with specified proportion and in required thickness with top surface painted with Asphalt/Coal tar.

3.11.2 MATERIALS

Cement

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C150 Type 1 or BS 12 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

Coarse aggregate

Coarse aggregate shall conform to the requirements of ASTM C 330.

Coarse aggregate shall be hard, durable, clean, free from dust and other deleterious material to be obtained by crushing 1st class/picked jhama bricks. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce a workable concrete of maximum density which has been considered to be 10mm down graded in this case.

Materials shall also conform to the requirements specified in the relevant Sub-section of the Section titled 'Construction Materials' of this Specification.

Fine aggregate

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of DPC and conform to the requirement of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on 'Construction Materials' of this Specification. Sand, to be used for Damp Proof Course, will be of FM normally not below 1.8 or as directed by the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

Asphalt

Asphalt shall conform to the requirements of ASTM D 312. Type-1 shall be used below ground and Type- 2 shall be used above ground.

3.11.3 CONSTRUCTION METHODS

25mm to below 40mm thick cement concrete mixture prepared with 1 part cement, 2 parts sand and 4 parts brick chips is to be installed following the procedures stated under the Section on 'Concrete Work' of this Specification. In case of DPC designed with a 40mm thickness, the cement concrete mixture may be prepared with 1 part cement, 1½ parts sand and 3 parts brick chips. Two coats of hot asphalt should be applied over the cement concrete when the concrete has been fully cured and dried. The surface to be damp-proofed shall be primed and thoroughly mopped with asphalt. When the first mopping of asphalt has set sufficiently, the entire surface shall be mopped with second coating of hot asphalt. Special care shall be taken to see that there are no skips in the coatings and that all surfaces are thoroughly covered. The asphalt used should not melt or soften in the hottest days and should not get squeezed due to pressure of the masonry over it.

All concrete surfaces, which are to be damp-proofed shall be reasonably smooth and free from foreign material that would prevent bond. The surface shall be dry and immediately before the application of the

primer, the surface shall be thoroughly cleaned of dust and loose materials.
The damp-proof course should be laid flush with the floor surface and should not be carried across doorways or other openings. The upper layer of cement concrete floors should be continued over such openings and should be laid at the same time as the floors. The asphalt or tar layer should be laid under the concrete at the openings. Where concrete is laid on bitumen or tar, the surface of the bitumen or tar must be sprinkled with dry sand.
The position of the damp proof course is also an important factor and it should be laid at such a height that it is above the normal level to which water splashes from the ground when it is raining. A damp proof course should not be less than 15cm above the highest level of the ground.

3.11.4 MEASUREMENT

Damp proofing shall be measured in square meter of the works completed in place, in accordance with the Specifications stated herein and/or with the provisions of the Bill of Quantities and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.11.5 PAYMENT

The amount of completed and accepted work as measured above shall be paid for at the Contract unit price per square meter. The payment shall constitute the full compensation for the cost of furnishing all equipment, materials, labour for preparation of concrete mixture and its casting, compacting, curing, including, asphalt painting including all storage, handling and transport and all incidentals necessary for the satisfactory completion of the damp-proofing as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Damp-proofing	Square meter / Square feet

3.12 SYNTHETIC ENAMEL PAINT

Works covered under this item shall consist of painting metallic surface or wooden surface where water proofing is required or the places as directed by the Engineer. Synthetic enamel paint of any approved brand and colour shall be used in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers. Painting shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

3.12.1 MATERIALS

Paint shall consist of ready-mixed synthetic enamel of approved type supplied in original sealed containers bearing the name of the manufacturer of the paint.
All painting materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.
Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

3.12.2 STORAGE OF MATERIALS

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.
Storage area shall be maintained in a neat and clean condition with surroundings protected from damage. Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.
Storage area shall be all time accessible to the Engineer.

3.12.3 CONSTRUCTION METHODS

General
Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of paints proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.
Colours And Samples
Colour scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.
For all painted finishes, samples shall be prepared as per direction of the Engineer on pieces of the same kind of material surface at least on an area of 150mm by 300mm. The finished sample shall be approved by the Engineer.
Protection
Drop cloths or other approved protection materials shall be furnished and laid on all areas where painting and finishing is being done so as to adequately protect floor and other places from all damages caused during the execution of the painting work.
SURFACE PREPARATION
For Metallic Surface
All metallic surfaces shall be prepared before application of paint.
For ferrous metal, the surfaces shall be cleaned by brushing with wire brush or sand paper to remove all rust, weld spatter an other foreign particles. Any grease and oil film shall be removed with a solvent, using a fine steel wood pad or a coarse cloth. All damages to shop coat caused by erection, repairing and cleaning shall be spot primed with the same materials used for the shop coat.
In case of galvanized metal, the surfaces shall be cleaned and dried. Any grease and oil film shall also be removed with a solvent, using a fine steel wood pad or a coarse cloth. It is considered that paint will adhere to galvanized iron if the surface is washed with vinegar or slaked lime and washing soda before painting.
In all cases manufacturer's instructions are to be strictly followed in preparing the surfaces to be painted.

Technical Specifications

For Wooden Surface

Wood, the surfaces, which are to be painted, shall be well seasoned and the surface to be painted shall be perfectly dry. The surfaces of woodwork to be painted or polished should be rubbed down perfectly smooth with medium and fine grade sandpaper. All rubbing to be done with the grain. Worked timber should be primed as soon as possible particularly on the cut end grain. New woodwork shall be knotted, primed and stopped before given coats of paint.

APPLICATION OF PAINT

Wooden And Ferrous Metallic Surfaces

The workmanship for painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before painting or finishing is started.

All paint shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Paint shall be worked into all corners and crevices. Materials shall be applied in strict accordance with the manufacturer's directions. In particular, no prepared paint shall be thinned by any methods except as directed by the manufacturer. All paint shall be thoroughly mixed before being applied.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior paints and interior paints respectively. Each coat shall be thoroughly dry before application of subsequent coat.

All natural finished woodwork, painted woodwork and painted metal shall be slightly sanded between coats using No.'00' sandpaper. The finished surface must be smooth, evenly leveled and free from brush marks.

Natural finished woodwork only shall be rubbed with fine sandpaper after the last coat has received the desired finish as per approved sample.

All woodwork for natural finish shall be sealed on the back and all surfaces, which will be concealed after erection with two coats of an approved transparent sealer prior to installation.

After being fitted by the Carpenter, all edges of the doors and windows shall be finished in the same way as the faces.

All exposed piping (except PVC), if specified shall be painted to match the adjoining wall surfaces where such wall surfaces are either glazed tile or painted.

Painting around finish hardware of other removable items already in place shall not be allowed.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during painting.

Galvanized Iron Surfaces

Galvanized iron should not be painted until it has been exposed to the weather for a year as paint adheres badly to new galvanized iron. If necessary to paint sooner, a coat composed of about 200 grams of copper acetate added to 5 litres of water, or 60 grams of muriatic acid added to a mixture of 60 grams each of copper chloride, copper nitrate and sal-ammoniac, dissolved in 5 litres of soft water, to which a small quantity of hydrochloric acid has been added, should be given. This will be sufficient for about a surface area of 250 square meter.

Completion

At completion of painting work, the Contractor shall remove any paint spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment

and other surfaces leaving these surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and the Contractor shall repaint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes. All rubbish and accumulated painting materials shall be removed from the premises.

3.12.4 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually painted with required quality in accordance with the provisions of the BOQ and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.12.5 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and paint and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Subsection the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Synthetic enamel painting	Square meter / Square feet

3.13 PAINTS AND PROTECTIVE MATERIALS

3.13.1 KNOTTING

Knotting shall be uniform dispersion of lac or suitable resin (natural or synthetic) in a suitable solvent. White lead paint shall be made from pure white lead in accordance with BS 239, mixed with fine boiled linseed oil, turpentine, dryers and pigments and strained free from skins and all extraneous matter before being pigments. If so used, the quantity shall not exceed 8% of the paint mixed ready for the brush. No other ingredient except the coloring matter will be allowed and the color shall be produced by using the least required amount of coloring matter. The proportions of the ingredients for the various coats shall be subject to the approval of the Engineer.

3.13.2 RED LEAD PAINT

Red lead paint shall be made from non-setting red lead in accordance with BS 217, thoroughly ground and well and freely mixed with approximately 15% of boiled linseed oil to give a paint with good covering power, bobby and adhesion. It shall be determined by tests to be made by the Contractor to the satisfaction of the Engineer. The Engineer may select samples of the paint for analysis after a sufficient quantity of the work about to be painted has been mixed.

3.13.3 LINSEED OIL PUTTY

Putty for stopping and glazing shall consist of whiting/chalk powder thoroughly ground with linseed oil to form a smooth paste, and shall conform BS 544.

3.13.4 VARNISHES/WOOD POLISH

The material is required to be clear and transparent and when applied shall on drying, give a glossy coating free from fun and specks. The composition of the varnish shall conform to the requirements of BS 274.

3.13.5 WHITE WASH

White wash shall be made from pure flat lime brought to the work in an un slaked condition. Water shall be added to this lime in a tub until the mixture is of the consistency of cream and shall be allowed to rest for a period of 48 hours. The mixture shall then be strained through an approved cloth strainer and 4 kg of

gum boiled with 12 kg of rice and a suitable quantity of blue shall be added per cubic meter of the mixture.

3.13.6 COLOUR WASH

Colour wash, where not of an approved proprietary brand, shall be made from pure selected fat lime as described above for white wash, to which shall be added and intimately mixed the necessary pigment to produce the tint specified. The pigment shall be to the approval of the Engineer.

3.13.7 OIL BOUND DISTEMPER

Oil bound distemper shall comply with BS 1053 Type-1 and shall be obtained from an approved manufacturer.

3.13.8 EMULSION PAINTS

Berger/ICI Emulsion Paints shall preferably be used but the Engineer may allow any other brands of equivalent standard subject to the production of appropriate test certificates and guarantees.

3.13.9 CREOSOTE

The Creosote is a paint used for preservation of timber. It shall be pure tar distillate of the best quality as obtained and sold under the trade name "'SOLIGNUM'. The 'SOLIGNUM' shall be clear so as not to mar the timber. Other brands equivalent to 'SOLIGNUM' may also be used, if only approved by the Engineer.

3.13.10 STORAGE AND HANDLING OF PAINT, VARNISHES, ETC

Paints, varnishes, lacquers and thinners shall be kept in properly sealed or closed containers. The containers shall be kept in a well-ventilated location, free from excessive heat, smoke, sparks or flames. The floor of the paint store shall have at least 100 mm thick loose sand on it.
Temporary electrical wiring and fittings shall not be installed in a paint store. When electrical lights, switches or electrical equipment are necessary to be stored or used in the same room, the room shall be designed in a way to reduce explosion risks.
Buckets containing sand shall be kept ready for use. A five-kilogram dry powder fire extinguisher conforming to accepted standards shall be kept at an easily accessible position close to the paint store.

3.14 PLASTIC PAINTING

Works covered under this item shall consist of painting plastered wall or ceiling surfaces or the places as directed by the Engineer. Synthetic resin emulsion paint of any approved brand and colour shall be used in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers. Painting shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

3.14.1 MATERIALS

Paint shall consist of ready-mixed synthetic emulsion resin base water-thinned approved products supplied in original sealed containers bearing the manufacturer's trade mark.
All painting materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.
Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

Storage Of Materials

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.
Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.
Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.
Storage area shall be all time accessible to the Engineer.

3.14.2 CONSTRUCTION METHODS

General

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of paints proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

Colours And Samples

Colour scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.

For all finished painting on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

Protection

Drop cloths or other approved protection materials shall be furnished and laid on all areas where painting and finishing is being done so as to adequately protect floor and other places from all damages caused during the execution of the painting work.

Surface Preparation

All surfaces to be painted shall be thoroughly cleaned of all grit, grease, dirt, loose materials, mortar drippings and the like. It is better that some soap is added in the wash.

The surface shall be given a thorough rub down to remove all loose materials and all cracks and surface irregularities shall be prepared with patching plaster and filler to obtain a smooth and even surface to the satisfaction of the Engineer. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Brush shall always be cleaned after use. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the first coat.

Voids and holes shall be filled after first the coat becomes dry by using filler compatible with the finishing specified and tinted, if required to camouflage repairs.

In the case of new cement plaster walls, a solution of 2 kg of zinc sulphate in 4 litres of water should be applied to the surface and when dry should be given a coat of pure raw linseed oil; or the surface can be treated with dilute sulphuric or hydrochloric acid (1 part acid to 50 parts water) and then washed down with water. Cares shall be taken to ensure that acids are added to the water and not water to the acids.

Application Of Paint

The workmanship for painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before painting or finishing is started.

All paints shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Paint shall be worked into all corners and crevices.

Materials shall be applied in strict accordance with the manufacturer's directions. In particular, no prepared paint shall be thinned by any method except as directed by the manufacturer. All paint shall be thoroughly mixed before being applied.

Each coat shall be thoroughly dry before application of subsequent coat.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior painting respectively.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.
Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.
The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during painting.

Completion

At completion of painting work, the Contractor shall remove any paint spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and the Contractor shall repaint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes. All rubbish and accumulated painting materials shall be removed from the premises.

3.14.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually painted with required quality in accordance with the provisions of the BOQ and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.14.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and paint and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Subsection, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Plastic painting on plastered surface	Square meter / Square feet

3.15 DISTEMPERING

Works covered under this item shall consist of distempering plastered wall or ceiling surfaces or the places as directed by the Engineer. Distemper of any approved brand and colour shall be used in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers.
Distempering shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

3.15.1 MATERIALS

Paint shall consist of approved ready-mixed distemper supplied in original sealed containers bearing the manufacturer's trademark.
All distempering materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals.
Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

Storage Of Materials

Materials and tools shall be stored in a single place at the Site as designated by the Engineer.
Storage area shall be maintained in a neat and clean condition with surroundings protected from damage. Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day's work. Every precaution shall be taken to prevent fire.
Storage area shall be all time accessible to the Engineer.

3.15.2 CONSTRUCTION METHODS

General

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of distemper proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

Colours And Samples

Colour scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.

For all finished distempering on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

Protection

Drop cloths or other approved protection materials shall be furnished and laid on all areas where distempering and finishing is being done so as to adequately protect floor and other places from all damages caused during the execution of the distempering work.

Surface Preparation

All surfaces to be distempered shall be thoroughly cleaned of all grit, grease, dirt, loose materials, mortar drippings and the like.

The surface shall be given a thorough rub down to remove all loose materials and all cracks and surface irregularities shall be prepared with patching plaster and filler to obtain a smooth and even surface to the satisfaction of the Engineer. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Brush shall always be cleaned after use. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from of marks before applying the first coat.

Voids and holes shall be filled after first the coat becomes dry by using filler compatible with the finishing specified and tinted, if required to camouflage repairs.

In the case of new cement plaster walls, a solution of 2 kg of zinc sulphate in 4 litres of water should be applied to the plastered surface and when dry should be given a coat of pure raw linseed oil; or the surface may be treated with dilute sulphuric or hydrochloric acid (1 part acid to 50 parts water) and then washed down with water. Cares shall be taken to ensure that acids are added to the water and not water to the acids.

Application Of Distemper

The workmanship for painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before distempering or finishing is started.

All distemper shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Distemper shall be worked into all corners and crevices.

Materials shall be applied in strict accordance with the manufacturer's directions. In particular, no prepared distemper shall be thinned by any method except as directed by the manufacturer. All distemper shall be thoroughly mixed before being applied.

Each coat shall be thoroughly dry before application of subsequent coat.

Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior painting respectively.

Each coat applied, must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for

inspection.
No exterior distempering shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.
Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.
The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during distempering.

Completion

At completion of distempering work, the Contractor shall remove any distemper spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and the Contractor shall repaint with distemper or retouch, as directed by the Engineer, any surface which does not comply with the requirements of these specifications or which has been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.
All rubbish and accumulated painting materials shall be removed from the premises.

3.15.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually distempered with required quality in accordance with the provisions of the BOQ and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.15.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and distemper and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Subsection, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Distempering plastered surface	Square meter / Square feet

3.16 WHITE WASHING

Works covered under this item shall consist of white washing on the plastered wall or ceiling surfaces or at locations as directed by the Engineer in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer. White washing shall be done in a manner to obtain an even, smooth finish without any mark of brush and joint.

3.16.1 MATERIALS

Limestone

Limestone is high calcium lime with about 6% material insoluble in acid, obtained by burning pure limestone or chalk in a kiln. Limestone shall be slaked as early as possible after it is burnt in a kiln. Stone lime should be stored in an enclosed space in large heaps and air excluded as far as possible. Un-slaked lime weighs 640 kilogram per cubic meter when fresh, increasing to about 800 kilogram per cubic meter after 10 days.

Shell lime

Shell lime is also high calcium lime with about 6% material insoluble in acid, obtained by burning seashells in a kiln.

Gum Arabic

This is a kind of glue used as a binding agent between the white wash and the plaster surfaces.

Robin Blue

Robin blue is a kind of manufactured ready-made blue available in packets from reputed manufacturer. This is required for maintaining the whiteness of the wash.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

3.16.2 CONSTRUCTION METHODS

Samples

White washing scheme shall conform the Finish Schedule and as directed by the Engineer. All matching shall be to the satisfaction of the Engineer.

For all finished white washing on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be washed. The finished samples shall be approved by the Engineer.

Protection

Drop cloths or other approved protection materials shall be furnished and laid on all areas where white washing is being done so as to adequately protect floor and other places from all damage caused during the execution of the distempering work.

Preparation Of White Wash

The lime shall be brought to the Site in an un-slaked condition and thoroughly slaked on the spot, mixed and stirred with sufficient water and requisite amount of blue and gum to make a thin cream and allowed to stand for 24 hours. If 4 grams of gum (or shellac) and 50 grams of common salt dissolved in hot water are added to 1 kilogram of limestone for the last coat, the white wash will not easily rub off. Indigo (blue) upto 3 grams per kilogram of lime dissolved in water is added and the wash stirred well.

The lime is placed 30cm deep in a drum or a tub with about 90cm of water and allowed to stand for about 24 hours or such longer period as may be necessary to slake the lime completely. It is better to add lime to the water and not water to the lime. The mixture should be well stirred.

Lime is considered to be completely slaked when the temperature of the lime and the water ceases to rise and any further addition of water also produces no further chemical action or heat. As a precaution, water should be allowed to stand on for 12 hours or more. A vigorous slaking with heat and noise indicates a high calcium content. After slaking, the lime should be screened through a 3.35mm sieve or kept in excess of water to meet the requirements. Limes must be thoroughly slaked which is also ground very fine. Any un-slaked particles left will produce "blisters".

Application Of White Wash

The workmanship for white washing shall be of high quality. Experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before washing or finishing is started.

The lime wash should be strained through a course cloth or sieved through a fine wire gauge before applying.

All white washing shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. White washing shall be worked in to all corners and crevices.

The coats shall be applied alternatively vertically and horizontally. One stroke is given from the top down- wards and the other from the bottom up-wards over the first stroke and similarly, one stroke from the right and another from the left over the first brush before it dries. Each coat shall be let to dry before applying the next coat.

White wash shall be applied on surfaces in two coats over a priming coat. The final coat shall be applied vertically and finished surface shall be free of dust, dirt and must be free from brush marks. The finished dry surface shall not readily come off on the hand when rubbed.

Brush shall always be cleaned after use.
Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.
Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other works while applying white wash. Any damage, stains or spots caused by white washing shall be rectified and removed at the expenses of the Contractor.
Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.
No exterior washing shall be done in rainy and damp weather until the surfaces are thoroughly dry. No interior washing shall be done on damp surfaces.
Each coat shall be thoroughly dry before application of the subsequent coat.
Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior washing respectively.
The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during white washing.

Completion

At completion of white washing, the Contractor shall remove any wash spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and the Contractor shall rewash or retouch any surface, which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.
All rubbish and accumulated painting materials shall be removed from the premises.

3.16.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually white washed with required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.16.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and all white washing materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub- section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
White washing	Square meter / Square feet

3.17 CEMENT PLASTER & POINTING

3.17.1 12MM THICK CEMENT-SAND PLASTER ON BRICK MASONRY WALL

3.17.1.1 DESCRIPTION

This item of work shall consist of making 12mm or 19 mm thick cement plaster on Block masonry wall surfaces and at any other appropriate locations in cement mortar with specified proportion. The Work shall consist of furnishing all materials, its transportation and storage, supply of all labors, tools and equipment and the performance of all other allied works that would be required to complete the Work in

all respect. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

3.17.1.2 MATERIALS

Cement

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

Fine aggregate

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of plastering and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other deleterious substances and shall not contain any visibly solid materials. All requirements shall be similar to what have been stated under the relevant Sub-section of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification. The Contractor shall get the water tested by comparing with water of known satisfactory quality, if requested by the Engineer.

3.20.1.3 CONSTRUCTION METHODS

Preparation of mortar

Unless otherwise specified on the Drawings or in the BOQ or instructed by the Engineer, cement mortar for plaster works on block masonry walls shall consist by volume of one part Ordinary Portland cement and six parts screened sand of specified F.M. In each mortar, requisite quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use.

Mortar shall be used whilst freshly mixed and no softening or re-tampering will be allowed. Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform. Cement and sand shall be first mixed dry in the required proportion to obtain a uniform color of the mixture. Water shall then be added sparingly, only to the minimum as would be necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after water is added. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of adding water at the time of initial mixing.

Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.

Preparation of surface

Before application of plaster, all joints in brick masonry walls shall be adequately raked out with a hooked tool made for the purpose whilst the mortar is still green and not later than 48 hours of the time of lying and smooth concrete surfaces shall be roughened to provide key. Joints should not be raked out with a trowel or a hammer to avoid the edges of the bricks getting chipped. The brickwork should be brushed down with stiff wire brush so as to remove all loose dust from the joints. Surfaces to be rendered shall also be scrubbed clean of all loose materials and be made free from all dust, grease, etc. and be well wetted with water and kept dampen for 24 hours before applying plaster (the walls should not be soaked

but only damped evenly). On old walls it would be required to ensure a good key for the new rendering, to destroy the smooth surface of the brick masonry work with appropriate tools.
Application of plaster
Plaster shall consist of two coats when applied over brick masonry i.e. under and finish.
The under and finish coats shall be applied without an interval. The undercoat shall have a minimum thickness of 6mm and shall be leveled with straight edge and scratched for key. The finish coat shall be troweled over with care and leveled with a straight edge to obtain a flat smooth surface. All edges and corners, unless otherwise shown on the Drawings, shall be rounded or chamfered as directed by the Engineer. All moulds shall be neat, clean and true to template.
Plaster shall be floated and troweled to a true and plumbed surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless the area is over 28 square meter or prior permission is taken from the Engineer for a deviation. Plaster shall be stopped only at corners, construction or expansion joints.
If any crack appears in the plaster or any part sound hollow when tapped, or found to be soft or otherwise defective after the plaster has dried, the defects shall be mended by cutting out and re- plastering at the Contractor's own costs. Such woks should not leave any visible impression on the places mended.
The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or vehicles used for transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.
All plastering works shall be placed only after all brick masonry surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.
The plaster shall not be applied during rain sufficiently heavy or prolonged to wash the mortar. Mortar already applied, but becomes diluted by rain, shall be removed and replaced at the expenses of the Contractor before continuing any further works.

3.20.1.4 SCAFFOLDING

The scaffolding shall be sound and strong enough to withstand all loads likely to be imposed upon it and subject to the Engineer's approval. Pole, going into the masonry should be at a place, which can be filled with a header brick. The holes, which provide resting space for horizontal members shall not be left in masonry under 1m in width or immediately near the skewbacks of arches. The holes left in the masonry work for supporting the scaffolding shall be filled, made good and to be properly finished with plaster.

3.20.1.5 PROTECTION AND CURING

All plasters shall be kept moist throughout the progress of work and protected for a minimum 10 days immediately following completion against harmful effects of weather by suitable covering. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the plaster.
On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All cares shall be taken so that the plaster surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed,

3.20.1.6 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface of the finished plaster works completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.20.1.7 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of plaster which price shall constitute full compensation for furnishing all materials including their transportation and storage, mixing of mortar, plastering surfaces and corners, rounding and/or chamfering preparing, cleaning and watering the surfaces to be plastered, watering and

protecting the plaster after completion, providing scaffolding and its erection and removal, all other works and all incidentals necessary to complete the Work as per requirements described under this item of work, the BOQ, as shown on the Drawings and/or as directed by the Engineer.

Item of Payment	Unit
12mm thick cement-sand plaster	Square meter / Square feet

3.20.2 12MM THICK CEMENT-SAND PLASTER ON R.C.C SURFACES

3.20.2.1 DESCRIPTION

This item of work shall consist of making 12 mm thick cement plaster on R.C.C surfaces and at any other appropriate locations in cement mortar with specified proportion. The Work shall consist of supply of all materials, labor, tools and equipment, carriage and the performance of all other allied works. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

3.20.2.2 MATERIALS

Cement

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

Fine aggregate

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of plastering and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other deleterious substances and shall not contain any visibly solid materials. All requirements shall be similar to what have been stated under the relevant Sub-section of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification. The Contractor shall get the water tested by comparing with water of known satisfactory quality, if requested by the Engineer.

3.20.2.3 CONSTRUCTION METHODS

Preparation of mortar

Unless otherwise specified on the Drawings, or in the BOQ or instructed by the Engineer, cement mortar for plaster works on R.C.C surfaces shall consist of one part Ordinary Portland cement and four parts screened sand of specified F.M. by volume. In each mortar, right quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use. Mortar shall be used whilst freshly mixed and no softening or re-tampering will be allowed.

Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform, Cement and sand shall be first mixed dry in the required proportion to obtain a uniform color of the mixture. Water shall then be added sparingly, only the minimum necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after water is added. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of

adding water at the time of initial mixing.
Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.
Preparation of surface
Before application of plaster, smooth concrete surfaces shall be roughened to provide key. The surfaces shall be scrubbed clean of all loose materials and soaked with water and kept dampen for 2 hours before plastering. A neat cement coat shall be applied on all concrete surfaces before application of plaster.
Application of plaster
Plaster shall consist of a grout application and a finish coat, when applied direct to concrete surface. The under and finish coats shall be applied without an interval.
All edges and corners, unless otherwise shown on the Plans, shall be rounded or chamfered as directed by the Engineer. All molds shall be neat, clean and true to template.
Plaster shall be floated and troweled to a true surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless the area is over 28 square meter or prior permission is taken from the Engineer for a deviation. Plaster shall be stopped only at corners, construction or expansion joints.
If any crack appears in the plaster or any part sound hollow when tapped or found to be soft or otherwise defective after the plaster has dried, the defect shall be mended by cutting out and replastering at the Contractor's own costs.
The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.
All plastering works shall be placed only after all R.C.C surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.
The plaster shall not be applied during rain sufficiently heavy or prolonged to wash the mortar when the works are carried out under open sky. Mortar already applied, but becomes diluted by rain, shall be removed and replaced before continuing the work at the expenses of the Contractor.

3.20.2.4 SCAFFOLDING

The scaffolding shall be sound and strong enough to withstand all loads likely to be imposed upon it and subject to the Engineer's approval. If any place is left out or the plaster gets damaged by resting of poles, the places shall be made plastered or repaired before/on removal of the scaffolding at the expenses of the Contractor.

3.20.2.5 PROTECTION AND CURING

All plaster shall be kept moist throughout the progress of work and protected for a minimum 10 days immediately following completion against harmful effects of weather by suitable covering when the location is exposed under the open sky. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the plaster.
On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All cares shall be taken that the plaster surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed.

3.20.2.6 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface of the finished plaster works completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.20.2.7 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of plaster which price shall constitute full compensation for furnishing all materials including their transportation and storage, mixing of mortar, plastering surfaces and corners,

rounding or chamfering preparing, cleaning and watering the surface to be plastered, watering and protecting the plaster after completion, providing scaffolding and its erection and removal, all other works and all incidentals necessary to complete the Work as per requirements described under this item of work, the Bill of Quantities, as shown on the Drawings and/or as directed by the Engineer.

Item of Payment	Unit
6mm thick cement-sand plaster	Square meter / Square feet

3.20.3 12MM THICK CEMENT - SAND SKIRTING/DADO

3.20.3.1 DESCRIPTION

This item of work shall consist of providing 12mm thick cement-sand plaster with neat cement finishing in skirting/dado on brick masonry wall surfaces and at any other locations where necessary in cement mortar with specified proportion. The Work shall include supply of all labour, materials, tools and equipment, carriage and the performance of all necessary works. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

3.20.3.2 MATERIALS

Cement

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or BS 12 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

Fine aggregate

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of plastering and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on 'Construction Materials' of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

3.20.3.3 CONSTRUCTION METHODS

Preparation of mortar

Unless otherwise specified on the Drawings or in the BOQ or instructed by the Engineer, cement mortar for skirting/dado works on brick masonry walls shall consists by volume of one part Ordinary Portland cement and four parts screened sand of specified F.M. In each mortar, requisite quantity of water shall be added and the components mixed and thoroughly incorporated together to give a workability, appropriate to its use. Mortar shall be used whilst freshly mixed and no softening or retampering will be allowed. Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform, Cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour of the mixture. Water shall then be added sparingly, only the minimum necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.

Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30

minutes after addition of water. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of addition of water at the time of initial mixing.
Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.
Preparation of surface
Before application of skirting/dado, wall plaster, if there be any, shall be removed along the floor to the required height and the joints in brick-walls shall be adequately raked out to provide key. The surfaces shall be scrubbed clean of all loose materials and soaked with water and kept damped for 24 hours before skirting/dado works start.
Application of skirting/dado
Skirting/dado shall consist of two coats i.e under and finish. The under and finish coats shall be applied without an interval to permit the undercoat to set.
The undercoat shall have a minimum thickness of 6mm and the total built-up thickness will be same as that of the plaster on the wall. A 3mm groove shall be formed where skirting/dado meets wall plaster.
The skirting/dado shall be installed flushed with the finished wall surface. The intersection with the floor shall be right-angled and the top of the skirting/dado shall be straight and sharp.
The under-bed shall be laid as uniformly as possible and allowed to become firm before scratching for key and subsequently allowed to become thoroughly dry before applying the second under-coat. A neat cement paste of 3mm thickness shall be spread evenly over the second coat and shall be steel troweled under firm pressure to produce a dense uniform smooth surface free from trowel marks.
The finish coat shall be troweled over with care and leveled with a straight-edge to obtain a flat smooth surface including neat cement finishing. All edges and corners unless otherwise shown on the Drawings shall be rounded or chamfered as directed by the Engineer. All moulds shall be neat clean and true to template.
Skirting/dado shall be floated and troweled to a true and plumbed surface and tested frequently during the progress of the work with a straight edge sufficiently long. There shall be no overlaps or construction joints in single unbroken surface unless the area is over 28 square meter or prior permission is taken from the Engineer. Skirting/dado shall be stopped only at corners, sieves, construction or expansion joints.
If any crack appears in the skirting/dado, or any part sound hollow when tapped or found to be soft or otherwise defective after the skirting/dado has dried, the defect shall be made good by cutting out and re-plastering at the Contractor's own costs.
When the skirting/dado is applied on the plinth wall, it shall be plastered up to 150mm below the ground level.
The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.
All skirting/dado works shall be placed only after all brick-wall surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.
The skirting/dado shall not be applied during rain sufficiently heavy or prolonged to wash the mortar. Mortar already applied, but becomes diluted by rain shall be removed and replaced before continuing the work at the expenses of the Contractor.

3.20.3.4 PROTECTION AND CURING

All skirting/dado shall be kept moist throughout the progress of work and protected for a minimum 10 days immediately following completion against harmful effects of weather by suitable covering. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the skirting/dado.
On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All cares shall be taken that the skirting/dado surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed.

3.20.3.5 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface of the finished skirttng/dado works completed in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.20.3.6 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of skirting/dado which price shall constitute full compensation for furnishing all materials, mixing of mortar, plastering surfaces and corners, rounding and/or chamfering, preparing, cleaning and watering the surface to be skirted, watering and protecting the skirting/dado after completion, all other works and all incidentals necessary to complete the Work as per requirements described under this item of Work, the BOQ, as shown on the Drawings and/or as directed by the Engineer.

Item of Payment	Unit
12mm thick skirting/dado	Square meter / Square feet

3.21 RULE POINTING ON BLOCK MASONRY WALL JOINTS

3.21.1 DESCRIPTION

This item of work shall consist of making v-grooved pointing in the joints of the block masonry wall surfaces and at any other locations where necessary in cement mortar with specified proportion. The Work shall include supply of all labor, materials, tools and equipment, carriage and the performance of all necessary works. All works shall be carried out in accordance with these specifications and conforming to the levels, dimensions and designs as shown on the Drawings, provisions of the BOQ and/or to carry out the Work following the directions of the Engineer.

3.21.2 MATERIALS

Cement

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C 150 Type 1 or BS 12 or equivalent standard and those stated under the Section on ‘Construction Materials’ of this Specification.

Fine aggregate

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of rule pointing and conform to the requirements of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on ‘Construction Materials’ of this Specification. Sand, to be used for plastering work, will be normally of F.M. 1.2 or as directed by the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on ‘Concrete Work’ and ‘Construction Materials’ of this Specification.

3.21.3 CONSTRUCTION METHODS

- **Preparation Of Mortar**

Unless otherwise specified on the Drawings or in the BOQ or instructed by the Engineer, cement mortar for rule pointing works on brick masonry wall joints shall consist by volume of one part Ordinary Portland cement and two parts screened sand unless otherwise required by the Drawings or instructed by the Engineer. In each mortar, requisite quantity of water shall be added and the components mixed and

thoroughly incorporated together to give a workability, appropriate to its use. Mortar shall be used whilst freshly mixed and no softening or re-tampering will be allowed.
Mortar shall be mixed in an approved mechanical mixer unless hand-mixing is specifically permitted by the Engineer and in a manner as to accurately determine and control the quantity of each ingredient in the mortar. The cement and sand shall be first mixed dry until thoroughly mixed before adding mixing water. If hand mixing is permitted, the operation shall be carried out on a clean watertight platform. Cement and sand shall be first mixed dry in the required proportion to obtain a uniform color of the mixture. Water shall then be added sparingly, only the minimum necessary to produce a workable mixture of normal consistency. The water cement ratio in no case shall exceed 0.50 by weight, or as directed by the Engineer.
Only a sufficient quantity of sand and cement shall be mixed with water that can be used within 30 minutes after addition of water. The adding of additional water to and re-tempering (cement mortar that stiffened because of evaporation of water), shall be permitted only within 30 minutes from the time of addition of water at the time of initial mixing.
Mortar that has taken initial set shall not be used in the work with or without addition of fresh materials.

- **Preparation Of Surface**

Before rule pointing, the joints in brick-walls shall be adequately roughened. The surfaces shall be scrubbed clean of all loose materials and soaked with water and kept damped for 24 hours.
Making rule points
Unless otherwise specified, mortar for rule pointing shall be prepared with one part of Portland cement and two parts of sand generally of F.M. 1.2. Lime in powder form passing 100 mesh in the proportion of 2% by weight of cement shall also constitute an ingredient of the mortar.
The methods and equipment used for transporting and placing mortar shall be such, as not to damage or delay the use of mixed mortar. All equipment and tools used for mixing or transporting mortar shall be kept clean and free from set mortar, dirt or other deleterious foreign substances.
When all brick walls surfaces including the joints are well prepared as described earlier, mortar of specified proportion shall be applied at the joints and finished in rule or concave pointing as mentioned in the 'BOQ' or indicated on the Drawings or directed by the Engineer. The concave pointing shall be done with the help of rebar's wooden template to prepare semi-circular pointing intruding inside the brick wall joints. The Contractor shall remain very careful in maintaining the type of pointing as asked for in the Contract.
All rule-pointing works shall only start when all brick-wall surfaces have been prepared satisfactorily in accordance with the specifications and the Engineer's instructions.
The rule pointing works shall not be undertaken during rain sufficiently heavy or prolonged to wash the mortar. Mortar already applied, which becomes diluted by rain shall be removed and replaced before continuing the work at the expenses of the Contractor.

3.21.3 SCAFFOLDING

The scaffolding shall be sound and strong enough to withstand all loads likely to be imposed upon it and subject to the Engineer's approval. Pole, going into the masonry should be at a place, which can be filled with a header brick. The holes, which provide resting, space for horizontal members shall not be left in masonry under 1m in width or immediately near the skewbacks of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

3.21.4 PROTECTION AND CURING

All works shall be kept moist throughout the progress of work and protected for minimum 10 days immediately following completion against harmful effects of weather by suitable covering. During hot weather, all finished or partly completed works shall be covered or wetted in such a manner as will prevent rapid drying of the plaster.
On completion of works, all visible surfaces shall be free from damage or debris and shall look clean. All

cares shall be taken that the plaster surfaces are not stained or coated as the work proceeds. No rubbing of the faces to remove coating shall be allowed.

3.21.5 RE-POINTING OF EXISTING BRICK MASONRY WORK JOINTS

The extent of re-pointing of existing brick masonry works shall be jointly surveyed by the Contractor and the Engineer at the start of the work and the location of all repairs needed shall be recorded and permanently marked in paint, The defective mortar shall be carefully removed from the joints and the joints shall be cleaned immediately prior to re-pointing. The re-pointing shall be done with cement mortar of specified proportion to full depth, penetration and trimmed flush with the face of the brick masonry works.

Cracks in the existing brick masonry works shall be treated in the same way. Defective materials shall be carefully removed and the cracks shall be filled with cement mortar of specified proportion.

3.21.6 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface of the brick masonry works with all joints have been finished by rule pointing in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.21.7 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter of brick masonry wall which price shall constitute full compensation for furnishing all materials, mixing of mortar, rule pointing of joints, cleaning and watering the surface to be rule pointed, watering and protecting the work after completion, providing scaffolding and its erection and removal, all other works and all incidentals necessary to complete the Work as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and/or as directed by the Engineer.

Item of Payment	Unit
Rules pointing of joints of brick masonry wall	Square meter / Square feet

3.22 COLOUR WASHING

Works covered under this item shall consist of colour washing on the plastered wall or ceiling surfaces or at locations as directed by the Engineer in minimum 3 coats in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer. Colour washing shall be done in a manner to obtain an even, smooth finish without any mark of brush and joint.

3.22.1 MATERIALS

Lime stone
Limestone is high calcium lime with about 6% material insoluble in acid, obtained by burning pure limestone or chalk in a kiln. Limestone shall be slaked as early as possible after it is burnt in a kiln. Stone lime should be stored in an enclosed space in large heaps and air excluded as far as possible. Un-slaked lime weighs 640 kilogram per cubic meter when fresh, increasing to about 800 kilogram per cubic meter after 10 days.

Shell Lime
Shell lime is also high calcium lime with about 6% material insoluble in acid, obtained by burning seashells in a kiln.

Gum Arabic
This is a kind of glue used as a binding agent between the white wash and the plaster surfaces.

Colour
Mineral colours, not affected by lime, shall be added to white wash instead of indigo (blue).

Water
Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on ‘Concrete Work’ and ‘Construction Materials’ of this Specification.

3.22.2 CONSTRUCTION METHODS

Samples
Color washing scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer.
For all finished color washing on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be washed. The finished samples shall be approved by the Engineer.

Protection
Drop cloths or other approved protection materials shall be furnished and laid on all areas where color washing is being done so as to adequately protect floor and other places from all damage caused during the execution of the distempering work.

Surface Preparation
All surfaces to be colour washed shall essentially be thoroughly cleaned through removing all grit, grease, dirt, loose materials, mortar drippings and the like. It is better that some soap is added in the wash.
The surfaces shall be given a thorough rub down with a brush or by rubbing with an old gunny bag to remove all loose materials. All holes, cracks, surface irregularities and minor repairs shall be made good with patching plaster and lime putty to obtain a smooth and even surface to the satisfaction of the Engineer. Lime putty is obtained by slaking lime with water and sifting it. The filler shall be let dry for 24 hours before colour washing. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.
The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the prime coat.

Technical Specifications

In the case of new cement plaster walls, a solution of 2 kg of zinc sulphate in 4 litres of water should be applied to the plastered surface and when dry given a coat of pure raw linseed oil; or the surface may be treated with dilute sulphuric or hydrochloric acid (1 part acid to 50 parts water) and then washed down with water. Cares shall be taken to ensure that acids are added to the water and not water to the acids.

Preparation Of Colour Wash

The lime shall be brought to the Site in an un-slaked condition and thoroughly slaked on the spot, mixed and stirred with sufficient water and requisite amount of colour and gum to make a thin cream and allowed to stand for 24 hours. If 4 grams of gum (or shellac) and 50 grams of common salt dissolved in hot water are added to 1 kilogram of limestone for the last coat, the colour wash will not easily rub off. Mineral colour in requisite quantity per kilogram of lime dissolved in water is added and the wash stirred well.

The lime is placed 30cm deep in a drum or a tub with about 90cm of water and allowed to stand for about 24 hours or such longer period as may be necessary to slake the lime completely. It is better to add lime to the water and not water to the lime. The mixture should be well stirred.

Lime is considered to be completely slaked when the temperature of the lime and the water ceases to rise and any further addition of water also produces no further chemical action or heat. As a precaution, water should be allowed to stand on for 12 hours or more. A vigorous slaking with heat and noise indicates high calcium content. After slaking, the lime should be screened through a 3.35mm sieve or kept in excess of water to meet the requirements. Limes must be thoroughly slaked which is also ground very fine. Any un-slaked particles left will produce “blisters”.

Application Of Colour Wash

The workmanship for colour washing shall be of high quality. Experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before washing or finishing is started.

The colour wash should be strained through a course cloth or sieved through a fine wire gauge before applying.

All colour washing shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Colour washing shall be worked in to all corners and crevices.

The coats shall be applied alternatively vertically and horizontally. One stroke is given from the top down- wards and the other from the bottom up-wards over the first stroke and similarly, one stroke from the right and another from the left over the first brush before it dries. Each coat shall be let to dry before applying the next coat.

Colour wash shall be applied on the surfaces in two coats over a prime coat. The prime coat for the colour wash shall be of white wash with lime or with whiting. The final coat shall be applied vertically and finished surface shall be free of dust, dirt and must be free from brush marks. The finished dry surface shall not readily come off on the hand when rubbed.

In replacing one colour with another, a coat of white wash shall be given or the old paint scraped off, before the new colour is given. Gum or rice water shall be added as for white washing.

Brush shall always be cleaned after use.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other work while applying white wash. Any damage, stains or spots caused by colour washing shall be rectified and removed at the expenses of the Contractor.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior washing shall be done in rainy and damp weather until the surfaces are thoroughly dry.

No interior washing shall be done on damp surfaces.

Each coat shall be thoroughly dry before application of subsequent coat.
Drying time for every coat shall not be less than 72 hours and 48 hours for exterior and interior washing respectively.
The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during application of colour wash.

Completion

At completion of colour washing, the Contractor shall remove any wash spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and the Contractor shall rewash or retouch any surface, which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.
All rubbish and accumulated painting materials shall be removed from the premises.

3.22.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually colour washed with required quality in accordance with the provisions of the BOQ and/or shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.22.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and all colour washing materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub- section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Colour washing	Square meter / Square feet

3.23 COLOURED CEMENT PAINTING

Works covered under this item shall consist of applying coloured cement paint on the wall or ceiling plaster or at any other locations as directed by the Engineer. Cement paint of any approved brand and colour shall be used in minimum 2 coats over a coat of priming in accordance with these specifications as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers. Painting shall be done in a manner to obtain an even, smooth finish of confirm shade and without any mark of brush and joint.

3.23.1 MATERIALS

Cement Powder

Cement powder shall be manufactured of the best quality and of approved colour supplied in original sealed containers bearing the manufacturers labels and seals and be delivered at the Site.
Materials to be used in the work shall conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

3.23.2 CONSTRUCTION METHODS

General

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of cement powder proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

Samples

Coloured cement painting scheme shall conform the Finish Schedule and as directed by the Engineer. All tinting and matching shall be to the satisfaction of the Engineer. For all finished coloured cement painting on plastered masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

Protection

Drop cloths or other approved protection materials shall be furnished and laid on all areas where painting is being done so as to adequately protect floor and other places from all damages caused during the execution of the coloured cement painting.

Surface preparation

All surfaces to be painted shall essentially be thoroughly cleaned through removing all grit, grease, dirt, loose materials, mortar drippings and the like. It is better that some soap is added in the wash.

The surfaces shall be given a thorough rub down with a brush or by rubbing with an old gunny bag to remove all loose materials. All holes, cracks, surface irregularities and minor repairs shall be made good with patching plaster and lime putty to obtain a smooth and even surface to the satisfaction of the Engineer. Lime putty is obtained by slaking lime with water and sifting it. The filler shall be let dry for 24 hours before colour painting. The filler shall always be spread from the same face of the filling knife, the other face shall be kept clean and free. Filler shall be applied before priming and the surface shall be rubbed before the application to ensure clean work and again after application on allowing 12 hours to dry.

The plastered surfaces shall be made smooth by sand papering and made free from marks before applying the prime coat.

In case of any inconsistency with the manufacturer's instructions, the manufacturer's instructions shall prevail.

Preparation Of Paint

The paint shall be prepared by mixing and stirring coloured cement powder, sand/lime as per manufacturer's specifications and water in such quantities as will produce a mixture of the consistency of thin cream. When sufficiently mixed, the mixture shall be strained through a clean coarse cloth.

Application Of Paint

The workmanship for coloured cement painting shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be broom cleaned before washing or finishing is started.

All painting shall be applied with brushes under adequate illumination, evenly spread, smoothly flowed on without runs or sags. Painting shall be worked into all corners and crevices.

Painting shall be applied on the surfaces in two coats over a prime coat. The prime coat shall be of white wash with lime or with whiting. The coats shall be applied alternately vertically and horizontally. The final coat shall be applied vertically and finished surface shall be free from dust, dirt and must be free of brush marks. The finished dry surface shall not readily come off on the hand when rubbed.

In replacing one colour with another, a coat of white wash shall be given or the old paint scraped off, before the new colour is given. Gum or rice water shall be added as for white washing.

Brush shall always be cleaned after use.

Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other work while applying paint. Any damage, stains or spots caused by coloured cement painting shall be rectified and removed at the expenses of the Contractor.
Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.
No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.
Each coat shall be thoroughly dry before application of subsequent coat.
The washing shall be done with good hairbrush and not with brush made of jute.
Proper curing shall be done at least for 7 days on application of the final coat and/or as per instructions of the manufacturer. The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during application of paint.
In case of any inconsistency with the manufacturer's instructions, the manufacturer's instructions shall prevail.

Completion

At completion of coloured cement painting, the Contractor shall remove any paint spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and the Contractor shall repaint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes. All rubbish and accumulated painting materials shall be removed from the premises.

3.23.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually painted with required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.23.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and all painting materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities and/or as directed by the Engineer.

Item of Payment	Unit
Coloured cement painting	Square meter / Square feet

3.24 WATER REPELLENT PAINTING

Works covered under this item shall consist of applying two coats of clean silicon water repellent on exposed brick or concrete surfaces and cement rendered on wall, ceiling and at any other locations in accordance with these specifications, as per the provisions in the BOQ and/or as directed by the Engineer or as specified by the manufacturers.

3.24.1 MATERIALS

Silicon water repellent shall consist of sodium silicate or other alkaline silicates based clear approved product supplied in original sealed containers bearing the manufacturer's trade mark.
All silicon water repellent painting materials shall be of the best quality and be delivered at the Site in sealed original containers bearing manufacturer's labels and seals. Materials to be used in the work shall

conform to the reputed manufacturer's specifications and to the satisfaction of the Engineer.

3.24.2 CONSTRUCTION METHODS

General

Before purchasing materials, the Contractor shall submit to the Engineer a list showing the brand and type of silicon water repellent proposed for this item of work. Manufacturer's catalogue or specification sheets, in triplicate, for materials selected shall be submitted to the Engineer with the list of brands and types. No material shall be used without the approval of the Engineer.

Samples

For all finished silicon water repellent painting on masonry and concrete surfaces, samples shall be prepared as per direction of the Engineer on the surfaces to be painted. The finished samples shall be approved by the Engineer.

Protection

Drop cloths or other approved protection materials shall be furnished and laid on all areas where colour washing is being done so as to adequately protect floor and other places from all damages during the execution of the painting.

Surface Preparation

All surfaces to be silicon water repellent painted shall essentially be thoroughly cleaned by removing all grit, grease, dirt, loose materials, mortar drippings and the like.

The surfaces shall be given a thorough rub down with a brush or by rubbing with an old gunny bag to remove all loose materials. All holes, cracks, surface irregularities and minor repairs shall be prepared in such a manner so as to provide a smooth and even surface to the satisfaction of the Engineer.

Application Of Silicon Water Repellent Paint

The workmanship for silicon water repellent paint shall be of high quality and experienced and skilled painters shall be engaged for the work.

No work shall be done under conditions, which are not suitable for the production of good results. All spaces shall be neatly cleaned before painting or finishing starts.

All silicon water repellent paints shall be applied with brushes under adequate illumination, evenly spread and smoothly flowed on. Silicon water repellent paint shall be worked into all corners and crevices.

The application of water repellent coat shall strictly comply with the manufacturer's instruction. The application shall preferably be carried out after a period of dry weather and before application, the surface shall be thoroughly cleaned and dried. A heavy coat shall be applied evenly direct from the container by flooding the surface with a wide brush so that at least 6mm penetration is achieved. A second coat shall be applied in the similar manner, which shall follow after 24 hours.

Brush shall always be cleaned after use. Wherever scaffolding is necessary, it shall be free standing so as not to damage or scratch the painted surface.

Adequate precautionary measures shall be taken so as not to damage or stain floors, walls or any other work while applying the paint. Any damage, stains or spots caused by painting shall be rectified and removed at the expenses of the Contractor.

Each coat applied must be inspected and approved by the Engineer before the application of the succeeding coat. Otherwise, no credit for the coat applied will be given and the Contractor may require to repeat the work at his own expenses. The Contractor shall notify the Engineer when each coat is ready for inspection.

No exterior painting shall be done in rainy and damp weather until the surface is thoroughly dry. No interior painting shall be done on damp surfaces.

The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during painting.

Completion

At completion of silicon water repellent paint the Contractor shall remove any wash spot and stain caused during the whole process of works as stated under this Sub-section from floors, walls, glass, hardware, equipment and other surfaces leaving these surfaces in perfect condition.

The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection, and/or as per provision of the BOQ and the Contractor shall re-paint or retouch, as directed by the Engineer, any surface which do not comply with the requirements of these specifications and/or the provisions of the BOQ or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from all defects and blemishes.
All rubbish and accumulated painting materials shall be removed from the premises.

3.24.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually painted with silicon water repellent of required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.24.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport all silicon water repellent materials and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Sub-section, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Water repellent paint	Square meter / Square feet

3.25 VARNISHING

Works covered under this item shall consist of varnishing to the surfaces of wood works in three coats in accordance with these specifications, as per the provisions of the BOQ and/or as directed by the Engineer.

3.25.1 MATERIALS

Oil Varnish
This is a kind of varnish belonging to the class ‘Oil Varnish’. The essential constituent is ‘resin’ or rosin which is dissolved in oils, turpentine, or alcohol. Shellac, Gum Arabic, Rosin and Amber. Resins are most commonly used for preparation of varnishes. Various types of varnishes are obtainable in the market, each suited to a specific work. Preparation of varnishes is a difficult matter and it is best to purchase ready-made.

Storage Of Materials
Materials and tools shall be stored in a single place at the Site as designated by the Engineer.
Storage area shall be maintained in a neat and clean condition with surroundings protected from damage.
Inflammable materials shall be stored in sealed containers. Waste shall be removed from the premises at the end of each day’s work. Every precaution shall be taken to prevent fire.
Storage area shall be all time accessible to the Engineer.

3.25.2 CONSTRUCTION METHODS

Samples
Before starting full scale finishing work, sample finishing shall be done on similar wooden surfaces on an area of 300mm x 300mm and shall receive the approval of the Engineer.
Modifications, if required, in the above specimen shall be done depending on the outcome of sample work.
No payment will be made unless samples are made beforehand and approval of the Engineer is received for the same.

Surface Preparation
Wood, surfaces that would be varnished, shall be well seasoned. The surfaces to be varnished shall be perfectly dry.

Technical Specifications

The process of preparing the surfaces shall include removal of all machine and plain marks and defects that will make an imperfect surface. Unless the surface is perfectly smooth and free from defects, varnish shall not be applied. The following rules shall be maintained in preparing the wood surfaces.

ii. Before assembling the work, all marks shall be removed from the visible parts with a plane or cabinet scraper.

iii. All traces of glue from around the joints shall be removed.

iv. Defects, such as cracks and holes that can not be removed, shall be filled with stick shellac or its equivalent.

v. After the shellac or its equivalent hardens, it shall be placed down until it is nearly leveled with the adjoining surfaces.

The surfaces then shall be scraped and sanded thoroughly. Emery paper shall be used as abrasive. Four grades of abrasive paper shall be used successively in the order of No. 2, No. 1, No. 0 and No. 00. Sand papering shall be done with the grain. When thoroughly sand papered, the dust shall be brushed off with a stiff brush and inspected to see if the surfaces are free from all blemishes. It shall then be rubbed with a clean woolen rag.

Before application of varnish or painting, all articles shall receive inspection and approval of the Engineer.

Application

Type Of Finish

Unless otherwise specified wooden surfaces shall receive clear shellac varnish.

Finishing Materials

Fillers shall be White Zinc or natural paste fillers.

Sealers shall be of shellac wash coat. This is a mixture of seven parts alcohol to one part shellac, using Two-Pound-Cut shellac. Two-Pound-Cut shellac means that there are 1.8 kg of shellac mixed to 4.5 liters of alcohol.

Finish shall be done with a mixture of equal amount of alcohol and Four-Pound-Cut shellac.

Benzene shall be used as a cleaning fluid.

Application Method

Fillers made in the form of heavy paste by adding desired amount of turpentine shall be applied with a stiff brush, brushing first with the grain and then across it, covering only a small area at a time. It shall be allowed to dry for a few minutes until it loses its glossy appearance.

Excess fillers shall be wiped off across the grain with rough cloth. The surface shall then be rubbed down with the grain lightly with soft cloth to remove the excess. It should be pressed in such hardness so that the filler is not wiped off the pores.

Finishing shall be applied only after the filler has dried up.

Clean shellac varnish shall be applied with a good quality brush, 40mm to 75mm wide. Varnishing shall start near the center and top of a vertical surface or the middle of a horizontal surface, quickly brushing out in long sweeping strokes without going over the same area several times as shellac dries out vary rapidly.

Brushing should be done towards the edges and care should be taken not to allow the shellac to run over the edges and pile up. It shall then be allowed to dry for 3 to 4 hours. The surface shall be lightly rubbed down with No.00 dry abrasive paper along the grain.

Grit and dust shall be removed with soft cloth before applying the second coat with slightly reduced alcohol mixture. It shall then be allowed to dry and rubbed down lightly with No.00 dry abrasive paper along the grain.

Grit and dust shall be removed again before applying the third coat with 25 percent alcohol mixture.

After the last coat dries up, the surface shall be wiped out lightly with Benzene.

The workmanship for varnishing shall be of high quality for this purpose, experienced and skilled painters shall be engaged for the work.
No work shall be done under conditions, which are not congenial for the production of good results. All spaces shall be broom cleaned before varnishing or finishing starts.
All varnish shall be applied under adequate illumination. Varnish shall be worked into all corners and crevices.
The Contractor shall rectify at his own expenses any damage that may be caused to the adjacent works during varnishing.

Completion

At completion of varnishing work, the Contractor shall remove any varnished spot and stain caused during the whole process of works as stated under this Sub-section leaving the surfaces in perfect condition.
The Engineer shall conduct a final inspection of all works completed in accordance with this Subsection and as per provisions of the BOQ. The Contractor shall re-varnish or retouch, as directed by the Engineer, any surface which does not comply with the requirements of these specifications, as per provisions of the BOQ or which have been damaged during performing works. All surfaces finished under this Sub-section shall be left in perfect condition, free from defects and blemishes.
All rubbish and accumulated varnishing materials shall be removed from the premises.

3.25.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the surface area actually varnished with required quality in accordance with the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

3.25.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be paid at the Contract unit price per square meter which payment shall constitute the full compensation for furnishing all materials, equipment, appliances and labour including storage, transport, preparing, mixing and applying putty, primer and varnish and providing scaffolding as well as all incidentals necessary to complete the work as per specifications and requirements described under this Subsection, the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Varnishing	Square meter / Square feet

3.26 ROUGH CARPENTRY

3.26.1 GENERAL

RELATED WORK

- Architectural Wood Work
- Gypsum Board System

THIS SECTION INCLUDES

This Section specifies incidental rough carpentry required for support or attachment of other construction and not specified in other sections and includes, but is not limited to, the following items:

- Wood grounds, blockings, and nailers.
- Temporary and permanent grounds, blockings and supports required by other trades.

RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

- Wood grounds, nailers, and blocking.
- Wood furring.
- Wood sub-frames.

PRESERVATIVE TREATMENT

- Application is to be carried out after cutting and machining, but before assembly, by processor licensed by the treatment solution manufacturer
- Solution strengths and treatment by pressure, vacuum or immersion process are to be selected to achieve service life and to suit wood treatability.
- Moisture content of wood at time of treatment is to be as specified for use in the work.
- After treatment, allow wood to dry before use.
- For each batch of wood, provide certificate of assurance that treatment has been carried out as specified.
- Re-treat all treated wood which is sawn along the length, ploughed, thicknesses, planed or otherwise extensively processed.
- Treat wood surfaces exposed by minor cutting and drilling with two flood coats of solution recommended for the purpose by the treatment solution manufacturer.

SUBMITTALS

- Samples of all materials used in the work of this Section.
- Shop drawings for furring including details, sizes of wood sections, panel, spacing’s and method of attachment.

Technical Specifications

MDF (Fire Resistance)

- Medium density fibreboard's for fabric panels, 8-10mm thick.
- Strips of MDF around fabric panels edging.
- All MDF components to be fire resistant.

PLYWOOD

- Plywood: BS EN 636: Part 1, face grade for general use. Bonding is to be to BS 1203, type WBP for external use and type MR or INT for internal use.
- Marine Quality Plywood: to BS 1088 and BS 4079, excluding plywood made from gaboon.

CORK BOARD

Are to be pre-formed sheets that have been formed from clean granulated cork particles securely bound together by a synthetic resin of an insoluble nature. Minimum thickness of sheets is to be 25 mm (1"), width and length are to be as indicated on Drawings.

FASTNERS

- Nails: to BS 1202, Part 1, 2 or 3 generally, but non-ferrous types to Parts 2 or 3 for external use.
- Wood Screws: to BS 1210 generally, but non-ferrous types for external use.
- Self-Tapping Screws: to BS 4174.
- Dowels: mild steel, 10 mm (1/2") diameter, 100 mm (4") long, galvanized to BS EN ISO 1461 after fabrication.
- Cramps: mild steel, 25 x 3 x 250 mm (1" x 2/16" x 10") girth, turned up at one end and twice drilled for 3 mm (2/16") screws, fish-tailed at other end for building in and galvanized to BS 729 after fabrication.
- Plugs: either traditional hardwood plugs, shaped to twist and grip when driven, or proprietary fibre or plastics plugs, or other approved type.

TREATMENTS, ADHESIVE AND FINISHES

- Preservative Treatment: shall be type listed in BS 1282 (except coal tar creosote), obtained from an approved manufacturer, to give suitable protection against termites and other wood destroying organisms.
- Adhesive for Joinery: shall be close contact type to BS EN 301 or BS EN 302 suitable for the purpose. Obtain manufacturer's confirmation that adhesive is compatible with preservative treatment.

EXECUTION INSTALLATION

GENERAL

- Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- Apply field treatment to cut surfaces of preservative-treated lumber and plywood.
- Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
- Use hot-dip galvanized nails.
- Countersink nail heads on exposed carpentry work and fill holes with wood filler.

WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS

- Install wood grounds, nailers, blocking, and sleepers where shown and where required for scree ding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- Install permanent grounds of dressed, preservative-treated, key-bevelled lumber not less than 1-38 mm wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

WOOD FURRING

- Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- Firestop furred spaces of walls at each floor level and at ceiling with wood blocking or non-combustible materials, accurately fitted to close furred spaces.

Technical Specifications

- Furring to Receive Wood or Plastic Sheets or Boards: Install 19-by-63-mm actualsize furring at 600 mm o.c., horizontally and vertically. Select furring with no knots capable of producing bent-over nails and damage to paneling.
- Furring to Receive Gypsum Board: Install 19 (3/4")-by-38-mm (1½") actual-size furring at 400 mm (16") o.c., vertically.
- Furring to Receive Plaster Lath: Install 19 (3/4")-by-38-mm (1½") actual-size furring at 400 mm (16") o.c., vertically

3.27 TERMITE CONTROL

3.27.1 SCOPE

The work covered by this section of Specification consists of furnishing all labour, materials, equipmnt, services, miscellaneous and necessary items required to complete Termite Control and, related works as indicated on drawings, and specified herein, in strict accordance with this section of specifications, as subject to the terms and conditions of the Contract.

3.27.2 MATERIALS

i. Pesticides shall be 0.4% Termidor and/or as directed by the manufacturer, or solution of 0.5% Dieldrin or a 0.5% Aldrin, mixed in clean water for application in earth, and mixed in pure turpentine for application to wood.

ii. Pesticides (Dieldrin & Aldrin) shall be obtainable from the Government of Pakistan, Department of Agriculture, or other sources approved by Engineer in sealed drums at rates in force at the time of their acquisition and only in the quantity necessary for work of this Project. All mixing shall be done at site and the amount of pesticides used shall be verified by the Engineer

3.27.3 METHOD OF APPLICATION

Pesticides solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150, p.s.i. (10.5kg/cm 2) to all application to, on or in earth. Spraying to wood shall be done by hand compression with an approximate pressure of 20 p.s.i.

3.27.4 WORKMANSHIP

The treatment operation shall be carried out as follows:-

i. After the excavation for foundation trenches and pits is completed in each and every respect, and passed for concreting work, but before laying of concrete, Pesticide shall be penetrated to a depth of 1" (25 mm) ;minimum in porous earth at bottom and 2" (50mm) to 3" (75 mm) at sides of excavation.

ii. Stock piled excavated material to be used as back fill is to be treated as above. After backfilling to required grade the area is again to be sprayed.

iii. After grading, compaction and levelling of fill and before installation of any soling, all areas are to be sprayed with pesticide, penetrating a minimum of 1" (25mm) into soil.

iv. Pesticide solution shall be applied inside the building lines and for a distance of 10 feet (3 M) out side all building with specified pressure.

v. All rough wood work for the entire project is to be pesticide treated (before application of Soligum in the case of material to receive both treatments). Pesticide shall be sprayed on all surfaces of all the wooden work viz, door frames blocking, furring, planks,, boards etc, before installation. No spraying shall be necessary after field sawing, planning, joining or installation of such material. All spraying will be done within one week of working of the materials.

3.27.5 LOCATION AND SCHEDULING

i. Saturation of earth is to be done by adequate personnel and in such a manner as to in no way disrupt the progress of the work.

ii. Such work is to be scheduled and done by sufficient skilled personnel manner as to in no way impede the progress of the work.

iii. Care shall be exercised to ensure that no mark or damage occurs to the finished building as a result of the work under this section, and Contractor shall verify and ensure that no material used herein will impede the growth of grass or plants at areas where spraying is done.

3.27.6 STANDARDS

All methods of termite protections used herein be in accordance with best standard practices of National Pest Control Association, U.S.A. and the British Wood Preserving Association.

3.27.7 GUARANTEE

The Contractor is to guarantee that the building shall be free from termites (white ants), wood bores and other pests or rodents which cause damage to wood or other organic material for 10 years from the date of acceptance of the building.

In the event of any damage caused within the guaranteed period, the Contractor shall replace at his own cost such damage material, finishes affected and suitably preserve and treat the entire premises with the best method known to the trade to prevent the spreading of termites.

3.27.8 TESTING

All materials and samples shall be subject to testing in accordance with the relevant standards specified herein, and shall be rejected if found below these standards. Rejected materials shall be removed from the site immediately; Contractor shall quote a lump sum rate for the termite control testing and treatment of the ground and excavation covered by this specifications including all ditches, pits, excavations, wood etc., complete.

3.27.9 MEASUREMENT & PAYMENT

i. Unless otherwise specifically stated in the Bill of Quantities or herein, all the work involved within the scope of this section of specification shall be deemed to be inclusive of but not limited to the following:-

- CONTRACTOR's establishment charges, overhead charges, profit, interest.
- All other expenses, charges, taxes specified in the Conditions of CONTRACT.
- Labour and all costs in connection therewith.
- Use of plant, equipment and machinery and all costs in connection therewith, e.g. mobilizations, demobilization, transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand parking, removing, damaged, destroyed, salvaged.
- Material and goods, e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering cutting, joining fixing, wastage, destroyed, damaged, salvaged.

ii. The cost of all the works involved within the scope of this specification as per all the Drawings and Conditions of CONTRACT are covered only within the quoted lump sum rate of the item of the Bill of Quantities.

iii. No separate payment will be made for wood work etc. Covered under this section of the specifications, and all cost in connection therewith shall be included in the unit rates of the various items of the wood work affected by treatment

SECTION 3: ELECTRICAL WORKS

4.1 CONDUIT & PIPES

4.1.1 GENERAL

The work under this section consists of supplying, in¬stalling, and commissioning of all material and services of the complete conduit & pipe system as specified herein and/or shown on Tender Drawings and stated in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at site with other services for exact route, location and position of the electrical lines.

4.1.2 PVC CONDUITS

All wiring for light, power, control and other circuits shall be carried out in PVC pipe otherwise as stated in BOQ, minimum 25mm dia. The conduits and pipes shall be supplied complete with all accessories including bends, sockets, junction boxes of identical material as that of conduit and all cutting, repair, excavation backfilling, etc., required for complete installation. The conduits for internal wiring to lights, sockets and power circuit shall be of approved brand.

Manufactured smooth bends shall be used wherever conduit changes direction. The sharp 90 degree bends or tees shall not be allowed. All conduit accessories shall conform to same material specifications as given above for conduit.

The bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joints.

The round junction box for ceiling light points shall be of PVC having minimum dimensions of 63 mm diameter and 63mm deep. The outlet box at wall light points shall be general purpose type having minimum dimensions of 75mm x 75mm and 38 mm deep. Pull boxes and inspection boxes shall be installed in conduit runs where required to limit the pulling of the cables or for inspection purposes. The pull boxes shall be square having minimum dimension of 100mm and 50 mm deep. In all cases, the minimum length of inspection boxes shall be not less than four times the cable manufacturers recommended bending radius of the cable. These dimensions are minimum only and the Contrac¬tor shall determine the exact size keeping in view ease of maintenance and installation. In general the use of pull boxes and inspection boxes shall be avoided. The pull boxes and inspection boxes shall be of 16SWG. sheet steel provided with anti-rust paint and finished in gray enamel paint or orange powder coated paint. The face plate shall be secured to the box by means of flat head galvanized screw.

4.1.3 INSTALLATION

1. Conduits

The conduit shall be installed concealed in wall, column ceiling or under floor, on surface, above the false ceiling or as stated on the drawings. The drawings are diagrammatic and do not indicate the location of junction boxes, pull boxes or inspection boxes which shall be provided to suit site conditions. The concealed conduits shall have a minimum of 25 mm concrete cover, when concealed in R.C.C works. The conduits in R.C.C works shall be laid before pouring of concrete. Chisels shall not be made in R.C.C structure for conduits and accessories after pouring of concrete. In slab, conduits shall be laid over the bottom reinforcement steel and tied firmly to it. The conduit outlet boxes shall be held firmly to finish with the surface of the slab or beam. At expansions joints, flexible conduits or alternate arrangement shall be provided.

Where conduits have to be concealed in cement concrete work after concreting or in block masonry, chisels shall be made with appropriate tools and of required depth. The conduit shall then be firmly recessed and covered after plastering. All chisels for concealing conduits shall be carried out by the Contractor. The Contrac¬tor will be responsible for bringing back the general finish to the condition that it was before the cutting and chiselling by the Contractor.

The work of conduit installation and cutting in cement concrete work or brick work shall be coordinated with civil construction so as not to cause any undue hindrances and delays in progress. The Contractor shall obtain approval of the Consultant for route, etc. to suit the site conditions before starting chiselling and cutting. All junction boxes, outlet boxes, pull boxes etc., shall be installed concealed so as to finish with the surface.

Conduits installed on surface shall be fixed by means of black enamelled steel saddles and clamps having thickness of 3 mm or as mentioned in BOQ. The clamps shall be installed at a distance of not more than 600 mm.

All conduit bends shall be made with an approved conduit bending machine or hickory.

The radius of curvature of the inner edge of any bend shall not be less than the following table :

Conduit size	Radius
25 mm(1")	Not less than 150 mm.
32 mm (1-1/4")	Not less than 200 mm.
38 mm (1-1/2")	Not less than 255 mm.
50 mm (2")	Not less than 305 mm
70 mm (2-1/2")	Not less than 380 mm
82 mm (3")	Not less than 460 mm.
100 mm (4")	Not less than 610 mm

After completion of conduit in¬stallation, the system shall be checked for any charred or twisted portion prior to the pulling of wire. At all joints, PVC jointing solution or cement must be used.

The termination of conduits is shown diagrammatically on the drawings. The exact final location of the termination shall be coordinated with the equipment to be installed. Conduit ends pointing upwards or downwards shall be properly plugged, in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termina¬tion of conduit, soft bushes shall be fixed to prevent sharp edges of conduit ends from cutting or damaging the wires or cables to be pulled through them. Brass glands of appropriate sizes (as per size of conduit) with proper chuck nuts shall be used for fixing of conduits in junction boxes.

The entire conduit system shall be installed and tested before wiring is carried out. Any obstruction found shall be cleared by use of a cutting or other approved device and the conduit be cleaned out before the installation of cable.

4.1.4 OTHER ACCESSORIES

Outlet boxes, pull boxes, inspection boxes, switch and socket outlet boxes, fan regulator boxes, shall be of 16 SWG sheet steel, de-rusted, degreased, rust-proof with two coats of zinc chromate primer and painted with enamel, complete with earthing terminal. All boxes shall have ample wiring space, and boxes used outdoors shall be weather-proof.

All the pull boxes are to be properly labeled according to the type of services for which it is installed.

4.2 LED SURFACE MOUNTED PANEL LIGHTS

4.2.1 General Description

The LED Surface Mounted Panel Light is a high-efficiency lighting fixture designed for ceiling or wall mounting. It provides uniform illumination with low power consumption, long lifespan, and minimal maintenance. This 24-watt LED panel operates at 220-240V and is available in both round and square shapes, ensuring compatibility with various architectural and interior design requirements.

4.2.2 Material

- Panel Frame: Aluminum alloy, powder-coated for corrosion resistance
- Light Source: High-quality LED chips with a lifespan of 30,000–50,000 hours
- Diffuser: Frosted polycarbonate (PC) for glare-free light distribution

Technical Specifications

- Driver: Isolated LED driver with surge protection and efficient thermal management
- Mounting Bracket: Galvanized steel or aluminum for secure attachment

4.2.3 Job Conditions

- Ensure the electrical supply is within the specified range (220-240V, 50/60Hz).
- Confirm surface stability before installation (e.g., ceilings or walls should be structurally sound).
- Keep the installation area dry and free of dust or debris.
- Check for any obstructions in the ceiling or wall that may interfere with mounting.
- Adhere to safety protocols for electrical installations, including shutting off power before working..

4.2.4 Installation

- **Preparation**
  - Verify the LED panel specifications and ensure compatibility with the power supply.
  - Measure and mark the mounting positions for alignment.
- **Mounting**
  - Attach the provided bracket to the ceiling or wall using appropriate fasteners.
  - Ensure the bracket is level and securely fixed.
- **Electrical Connection**
  - Connect the LED driver to the main power supply (220-240V).
  - Ensure proper wiring using insulated connectors and confirm polarity.
  - Secure all electrical connections to prevent loose wiring.
- **Fixing the Panel Light**
  - Align the LED panel with the mounting bracket and snap it into place.
  - Check for a secure fit and ensure there is no movement.
- **Testing & Final Adjustments**
  - Turn on the power and verify the functionality of the LED panel.
  - Adjust positioning if necessary for uniform light distribution.
  - Ensure there is no flickering or loose wiring.

4.2.5 Adjusting & Final Alignment

- If the light intensity is uneven, adjust the panel alignment.
- In case of flickering, check and tighten electrical connections.

- Secure all mounting screws to prevent misalignment over time.

4.3 LED FLOOD SECURITY LIGHTS

4.3.1 General Description

The LED Flood Security Light is a high-efficiency, durable, and weather-resistant lighting fixture designed for outdoor security applications. It provides bright, wide-angle illumination with low power consumption and a long lifespan. This 30-watt floodlight operates on a 220-240V power supply and is built for reliable performance in various environmental conditions.

4.3.2 Material

- Housing: Die-cast aluminum with a corrosion-resistant powder-coated finish
- Light Source: High-lumen output LED chips with a lifespan of 30,000–50,000 hours
- Lens/Cover: Tempered glass with high light transmittance
- Reflector: Aluminum reflector with high-efficiency light distribution
- Bracket: Adjustable stainless steel or galvanized steel mounting bracket
- Driver: Isolated LED driver with over-voltage and surge protection
- Sealing: IP65 or higher rating for dust and water resistance

4.3.3 Job Conditions

- Ensure a stable power supply of 220-240V, 50/60Hz.
- The mounting surface should be strong enough to support the weight of the fixture.
- Verify that the installation location is free from excessive vibration or moisture intrusion.
- Keep the work area dry and clear of debris before installation.
- Follow all local electrical safety codes and regulations.

4.3.4 Installation

- **Preparation**
  - Inspect the LED floodlight for any damage before installation.
  - Identify the appropriate mounting height and angle for optimal coverage.
  - Turn off the power supply before making any electrical connections.
- **Mounting**
  - Secure the adjustable bracket to a wall, pole, or ceiling using appropriate anchors and screws.
  - Ensure the bracket is firmly fixed to withstand wind loads and vibrations.
- **Electrical Connection**

- Connect the LED floodlight wires to the main power supply (Live, Neutral, and Ground).
- Use waterproof connectors for outdoor installations.
- Ensure proper insulation and avoid loose wiring to prevent short circuits.

- **Adjusting the Light Angle**

  - Adjust the floodlight angle for optimal illumination using the adjustable bracket.
  - Tighten all screws to secure the desired position.

- **Testing & Final Adjustments**

  - Turn on the power and check the functionality of the LED floodlight.
  - Verify that the light covers the intended area effectively.
  - If needed, readjust the angle for better coverage.

4.3.5 Adjusting & Final Alignment

- If illumination is uneven, slightly adjust the mounting angle.
- Ensure all electrical connections are secure to prevent flickering or power loss.
- Periodically check the bracket and screws to prevent loosening due to environmental conditions.
- Clean the glass cover periodically for maximum light output.

4.4 CABLE TRAY & LADDERS

4.4.1 Scope of Works

1. Under this section of the specification cable tray shall be installed to support distribution cables, communication cables and all wiring cables not generally installed in conduit and or trunking.

2. The cable tray shall be installed in such a manner to enable easy access for cable installation.

3. The cable tray shall vary in type, i.e: where large cables are installed, ladder rack type cable tray shall be permitted. Where smaller type communication cables are installed, ventilated type cable tray shall be permitted.

4. Cable trays shall be Mild Steel Powder Coated finish or as specified in BOQ.

5. Cable ladders shall be installed in risers for the full length of the risers unless otherwise instructed by the Consultant.

4.4.2 QUALITY ASSURANCE

1. Acceptable Manufacturers

2. Subject to compliance with the requirements of the Contract Documents, acceptable manufacturers are to be firms regularly engaged in manufacturer of all materials specified in this section of types and sizes required, whose products have been in satisfactory use under similar service conditions for not less than ten years.

4.4.3 SUBMITTALS

1. Submit the standards to which the cable tray is manufactured to.

2. Submit shop drawings and data in accordance with the general requirements of the contract.

3. Show actual cable tray installation details, size and suspension system.

4.4.4 PRODUCTS

GENERAL

1. The cable tray system shall be of one manufacturer and shall include factory made trays, tray fittings, connections, complete with accessories and supports to from a complete tray support system.

2. The cable tray system shall include the following factory-made tray elements. Straight trays and ladders, fittings and horizontal and vertical bends of various angles crosses, tees, wyes, reducers, vertical riser elements, connectors, joint plates and all necessary fixing accessories including supports. No local or site fabrication of any cable tray system including ceiling and wall supports are acceptable. Threaded rods for ceiling supports are not acceptable.

4.5 CABLE TRAY

1. The whole of the tray work, fittings and supports shall be of mild steel after manufacture. The thickness of the powder coating on any element shall not be less than 80 microns with anti-corrosive treatment.

2. Cable trays shall be constructed from G.I of minimum thickness 12 gauge. Height shall be 60mm or as specified. Flange height shall be 100mm or as indicated in drawings.

3. Insert elements, bolts, screws, pins etc., shall be cadmium plated/stainless steel.

4. Tray work shall have oval perforations. Ladder type trays shall be used as required and/or approved by the Engineer.

5. All trays (straight and fittings) to be heavy duty returned flanged type unless specified otherwise.

6. Tray components are to be accurately rolled or formed to close tolerance and all edges rounded. Flanges are to have full round smooth edges.

7. Ladder racks for widths up to and including 300mm shall be constructed from G.I sections of minimum thickness 12 gauge. Height shall be 60mm or as specified. Ladders in excess of 300mm width shall be C Section construction with a minimum thickness of 12 gauge. Height shall be 100mm or as indicated in drawings. The rungs shall be spaced at a maximum 300mm.

8. Unless indicated otherwise on drawings, cable trays shall be used in the range and 150mm to 750mm wide, in five preferred standard sizes: 150, 300, 450, 600 and 750mm.

9. Other sizes shall be used where specified or previously agreed with the Engineer.

10. Return flanges shall be a minimum of 10mm deep, unless otherwise specified.

11. Minimum radii at side rails, horizontal, and vertical tees and crosses shall be in accordance with the Manufacturer's standard.

4.5.1 EXECUTION

4.5.1.1 INSTALLATION

1. Install all cable trays and ladder racks strictly in accordance with IEE and local authorities' requirements.

2. Drilling, machining or cutting shall not be carried out after application of protective coat, unless previously agreed by the Engineer. If cutting or drilling is necessary, edges shall be cleaned up and painted with zinc-based paint before erection.

3. Provision shall be made when installing all cables and cable trays for the expansion and settlement of the building.

4. Cables shall be fixed to the trays/ladders by means of PVC cleats and flame-retardant cleats for flame/fireproof cables with galvanized bolts, nuts and washers. Use galvanized metal trefoil cleats with rubber pad for single core cables

5. Control cables run and clipped in groups shall not exceed twelve in number and shall be not more than double banked. Power cables shall be laid in a single layer except with the prior approval of the Engineer. Power cables should be spaced 2D between centres of cables throughout the run of cables. Submit calculations for voltage drop for cables and increase the size if necessary.

6. Vertical distances between trays mounted horizontally shall be minimum of 250mm. Local reduction of distances between trays will be allowed to a minimum of 150mm with approval from the Engineer.

7. Trays shall be adequately supported to prevent sagging by more than 3 Deg. between fixed points. All supporting steel work shall be fixed at not more than 1-meter centers unless otherwise specified.

8. Where cable tray pass through floor arrange for 100mm concrete curb around opening and fire sealants shall be provided.

9. The Contractor shall submit calculations relating to tray / ladder work and tray / ladder supports demonstrating acceptable mechanical stresses and sag.

10. Where cable tray must pass below a beam a short length of tray shall be installed on the underside of the beam with 25mm spacers between the tray and the beam underside surface. Cables shall be strapped rigidly to the tray to prevent any possible sag in the cables.

11. Where cable tray is intended to cross a series of beams the tray shall be supported from each beam it crosses by metal supports suspended from below the underside of the beam - the space between the tray and the beam underside surface shall not exceed three times the diameter of the largest cable to be carried on the tray.

12. Cable tray covers are only required on roofs or outdoor where cables are installed exposed to weather conditions.

4.5.1.2 EARTHING

1. The entire cable tray and ladder system shall be bonded using 12mm x 1.5mm braided tin copper, which shall be bolted across each joint in the system by means of galvanized nuts and bolts, complete with flat and spring washers.

2. Tray systems shall be bonded to the main building earthing system as required or directed by the Engineer

4.5.1.3 FIRE BARRIERS

1. Arrange for opening in fire rated walls, and floor for width and depth of cable tray to run through in addition to the specified clearance of the above cable trays.

2. Arrange and make good fire rating of floors or walls after cables have been installed. For all floor openings of all risers (telephone, power) except vertical telecom cable risers where grating shall be provided.

3. All openings / sleeves within floor slabs and fire rated walls shall be sealed with proper fire rated material.

4.6 MAINS & SUB-CIRCUIT DISTRIBUTION

PART 1 – GENERAL

4.6.1 Work Description

A. Mains and sub-circuit distribution cablings of the LV System shall be as shown on the Drawings and as specified hereinafter.

B. All mains and sub-circuit cables shall be in conduits, trunking, cable trays and ladders as appropriate. Armoured cables shall be used for all circuits in open ground in trenches or on open trays and ladders. All the mains, sub-mains and final sub-circuits shall include insulated earthing conductor sized in accordance with BS7671.

C. The current carrying capacities and voltage drops of cables shall be in accordance with BS7671, with ratings adjusted to suit local conditions.

D. Cable joint is not acceptable for all cable installation.

4.6.2 Submissions

A. All technical submissions shall be approved by the Engineer prior to the respective stages of construction.
   1. Detailed schedule of cables and manufacturer's data, Manufacturer's type test certificates and testing documents shall be submitted for inspection. Detail requirement of cable schedule as specified in Section 3, Wire and cables;
   2. Calculations of voltage drop of cables;
   3. Calculations of the prospective short circuit current;
   4. Co-ordinated drawings showing all cable routings;
   5. Builder's works requirement;
   6. Detailed control wiring diagram.

PART 2 – CABLE INSTALLATION

4.6.3 GENERAL

A. Cables shall be delivered on robust cable drums with cable ends treated to form an effective seal. When a cable is cut from a drum, the cable and the end left on the drum shall be immediately sealed in approved manner to prevent the ingress of moisture.

B. Cables shall be installed along the routes as indicated on the Specification and Drawings and shall be agreed in detail with the Engineer before any work is commenced. There is no cost adjustment to any routing of the cables as required to suit the installation and subject to site co-ordination.

C. All necessary precautions shall be taken to prevent damage to cables during installation.

D. Where cables are installed in situations where works by M&E Services are still incomplete, all reasonable precautions shall be taken to protect the cables against damages arising from the execution of such other works.

E. Cable laying shall be carried out by means of normal hand running off the cable drum. Roller guides shall be used all through and be drawn through by hands. No cable winches shall be employed.

F. Cable entries into buildings shall be hermetically sealed with an appropriate fire, heat and water-resistant, non-ageing, flexible material.

G. Cables shall be adequately protected against all risk of mechanical damage to which they may be liable in normal conditions of services.

H. Cables shall be installed in accordance with BS7671. In particular, the internal radius of every bend in a cable shall be such that as not to cause damage to the cable and not less than the appropriate value stated in BS7671.

I. Except for cables laid in ducts, all cables as specified herein shall run on cable trays/cable ladder, vertically and horizontally, and properly fixed in the prescribed manner. Where cables are laid on cable trays/cable ladder in the horizontal directions, nylon cable ties shall be used.

Where cables are installed in the vertical direction, approved clips and saddles shall be used. The spacing of cable fixings shall be in accordance with BS7671.

J. Not more than one circuit of single core cables or one multi-core cable shall be grouped together. The spacing between groups of single core cables or multi-core cables shall not be less than twice the diameter of the largest cable in the adjacent group of cables.
K. Where cables pass through structural elements such as floors and walls, the opening made shall be sealed with approved fire-resistant material of not less than two (2) hours fire rating or not less than the fire rating of the slab/wall to prevent the spread of fire.
L. Where cables pass through expansion joints, the cables shall be formed into a loop which shall be of such size that any movement in the joint shall not stress the cables.

4.6.4 Final Sub-Circuit PVC Cable Installation

A. In general, cables are to be run in zinc coated trunking to BS 50085.
B. Unless otherwise in plant rooms, within false ceiling and boxed up riser, all final circuit wiring shall be in concealed conduit in concrete slab, wall, column, etc.
C. Cables in trunking shall be bunched in approved cable tie.
D. Trunking shall be properly sized to conform to IEE Regulations with minimum space factor of 45%.
E. BS Standard or relevant other Standards, name of the manufacturer, the voltage grade and the relevant BS number shall be printed on the outer sheathed insulation of the cables.
F. Cables for 3 phase, 4 wire system shall be colour coded – red, yellow, blue for phases, black for neutral and green/yellow for earth.
G. Minimum size of cable shall be 2.5mm^2 for lighting, 4mm^2 for power and 2.5mm^2 /4 mm^2 for earth continuity (depending on the phase cable) subject to a maximum volt drop of 2.5% of the nominal voltage.
H. The cable size shall be selected to ensure that it has adequate current carrying capacity and that the voltage drop at the apparatus supplied does not exceed the approved limit. Derating of cables shall also be taken into account for adverse conditions.
I. Connection of fixtures shall be by the “loop-in & loop-out” method.

4.6.5 Non-Armoured Mains & Sub-Mains Cable Installation

A. In general, the cables shall be installed on cable trays or ladders. They shall be installed to an acceptable way conforming to IEE Regulations to prevent losses in cables and performance of the current carrying capacity.
B. Proper labeling shall be installed at every 6 m interval.
C. Avoiding of overlapping of cable is necessary.
D. A three phase circuit cables shall be installed on the same tray.
E. The cables shall be terminated in suitably tinned copper compression connectors.
F. Cables shall be routed at high level on proprietary make horizontal cable trays or cable ladders (for large cables) and support systems similar to UNISTRUT or other approved equivalent system. All vertical runs including cabling to switchboards, etc. shall be secured on approved type cable ladder system. For horizontal runs, cables shall be secured neatly on the cable trays or ladders at close intervals by means of moulded polythene cleats similar to BICC “Telecleat” or other approved equal whereas claw cleats shall be used for securing vertical cables. Fixing shall be made with rawl bolts or other patented fixing devices of manufacturer details to the Engineer approval. Details of cable routes, terminations and support system shall be forwarded to the Engineer for review prior to installation.

4.6.6 Fire Resistant (FR) Cable Installation

A. Fire Resistant cables shall be installed on a separate cable tray without sharing with other sub-main/control cables.
B. Fire Resistant cables shall be installed in accordance with the maker's recommendations and instructions. Fire Resistant cables shall be run on proprietary make horizontal cable trays, vertical cable ladders, trunkings or conduits depending on the sizes. For horizontal runs, Fire Resistant cables of larger sizes shall be secured neatly on the cable trays or ladders at close intervals by means of moulded polythene cleats similar to BICC "Telecast' or other approved equal whereas fire resistant claw cleats shall be used for securing vertical runs.
C. All installation accessories shall be of manufacturer's standard products. Cable glands shall be of fire rating equal to the cable The bending radius of the cables measured from the inside of the bend shall be not less than eight times the diameter of the cable or to manufacturer's recommendation, whichever is more.
D. For emergency final circuit, the FR cables shall be installed in Gl conduit in concealed slab, wall, etc. unless otherwise approved by the Engineer.

4.6.7 Earth Continuity Conductor Installation

A. Each circuit wire shall have its own protective conductor with adequately sized in accordance with BS7671 using stranded copper cable with green/yellow PVC insulation.

4.6.8 CABLE TERMINATION

A. Tee-off

1. Tee-off as required for tapping of power supply from the main riser cables to individual circuits shall be suitable for such purposes. Installation method must be submitted for approval prior to commencement of works. Under all circumstances, the conductors to be tee-off shall be secured by means of proprietary made compression type mechanical connectors, enclosed in plastic protective shell and filled with acrylic resin. No strand of a stranded conductor shall be cut away in making the tee-off.

B. Cable Termination

1. Cable shall be terminated using suitably chosen cable glands as specified.
2. A PVC shroud as specified shall be fitted to cover the gland body.
3. In the case of armoured cables, all armour and all faces of armour clamps of connectors making contact with them shall be thoroughly cleaned before termination and the clamps shall be adequately tightened to ensure good electrical contact.
4. Cable conductor terminations shall be by means of heavy duty solderless cable lugs. The lugs shall be of high conductivity copper electro-tinned and applied to the conductor by means of a hydraulic crimping tool unless otherwise specified. Heat shrinkable tapes shall be used for insulating the termination whenever possible.

C. Armour Earthing

1. Metallic sheaths and/or armour of all cables in the same circuit shall be solidly bonded together at both ends of their runs. The bonding shall extend from the earth lug or earth lug attached to the cable glands to the main earth system.

2. The cross-sectional area of the bonding conductor shall be selected in accordance to BS7671.
3. The bonding conductor shall be as short and straight as possible.

4.6.8 CABLE IDENTIFICATION

A. Cables shall be provided with identification markers, at each end of the cable, at entry and exit points of buried ducts, and in such other positions as are necessary to identify and trace the route at any cable. Where cables are not enclosed in ducts and are of multiple runs, markers shall be provided at 15 meter intervals

B. Cable identification shall be assembled from elliptical profiled plasticised PVC markers, carrier strip and nylon ties, the complete assembly shall be suitable for a maximum service temperature of 70ºC.

C. Every core of a multicore cable shall be provided with identification at its termination in the form of tapes, sleeves or discs of appropriate colours.

4.7 LOW VOLTAGE SWITCHBOARDS

PART 1 – GENERAL

4.7.1 WORK DESCRIPTION

A. The switchboards, distribution boards and control panels shall be built in accordance with IEC 61439 “Factory Built Assemblies for Low Voltage” or BS 5486 “Factory-built Assemblies of Switchgear and Control Gear for Voltage up to and including 1000 AC and 1200V DC.

B. All factory built assemblies shall be capable of withstanding the electrical, mechanical and thermal stresses of the prospective fault level experience. The prospective fault levels of the various factory built assemblies shall be as indicated in the Drawings.

C. All equipment used in the factory built assemblies shall have been type tested/partial type tested. Type set certificates shall be submitted for all major equipment at the time of technical submission.
Besides, a full type test report as specified under IEC 61439, the Low voltage switchboard shall also be tested for electromagnetic compatibility (EMC), internal arcing-fault test and seismic withstand test under the relevant standards.

D. All factory built assemblies, as a complete unit shall have a rating equal to or greater than the integrated equipment rating as indicated in the Drawing.

E. All factory built assemblies subject to rain or wet conditions or located outside electrical switch room shall be weatherproof constructed to IP 66, able to withstand high impact strength of 60 KN/m^2 (min), temperature resistant with consideration of Ambient temperature 45 degrees C and average switch room temperature 30 degrees C. Flame retardant and corrosion resistant.

4.7.2 STANDARDS

A. The LV switchboards and distribution boards shall be constructed in accordance with the latest revision of the following standards:

1.	BS 88-2	:	Cartridge fuses for voltages up to and including 1000V AC and 1500V DC.
2.	BS 89-2	:	Direct acting electrical indicating analogue electrical measuring instruments and their accessories.

3.	BS 142	:	Electrical protection relays
4.	BS 159	:	Busbars and busbar connections
5.	BS 13601	:	Copper for electrical purposes. Rods and bars.
6.	BS EN 60898	:	Circuit-breakers for over current protection for household and similar installations.
7.	BS 61869	:	Current transformers
8.	BS EN 60947-2	:	Low-voltage switchgear and controlgear. Circuit-breakers.
9.	BS EN 60947-2	:	Control switches (switching devices, including contactor relays, for control and auxiliary circuits, for voltages up to and including 1000V AC and 1200V DC).
10.	BS EN 60947	:	Air-break switches, air-break disconnectors, air break switch disconnectors and fuse combination units for voltages up to and including 1000V AC and 1200V DC.
11.	BS EN 60947	:	Degrees of protection of enclosures of switchgear and control gear for voltages up to and including 1000V AC and 1200V DC.
12.	BS 5424	:	Control gear for voltages up to and including 1000V AC and 1200V DC Contactors.
13.	BS 61439	:	Low-voltage switchgear and control gear assemblies. Specification for type tested and partially type tested assemblies.(General requirements)
14.	BS EN 62053-11	:	Electricity meters – Specification for Class 0.5, 1 and 2 single phase and polyphase, single-rate and multi-rate watt-hour meters.
15.	BS EN 61810-2	:	Electrical relays.
16.	BS 6004	:	PVC insulated cables, non-armoured, for electric power, lighting and internal wiring.
17.	BS 6231		PVC insulated cables for switchgear and controlgear wiring.
18.	BS 7430		Code of practice for Earthing
19.	IEC 61439	:	Low-voltage switchgear and control gear assemblies Type-tested and partially type-tested assemblies
20.	AS 3439-1	:	Low-voltage switchgear and control gear assemblies. Type-tested and partially type-tested assemblies
21.	IEC 60068-3-3	:	Environment testing: Guidance Seismic test methods for equipment.

B. BS/IEC or other National standards not mentioned above but are applicable to this installation shall also apply.

4.7.3 SUBMISSION

A. A component list and catalogues.

B. Detailed shop drawings of all factory built assemblies shall be submitted for approval before construction commences.

C. Such drawings shall show the proposed method of construction of the cubicles, method of supporting equipment and busbars, full details of busbar layout, method of support, electrical control wiring diagrams, equipment weight, colors, surface treatment and mounting type etc.
D. The drawings shall also incorporate a full list of proposed materials. The construction shall not commence until the drawings are approved for construction.
E. Factory and site testing procedures and report formats shall also be included.

PART 2 – PRODUCTS

4.7.4 GENERAL

A. The factory built assemblies shall be of the totally enclosed, modular cubicle type, which are extensible and suitable for floor mounting as indicated in the drawings. The assemblies shall be manufactured in a facility that is ISO 9000 certified.
B. The factory built assemblies shall be compartmented and utilize sheet steel plates of thickness as detailed below. The panels shall be vermin proof and constructed to a minimum degree of protection of IP ratings to BS 60529. The IP ratings indicated below shall be applicable unless otherwise indicated in the drawing.
C. Main and Sub-Switchboards
    1. 2mm thick sheet steel
    2. Form 4a, Type 3 for Main Board and for Emergency Board and Form 2b, Type 2 for Distribution Board unless otherwise specified to BS 61439 with separation of busbars from the functional units and separation of all functional units from one another
    3. Minimum IP 44 and IP 2X after opening of doors & panels (of external covers) unless otherwise specified.
    4. IP66 for location subject to rain wet conditions or located outside electrical switch room.
    5. Switchboard frame shall be of modular detail and extensible.
    6. The interior of each cubicle shall be dust inert and vermin resistant.
D. Switchboard frames shall be fabrication of 2.0mm thick electro-galvanized steel. All joints shall be neatly formed and finished flush with the adjacent surfaces by grinding and/or machining. No joints shall be located on a corner and all bare edges shall be lipped.
E. Structural members and bracing, where necessary, shall be welded or bolted to the frame.

4.7.5 DOORS AND PANELS

A. Full access shall be provided to service and maintain all equipment inside each cubicle by means of a suitable hinged door that shall open a minimum of 120 degrees. All hinged doors shall have an earth braid connected to the cubicle.
B. Doors and panels shall be constructed of 2 mm electro-galvanized sheet steel, pressed or rolled so that edges are given a neat round finish and shall reinforced with a suitable frame welded to the inside folded edge of the door. An approved stiffener shall be welded to the inside of each door and/or panel.
C. Doors shall hang on substantially concealed non-corrosive hinges and shall be fitted with good quality door handles to Engineer's approval which shall be lockable and operable by the same key. The door handles shall be fitted with toggles to operate rods to latch with suitable slots in both the top and bottom of the switchboards. Latching rods shall be guided by brackets. The latching rods and associated brackets shall be cadmium plated.
D. All front, side and top panels shall be constructed in a manner similar to that specified for doors above. They shall be fitted to the frame from the outside with captive, hand tightened screw. Panels longer than 1.2 meters shall be provided with 3 point locking system

4.7.6 BASEPLATE AND INSULATING PANELS

A. The switchboards shall be mounted on 50mm X 50mm C-channel. Wherever insulating panels are required to mount special equipment, they shall be of high quality black bakelite, polished on the front.
B. All edges must be cut straight and square and shall be chamfered on the front edge with a 3mm chamfer.

4.7.7 FINISHING OF METAL WORK

A. Panel work of the switchboards shall be finished with electrostatic epoxy powder coating of minimum 50 microns all treat with 180 ^{0}C, 12 minute oven backing. All metal work shall be rust inhibited and sprayed with two coats of primer. The painting shall be of best quality oven-bake epoxy powder coated, of Grey colour.
B. After erection on site and after all inspection and tests have been carried out, the Contractor shall thoroughly clean all painted parts, touch-up with application of an additional coat of anti-corrosive structural priming paint to any part of the originally painted surfaces that have been scratched or otherwise marked and at least one additional touch-up finishing coat of Grey colour.

4.7.8 BUSBARS AND CURRENT CARRYING PARTS

A. The manufacturing of the busbar system shall comply to the latest edition of BS 159. All busbars and current carrying parts shall be manufactured to carry a current density of not more than 1.55 A/mm^2 and shall be capable of carrying normal current continuously without the temperature rise of any part exceeding 30^{0}C. Their location shall be such as to ensure adequate spacing between conductors and they shall be securely fastened and braced to withstand all stress set up during transportation, erection and normal operation, and under short circuit conditions. The busbars shall not be damaged in any way under a fault of short circuit experience with minimum 46 MVA for 3 seconds. Where two or more conductors are used to form a phase, it shall be separated with an air gap sufficient to allow for the ventilation of the individual conductors all round. Busbar supports shall be made of slotted first grade “Bakelite” or glass fiber reinforced polymer able to withstand minimum operating temperature of 110^{0}C.
B. All connections in current carrying parts shall be made by means of bolts with lock nuts. The use of tapped holes and studs or any other alternative method of connection in current carrying parts shall not be employed without the express approval of the Engineer prior to manufacture.
C. Busbars shall be provided with approved shrinkable tube of adhesive stickers of appropriate phase colour to indicate phases.
D. All connections, tapping and clamping shall be made in an approved manner to ensure minimum contact resistance. All connections in the busbars shall be firmly bolted and clamped with even tension. Before assembly, all busbar joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints.
E. All intermediate conducting material shall be used when there is a possibility of electrolytic action when contacts of the copper busbars with dissimilar metals are made.
F. An earth bar minimum size comply with BS 7671 and BS 7430 with minimum 50mm x 10mm to each vertical section of the cubicle units and shall run the full length at the bottom of each switchboard. All metal parts of the switchboards and associated equipment shall be bonded and connected to this earth bar. Minimum 2 connections to main earthing system shall be provided. The protective circuit shall have a rated conditional short circuit current of 39kA at 240V and a rated peak and short-circuit withstand current of 81.9kA and 39kA for 1 sec respectively.

G. The neutral busbar shall be the same size of that of the phase bars and shall be provided with an adequate number of terminals including cable lugs, bolts, etc. to suit the installation.
H. For circuits not less than 200A, busbar drops to moulded case circuit breakers or other apparatus shall be made of circular or rectangular busbar covered with Nylex tubing of appropriate colour and terminated in adequately sized concentric lug, of lug type, cone grip cable sockets or approved equal. Cables may be used for circuits less than 200A to type test configuration.
I. All visible rectangular busbars shall be bare tinned type size 1.55A/mm^2 based on current density. Rated current of assembly shall be based on tinned busbar and must be certified by type testing.
J. All screws, bolts, washers used for the busbars shall be cadmium plated. All contact parts of the busbars and connections shall be sanded and coated with a thin coat of chemical inert petroleum jelly. All bolts shall be tightened with an even tension. Approved spring washers shall be used at all joints complete with cadmium plated high tensile steel bolts.
K. All busbars and switchgear terminals to which outgoing or incoming cables are terminated shall be manufactured for a maximum temperature of 30^0C above ambient. Where there are two incomers to the Low voltage switchboard, the bus-coupler and the busbar works shall type tested to certify the integrity of the system.

4.7.9 INSULATION

A. The clearances and insulation shall be such as to withstand the standard 3 kV dielectric tests on the switchboard.
B. All insulation used shall be of the best quality and sufficiently strong to withstand all stresses which may be imposed on it in the ordinary erection and operation of the switchboards.
C. Where insulators are cemented or jointed to metal parts, such jointing shall be of such a nature that no dangerous stresses are set up in the insulators by the unequal expansion or contraction of the insulation and the metal through the range of temperatures stated.

4.7.10 CABLE OR BUSDUCT ENTRIES

A. Provision shall be made within the factory built assemblies for the proper support and bracing of outgoing and incoming cables or bus ducts.
B. Weatherproof cable glands and all necessary non-ferrous gland plates, etc. shall be provided for all cables entering or leaving the switchboards. Cable terminating end boxes shall be mounted from top of the switchgear in the cubicles. Cable supports shall be provided for the termination boxes.
C. Bus duct entries to the switchboard shall be liaised with bus duct vendor for the exact position and phasing.
D. Detail of cable or bus duct in and out of the switchboard shall take into the IP rating requirement as specified for the switchboard.

4.7.11 PHASING

A. Phase rotation shall be strictly maintained throughout the project. Phase distinguishing colors shall be RED, YELLOW and BLUE.

4.7.12 LABELS

A. All factory built assemblies and equipment shall be clearly labeled in accordance with Local Authority's regulations and to indicate its functions by means of engraved 'Traffolite' labels. Plastic labels are not acceptable. Emergency Main Switch Board shall be "red-on-white" others shall be "black-on-white". Engraved lettering not less than 20mm high or as otherwise required and approved.
B. Labels shall be attached by means of chrome finished countersunk screws and nuts.

C. Prior to engraving the labels, a label schedule shall be submitted for approval. Allow for two spare sets of label blanks and the cost of engraving as directed by the Engineer. If not so directed, the spare sets of labels are to become the property of the Employer.

4.7.13 SPECIFICATION FOR SPARES

A. The switchboards shall incorporate a rack for mounting spares, moulded case circuit breakers and a minimum of 20 percent standby/space capacities shall be provided for future installation of circuit breakers.
B. End covers and pre-drilled holes at main busbars shall be manufactured for future extension of the switchboards at both ends.
C. Spare shall be provided according to those as specified in the DB schedule/Single line diagram.

4.7.14 BASE SUPPORTS

A. The base support shall be fabricated from 50mm x 50mm C-channel base sufficiently stiffened to adequately support the switchboard. The base shall be hot dip galvanized after fabrication. The base may be made as part of the switchboard.

4.7.15 VENTILATION

A. All switchboards shall be properly natural ventilated. Force ventilation to achieve the required rating of the assembly is prohibited.
B. Vents shall be provided with the consideration of IP rating as specified.
C. Detailed calculation shall be submitted to verify the total heat from the switchgear and switchboard and the amount of vents and ventilation fans size.

4.7.16 INDICATING INSTRUMENTS

A. Indicating instruments shall comply with BS 89. Meters for external panel mounting shall be of the flush pattern type with square escutcheon plate's finished matt black and polycarbonate cases.
B. The main low voltage switchboards shall be provided with High performance and high accuracy power meter/ Energy Analyzer with LCD display that capable of indicating real-time readings, demand reading, energy readings, set up and resets menus shall be installed for the main switchboards. Power meter shall be provided for the circuits above 100A or as specified on the drawings.
C. The reading shall include but not limit to current (per phase, neutral and earth), voltage (L-L, L-N), real power, reactive power, apparent power, power factor, frequency, energy, power quality readings such as voltage and current THD, demand, date/time stamping, on-board memory for alarms/relay functions such as under/over conditions, phase unbalance conditions, data log, event log, etc.
D. The meter power shall accept inputs from standard 5A current transformers and has full-scale input of 10A. The voltage inputs shall be directly connected to 3 phase circuits of 600V and below without the need for Potential or current transformer. All reading shall be scaled to their actual values without the need for a multiplier.
E. The power meter set up and resets shall be password protected and easily done via the meter display or via network software.
F. In addition, unless otherwise specified, following analogue indicating instrument shall be installed for sub-board and distribution boards above 100A incoming or as specified on the drawings.

G. Ammeter and voltmeters shall be of moving iron coil spring controlled type with 96mm square dials, accuracy Class 1.5 with external zero adjustment screw that is accessible from the front.
H. Ammeters shall be selected such that full load current indications are not less than the two thirds of linear scale of the meter and have a suppressed upper scale.
I. Ammeters shall be capable of taking overloads of 2 times continuously and voltmeter 1.2 times continuously.
J. Ammeters at the main incoming feeders shall in addition to the moving iron mechanism be provided with thermal bimetal indicators with draw pointers to record maximum demands. The mechanism shall not respond to short current peaks and shall be manually resettable.
K. Frequency indicators shall be of the vibrating reed type. The meter shall be capable of proper operation for voltage variation of ± 10% rated voltage.
L. Power factor meters shall be of the electrodynamics crossed coil mechanism suitable for balance load, three phase four-wire system. The accuracy class shall be 1.5 and range 0.5 lag to 0.5 lead.
M. Monitoring Kilowatt-Hour Meters and current transformers where specified shall be provided. The kilowatt-hour meter shall have a digital display reading up to 100 million Kilowatt-Hours and to the nearest 100 KW-Hr. The overall accuracy shall be better than ± 2.0%.
N. The KWh meters shall be of flush mounting, rear connection type, current transformer operated and suitable for three phase balanced and unbalanced loads. The meter shall be complete with the three metering elements and shall have a cyclometer register with six rollers.
O. Instrument dials shall be white with black markings, and scales shall be of such material that ageing, peeling or discoloration will not take place under tropical conditions.
P. All instruments, when mounted on the switchboard, wired and ready for service, shall be in good order and condition in every way. The measuring elements shall be completely free from any discernible stickiness either at zero or upscale, and they shall be capable of attaining the performance guaranteed by the manufacturers of the respective instruments.
Q. All terminals shall be completely insulated and potential circuits shall be suitable fused.

4.7.17 SELECTOR SWITCHES

A. The switches shall be of the panel mounting type with totally enclosed contacts and stud connection. Ammeter selector switches shall have make before break contacts to ensure that the current transformers are never open circuited.
B. The ammeter selector switch shall be suitable for measuring the current in each phase independently.
C. The voltmeter selector switcher shall be 7-way type. Voltmeter selector switches shall have break before make contacts.

4.7.18 CURRENT TRANSFORMERS

A. Current transformers necessary for the operation of instruments and meters shall comply with BS 61869 and be of the ‘straight through’ epoxy-resin type. Measuring current transformer shall be of accuracy class 1 and for metering of accuracy Class 0.2 (for energy metering).
B. They shall be adequately rated in V.A. to carry the summation of all V.A. burdens of connected loads, and shall be capable of carrying current of the corresponding circuit breakers and fuses. The output secondary current shall be 5 amperes.
C. They shall be capable of operation, without damage, with open circuited secondary and full load current flowing in the primary.
D. Current transformers shall be adequately supported and installed as to permit easy access and to be readily replaceable, if necessary, without dismantling of adjacent equipment.

E. All current transformers shall be provided with an identifying label giving type, ratio, class, output and serial number.
F. Current transformers provided for protective gear purposes shall have overcurrent and accuracy limit factors not less than those corresponding to the short circuit level of the system. The output of each current transformer shall be not less than that specified and the capacity of the current transformers provided shall be adequate for operation of the associated protective devices and instruments. Where double ratio secondary windings are specified, a label shall be provided at the secondary terminals of the current transformer indicating clearly the connection required for either ratio. These connections and the ratio in use shall be shown on the appropriate schematic and connection diagrams. Protection current transformer shall be of a accuracy Class 5P 10 and the burden in no case shall be less than 15VA.
G. Magnetization curves shall be submitted at the time of shop drawing submission.

4.7.19 CONTACTORS

A. Contactors shall be fully tropicalized and robust construction and shall comply with relevant parts of BS 5424 and be rated for the following duties.
B. Contactors for voltages up to and including 1000 volts A.C. and 1200 volts D.C. (BS 5424 Part 1).
   1. Rated duty - Uninterrupted
   2. Mechanical duty - Class I
   3. Making and Breaking - AC4 Category

C. Contactors shall be selected to suit the load such that a minimum electrical life of one million operations is ensured. The mechanical life shall be at least 5 million operations.
D. Contactors shall have at least 15 times making capacity and 10 times breaking capacity for contactors less than 100 amps and 10 times and 8 times respectively for contactors above 100 amps. The selection of contactors shall be coordinated with the prospective fault levels suitable at that point of installation.
E. Contactors shall generally be suitable for rail mounting and be of modular detail. The coil shall be suitable for +10% and –15% of nominal main voltage. Provision shall be made on the contactors for affixing of termination and contactor identification labels.
F. Contactors shall be provided in sheet steel enclosure of a tropical finish and vermin proof. Adequate ventilation shall be accordance with BS 5424, category IP 42 for indoor service and IP 65 for outdoor service.
G. The contactor shall be located within the enclosure so that upon making or opening of the contactor under normal or fault conditions, damage will not be caused to other equipment and wiring within the enclosure.
H. An isolating switch shall be provided for each contactor circuit except that if there is more than one contactor and they are grouped together, one incoming supply isolating switch shall be provided to isolate all contactor circuits. Al mechanical interlocking device between the isolating switch and panel cover shall be provided to prevent access to live parts within the panel when the isolating switch is in the “ON” position.
I. Contactors equipped with both local and remote control shall have local/remote changeover switches capable of being locked by padlock in the either position.
J. Contactor shall be provided with spare auxiliary (2 No. + 2 NC) in addition to other required auxiliary contacts specified in the Contract.

PART 3 – RELAYS

4.7.20 Control Relays

A. All control and indication relays shall be of the heavy-duty pattern fully tropicalized type.
B. Relays shall be grouped conveniently in dust proof cases with removable covers given access for adjustment, cleaning, etc., without dismantling the relay.

4.7.21 PROTECTION RELAYS

A. Protection relays shall be approved types complying with BS 142 or equal and shall have approved characteristics and be flush mounted in dust proof cases. Relay cases shall generally be finished in black enamel.
B. Relays shall be of construction detail arranged so that adjustments, testing and replacements can be effected with the minimum of time and labour. Relays of the hand reset type shall be capable of being reset without opening the case.
C. Relay contacts shall make firmly without bounce and the whole of the relay mechanisms shall be as far as possible unaffected by vibration or external magnetic fields.
D. Relays, where appropriate shall be provided with flag indicators of approved type, phase colored where applicable. Flag indicators shall be of the hand-reset pattern and shall be capable of being reset without opening the case. Where two or more phase elements are included in one case separate indicator shall be provided for each element.
E. Relays with provision for manual operation from outside the case, other than resetting will not be accepted, and time delay relays shall not be of the dashpot type.
F. Relays shall be provided with clearly inscribed labels describing their application and rating in addition to the general-purpose labels.
G. Approved means shall be provided on the relay panels for the testing of protective relays and associated circuits. Withdraw able type cases and plug-in type test facilities being preferred.
H. Full discrimination relay curves indicate relay setting shall be co-ordinate by the Contractor and submit for approval. The submission shall cover both O/C & E/F protection up to final circuit and shall be endorsed by the Contractor's Installation Engineer.

4.7.22 OVERCURRENT PROTECTION

A. Overcurrent protection shall be of the current transformers operated direct acting type. Where instantaneous trip is specified, the relay shall incorporate on electronic timer with adjustable time delay setting.
B. Where IDMT characteristic is required the time/current characteristic shall comply with BS 142. IDMT type relay shall consist of an electromagnet with shading rings on the pole pieces driving an induction disc. Current setting shall be of a plug and bridging socket arrangement and time lag setting shall be by setting screw located above the time scale.
C. Overload phase indicator shall be provided to show the phase overload condition.
D. The range of current setting adjustment for phase faults shall be 50% of 200% of rated full load with tapping at 25% intervals and the time setting adjustment shall be 0 to 3 seconds at 10 times the normal operating current. The current/time characteristics of the relays shall be in

accordance with the British Standard Curve and shall be provided during the technical submission.

E. Both electromechanical and electronic type protective relays may be considered. Submission of full technical detail and approval shall be obtained prior to installation.

4.7.23 EARTH LEAKAGE PROTECTION

A. The earth leakage relays shall be of the instantaneous type with adjustable current settings from 5% to 40% in 5% steps.
B. The operating coils and contacts shall be adequately rated to carry the necessary load. Operating indicator and reset facilities shall be provided.
C. The relays shall house in dust proof sheet metal casings, provided with viewing glass.
D. Both electromechanical and electronic type protective relays may be considered. Submission of full technical detail and approval shall be obtained prior to installation.

PART 4 – CONTROL CIRCUIT WIRING AND AUXILLARY

4.7.24 CONTROL CIRCUIT WIRING

A. All wiring shall be arranged in a regular manner with bends set at 90 degree and securely held in position with suitable clips and where convenient shall be installed in the uprights and/or back-stays insulating bushes being used where necessary.
B. Control wiring of the switchboard shall be carried out in PVC insulated switchboard cable of size not less than 1.5mm^2 and those for current measurement shall be minimum 2.5mm^2. All meter wiring shall be of similar colors to those of the respective bus bars, etc., to which connections are made. The cable termination shall be made with cable lugs.
C. No wires/cables shall be tee-off or jointed between terminal points.
D. Wiring shall be carried out in such a manner as to make circuits and connections easily traceable. Cable marking ferrules or similar shall be used at each termination. Terminals shall be designated in an approved manner.
E. All terminals shall be fitted with brass washers and securely fixed with lock nuts.
F. Displacement Insulation push-in type termination for cable up to 2.5mm^2, tunnel type terminals shall be provided for cables up to and below 6mm^2. Cables larger than 6mm^2 shall be terminated with compression cable lugs or proprietary makes of termination approved by the Engineer.

4.7.25 ANTI-CONDENSATION HEATERS

A. Anti-condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch and adjustable thermostat suitable for electrical operation at 230 volts A.C. 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5^{0}C. The electrical apparatus so protected shall be detailed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation.
B. As a general rule, the heaters shall be placed at the bottom of the cubicle.

4.7.26 TERMINAL BOARDS

A. All terminal boards shall be mounted in accessible positions and, when in enclosed cubicles shall be inclined downwards towards the door. Spacing of adjacent terminal boards shall not be less than 100 mm and the bottom of each board shall not be less than 200 mm above the

incoming cable gland plate. Separate studs shall be provided on each terminal strip for the cores of incoming and outgoing cables including all spare cores.

B. Brass bolts and studs shall be of not less than 6 mm diameter size but stainless steel and bronze down to 4.5 mm diameter may be used provided that the current carrying capacity is adequate. All studs shall be provided with nuts, washers and lock nuts or lock washers. Where pinch type terminations shall be provided. They shall have adequate current carrying capacity and shall be provided with locking devices. Insulated barriers shall be fitted between adjacent terminals.
C. 400/230 volt and higher voltage circuit terminals shall be segregated from other terminals and shall be fitted with non-flammable transparent plastic covers to prevent contact with any live parts. They shall have warning labels with red lettering, mounted thereof in a conspicuous position.
D. All connections shall be made at the front of the terminal boards and no live metal shall be exposed at the back.

4.7.27 Fuses and Disconnecting Links

A. All fuse link and disconnecting link assemblies associated with electrical installation, instrument, protection and control circuits shall be of approved type and grouped as far as possible according to their functions. They shall be clearly labeled, both on the panels and the associated wiring diagrams.
B. Fuse link and disconnecting link assemblies associated with tripping circuits shall preferably be mounted on the outside of controlling compartment. All others shall be mounted internally.
C. Carriers and base for flush links shall be black. Disconnecting link carriers and bases shall be white.

D. All fuse links shall be High Rupturing Capacity (HRC) cartridge type and all fuse switches and distribution boards and the like shall be suitable for the accommodation of these fuses.
E. Each cartridge shall incorporate a fuse element of appropriate current rating and fusing factor in order that adequate protection and discrimination is provided to the circuit.
F. The high rupturing capacity (HRC) cartridge fuses of rating shown shall conform to BS 88 Part 2 Class Q1 with minimum breaking capacity of 80 KA. When fuses are used for motor protection they shall have Class R rating. Fuse bases and carriers shall be made of high-grade phenolic moulding.

4.7.28 PUSH BUTTON

A. All the push buttons shall be made of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. Unless otherwise specified, they shall be of the non-retaining type. All push buttons shall have minimum IP54 ingress protection rating.
B. The contacts of all push buttons shall be of adequate strength and have a positive wiping action when in operation.

4.7.29 INDICATING LAMPS AND FITTINGS

A. Indicating lamps fitted to the fascia of switch and instrument cubicles or panels shall be adequately ventilated.
B. Lamps shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors.
C. The bezel of metal holding the lamp glass shall be easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.

D. The lamps shall be LED type. The rated lamp voltage shall be 4% in excess of the auxiliary supply voltage AC 230V and DC 48V
E. The lamp glasses/lens shall be in the standard colors, red, yellow, blue and amber. The color shall be in the glass/lens and not an applied coating and the different colored glasses/lens shall be interchangeable.
F. Neon indicating lamps shall not be used with coloured lens.
G. Unless otherwise indicated or agreed with the Engineer, all lamp colours shall conform to the following practice:
    1. Red - red phase;
    2. Yellow - yellow phase;
    3. Blue - blue phase;
    4. White - supply available.

4.7.30 RADIO INTERFERENCE SUPPRESSION

A. All Plant and apparatus, including such items as contactors, starters, relays and the like where the normal operation is such that interruption of low frequency or direct current occur, shall be fitted with means of suppressing all interference frequencies caused.
B. The standard of interference suppression shall be in accordance with the current edition of BS 800 incorporating all amendments but extended to include the frequency ranges 300 to 360 MHz and 1.000 to 3,400 MHz.
C. Details of the equipment and methods to be used in quantitative assessment of the level of radio interference shall be as specified in BS 55016-1-4.
D. For guidance in the installation of electrical equipment to meet the foregoing standards, reference shall be made to BS Code of Practice CP:1006 “General Aspects of Radio Interference Suppression: which deals with interference caused by electrical apparatus and installations.

4.7.31 SURGE PROTECTION DEVICES

A. Surge Protection devices shall be provided whichever cable route from external or to external of the building.

PART 5 - EXECUTION

4.7.32 5.01 TESTING AND COMMISSIONING

A. All switchboards shall be tested and certified by the installation Engineer that it is safe before supply is energized, and that all the equipment comply with the requirements of the Specification.
B. Generally such tests in the factory and repeated at site are as follows:
    1. Insulation resistance tests;
    2. Earth continuity tests;
    3. Dielectric test – 3 kV DC for 1 minute;
    4. Check of clearance and creep age distances;
    5. Tests to prove correct operation of controls, interlocks, tripping and closing circuits, indications, etc.;
    6. Phasing tests;
    7. Operation of all protective gear circuits by primary injection and system fault tests to check sensitivity and stability;
    8. Test of accuracy of all measuring instruments;

9. Test operation of alarm devices;
10. Interfacing test with BMS
11. Checking of all internal cabling and function operation;
12. Above tests are minimum requirement and shall include all other tests required by the Engineer to verify compliance with the Specification.

C. Triplicate sets of all principal test records and test certificates are to be supplied for all the tests carried out in accordance with the Specification to the Engineer for approval before dispatch from the switchboard factory.

D. All costs, materials, equipment, labor, etc. necessary for the execution of the testing shall be included in this portion of work.
E. The Contractor shall include the cost for allowing the Engineer or his representative to witness the factory tests.

4.7.33 TRANSPORTATION

A. Switchboards are not allow to be delivered to site until the electrical room or switch room is in a clean and acceptable condition with lockable doors.
B. Switchboards transported to site shall be fully covered with weatherproof covers and transportation eye bolts shall be provided for handling at site.
C. Switchboards which are poorly packed and result in signs of corrosion will be rejected.
D. All necessary measures to cover and protect the switchboards at site shall be provided. Such measures shall include a complete PVC blanket over the whole switchboard or distribution board.

4.7.34 REJECTION OF SWITCHBOARD

A. If any of the above tests fail to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site, the Engineer may reject the item or defective component thereof, whichever is considered necessary, and after adjustment or modification as directed by the Engineer, the Contractor shall submit that item for further inspection and/or test. In the event of the defective item being of such nature that the requirements of this Specification cannot be fulfilled by adjustment or modification, such item is to be replaced by the Contractor at his own expense, to the entire satisfaction of the Engineer. Delivery of switchboard on site without significant cable connection (Say 80%) shall not entitle progress payment certified for material delivery on site.

4.7.35 EARTHING

A. Suitable earthing terminals or studs shall be provided on the frame for the connection of 25 mm x 3 mm copper strip to the main earthing bar in the switchroom.
B. A main earthing bar of HDHC copper with cross-sectional area in compliance with BS 7671 and BS 7430 50 mm x 6 mm shall be provided in the switchroom and to which all earthing connections shall be made. This earthing bar shall run along the wall adjacent to the full length of the main switchboard. Two connections to main earthing system shall be provided.

4.7.36 PROVISION OF ELECTRICAL SERVICES AND EQUIPMENT TO MEET LOCAL AUTHORITIES' REQUIREMENT

A. All other requirements by Local Authority that are imposed in the course of execution of the work, particularly those listed below shall be provided.

1. Danger signs;
2. Rubber floor mat of 6m thickness and 1 meter width provided for the full length of the switchboard;
3. A dry chemical type fire extinguisher of 9 kg capacity with approved label;
4. Framed single line diagram with minimum A1 size endorsed by Contractor's Qualified personnel;
5. 'First-Aid' Demonstration sign;
6. Sand for cable trenches after completion of all cable installation work, if applicable.

4.8 LUMINAIRES AND ACCESSORIES

4.8.1 General

4.8.2 Work Description

A. The luminaires schedule indicates the detail requirement of the luminaires selection. The exact luminaires of the installation subject to Engineer approval on the sample. The Contractor shall be responsible to ensure the selected luminaires suit the location of installation. No time and cost adjustment for the Contractor to provide the approved selected luminaires.

B. The Contractor shall co-ordinate the fixing detail of the luminaires, any accessories, brackets, waterproof termination box etc, required to complete the installation shall be included in the Contract

C. Certain types of electrical equipment or systems involving sudden changes, or low frequency or of direct electric current such as fluorescent lamps, contactors, etc. shall be fitted with radio and television interference suppression components suitable to meet the levels specified in BS 800 "Limits of Radio Interference characteristics of household electrical appliances".

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4.8.3 Standards

A. The manufacturing of the luminaires shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this Specification and Drawings, whichever is the more stringent and acceptable to the Engineer.

B. Following Standards to be followed

- IEC 62031 - LED used in Luminaries
- IEC 62471 - Photo-biological Safety
- IEC 61347-1 / 2 - LED drivers
- IEC 62384 - Independent driver Performance
- IESNA LM 80:2008 - Lumen Maintenance of LED light source

C. In the adoption of standards and requirements, the Contractor shall take the following precedence

1. Engineer's decision;
2. Local codes of practice;
3. Drawings;
4. Specification;
5. International standards and requirements.

4.8.4 Submission

A. All technical submissions shall be approved by the Engineer prior to he respective stages of construction.

B. As a minimum requirement, the submission shall include the following:

1. Luminaires colour cut sheet submission with manufacturer's data, lamp date, IP rating, location of installation, quantity.
2. Sample submission;
3. Lit-up sample submission as required by Engineer.
4. Lit-up sample for all lamp with indication of location of installation and manufacturer recommended lamp life span.
5. Illumination computer print out for area as required by Engineer.
6. Shop Drawings of the fixing details showing the coordinated installation details.
7. test reports for all emergency use luminaires.
8. Builder's works requirement.

4.8.5 Product

4.8.5.1 Internal Wiring within Luminaires

A. Cables interconnecting components shall be heat resisting cables and shall be neatly bundled by nylon self-locking cable ties and shall be properly routed and secured away from heat generating accessories like control gear, etc.
B. Cables used for internal wiring of the luminaires shall be of appropriate type and size. The insulation of the cables shall be able to withstand throughout the life of the luminaires the maximum temperature of not less than 105^0 C.
C. Where wiring passes through the edge of any metal section of the fitting, it shall be protected by an approved grommet. All connections of wires to terminals shall be of approved types. All wirings shall be concealed from view with the luminaires installed.
D. All cable terminations within the luminaires shall be suitably shrouded. At every luminaires, an earthing terminal shall be provided for connection to the circuit protective conductor.

4.8.5.2 led LIGHT FIXTURE

A. The LED lamp / light fixture shall comply and conform the following specification:

Luminous Efficacy	> 90 lumens/Watt
CRI	> 80
Colour Temperature	Inter Lighting Fixture 4000k External Lighting Fixture 3000k (as per BOQ & drawings)
UGR	Within the prescribed limits.
Useful Life	3000hr to 3500hr
Warranty	1 years or above

B. The body of the light fixtures shall be minimum 18 SWG sheet steel or die cast, properly de-rusted, degreased, finished in heat resistant paint, stove enamelled. Appropriate size bushed wire entry holes, fixing holes, and earth terminal shall be provided. The lamps for these fixtures shall be made with Light Emitting Diodes capable to emit the desired colour as mentioned in

drawings or BOQ. The fixture shall be supplied with appropriate driver either fixed or detached and shall be selected according to the wattage/type as indicated on drawings/ Documents.

C. Weatherproof light fixtures shall comprise of UV treated plastic body or aluminium body and gasketted clear glass cover secured to the body by means of wing nuts/screws to give a weatherproof and watertight fit. The gasket shall be weather resistance type.
D. The glass shade of the light fixtures shall be opal white or clear as furnished by the manufacturer with the light fixture unless specified and free from any air bubbles or voids. The shade may be spherical, cylindrical, flattened bottom or any other shape as specified in the drawings or BOQ.

4.8.5.3 LED FIXTURE FITTING & INSTALLATION

A. The mounting heights of light fixtures are indicated on the drawings, and position of fixtures are according to the mentioned scale.
B. The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position.

C. Glasses, shades, reflectors, diffusers, etc., must be in a clear condition after installation. An earth wire connected to the earth terminal in the fitting shall earth all light fixtures.
D. The LED light fixtures on the surface of ceiling shall be installed with the back of the body flush with the ceiling surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light fixture to the ceiling. For light fixtures installation on false ceiling the installation method/detail shall be coordinated with ceiling design and submitted for approval of Engineer. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling
E. After fabrication, metal surfaces shall be thoroughly cleaned back to the parent metal and all dust, moisture grease or oil shall be removed.
F. Except where specified or shown as being aluminium, metalware for LED Panel fittings, reflectors, channels, etc., shall be constructed from mild steel or zinc anneal sheet not less than 20SWG thickness. All corners and joints exposed to normal view shall be welded, ground smooth and filled where necessary before painting.
G. All scale and corrosion products shall be removed after which the finished article shall be cleaned with trichloroethylene.
H. The metalware shall be spray painted with high grade polyester powder coat on both sides and stoved. Total thickness of paint build up shall be not less than 50 micron. Finished colour shall be to approval on all surfaces.
I. All plastic diffuser shall be of non-deteriorating, colour stable material and of acrylic material.
J. Recessed lighting fittings shall be supported from the RC ceiling slabs using appropriate fixing accessories such as steel rod, spring clips, ceiling brackets, suspension hooks, profile brackets, etc. to ensure proper Installation of the fittings on different types of ceiling panels. Where light fittings are installed directly below large ductworks etc., the Contractor shall install suitable brackets, channels, etc. to facilitate suspension/support of the light fittings from the ceiling slabs. An adjustable resilient spring-clip shall be provided to enable the suspension length to be adjusted to fine tolerances. Suspension sets shall be adjustable proprietary make type manufactured to carry the weight of the lighting fittings and shall be of adequate lengths for installation on the false ceiling panels concerned. Suspension rods shall be of least 5mm diameter and shall fixed at positions recommended by the lighting fitting manufacturers.
K. At least four (4) suspension rods shall be provided for each fitting (Hanging Type). Lighting fittings shall be supported in a manner that will ensure that the weight of each fitting is equally

distributed to all supporting rods with the fitting remaining in level position. Suspension sets where exposed to sight shall be of adjustable rod type of minimum diameter 20mm with all necessary accessories

L. All diffusers shall be hinged at one side of the fitting for maintenance purposes and snap fit back into position.
M. All light fittings used as emergency lights including exit signs shall be constructed and installed In accordance with the current edition of BS5266 Code of Practice for the Design, Installation and Maintenance of Emergency Evacuation Lighting and Power Supply Systems in Buildings. Exit signs shall be complied with Civil Defence requirements.
N. Identification symbol in accordance with BS5266 shall be displayed on or adjacent to each emergency lighting fitting. The symbol shall not be fixed to the diffuser of an emergency lighting fitting or to removable ceiling tiles.

4.8.5.4 EXTERNAL LIGHTING

A. Lighting poles for the pole lights shall be constructed using hot-dip octagonal steel columns with the base compartment housing the lamp fusegear which shall consist of a single fully shrouded single pole and neutral single entry type cut-out with HRC fuse, appropriate size MCB complete with cable sealing box, armour clamps and compression gland, where required, suitable for reception of looping PVC/SWA/PVC cables or PVC cables of the sizes as required. The finishing colour coat shall be subject to the Engineer's approval.

B. Wiring between lamp and cut-out MCB shall be three core 2.5sq mm tinned annealed circular copper conductor PVC insulated black PVC sheathed.

C. Weather proof connection board shell be provided for the supply of landscape lighting as indicated on the drawings.

D. Lightning protection earth electrode for pole lighting higher than 6 m shall be provided by the Contractor.

A. Electronic ballasts shall be of high frequency fixed output type, low loss of less than 5 watts, suitable for T5 slim fluorescent tubes. All electronic ballasts shall comply with IEC928, IEC929 and BSEN55015 where required.

4.8.5.5 LED FIXTURE LIFE SPAN

A. The selection of luminaires shall take into account the requirements for heat dissipation, weatherproofing, insect proofing and the vibrations at the location of the installation. All luminaires installed in the Works shall have a minimum fixture operation life of not less than 80% of the average lamp life stated by the lamp manufacturer. If any lamps fail before this time, this will be treated as evidence of non-compliance of all the lamps of the same type in the installation concerned and in other installations which have the same performance criteria. The Contractor will be held responsible for the replacement cost of the affected lamps and all lamps of the same type in installations with the same performance criteria.

4.8.5.6 Led Tube

A. Master LED should be capable to operate between -20ºC to 45ºC ambient temperature. While its storage temperature should be in the range of -40ºC to 65º .
B. Rated average life of LED shall be 40,000 hours. There shall be no mercury and glass in LED. LED should not have any breakage and pollution risk.

C. Led should has 50,000 switching cycles and 80 CRI. Master LED tube should contains only visible light.
D. Master LED should be suitable to be fix in any fluorescent fitting / fixture. But MAS LED tube STD 1200mm should be 100% comply with IEC requirement on T8 dimension.

4.8.5.7 Decorative Poles

E. The pole shall be made of hot dip galvanized having wall thickness minimum 4mm. The material grade shall be LM3.The length and other dimensions of the pole shall be as per drawings.
F. Poles shall be electrically welded (if required) with the joints. Excessive porosity and lack of fusion in welding may be removed by chipping and the joints should be re-welded so as to ensure dependable operation of the poles. The decorative pole shall be hot dip galvanized with fiber coated with black finish, while conventional poles shall be hot dip galvanized and octagonal shape suitable for highly corrosive area (as per Architect/client requirement). The pole shall be Corrosion resistant. The Pole structure should be suitable for safe wind pressure of 160 Km/hr.
G. Contractor shall submit the following details.

- Details and its welding procedure and material used in the welding.
- Shop drawings of the offered pole.

H. The manufacturer/supplier shall provide quality assurance certificate.

I. The transport and storage of poles at site shall be carried out in a neat and clean manner. Wooden rack with appropriate grooves shall be provided for stacking of poles to prevent any direct contact with ground. Any pole damaged during transportation or storage or installation shall be replaced by the contractor without additional cost to the Employer. Any damage to paint work shall be made good before installation by the contractor free of cost. Poles shall have self-locking inspection door operable with special key only. Pole inner compartment or pole inside diameter in front of inspection door shall be suitable to hold cable connection box. The details of pole shall be as per drawings.

4.8.5.8 Pole Light Fixtures

A. Material

The Road light fixture shall be as per international standard and made of non-corrosive high pressure molded aluminum housing, minimal glare, body in silver / grey/black color, achromatizing treatment, Operation Life minimum 50,000 hours and made by one of the approved manufacturers, complete in all respects. Metalized high purity aluminum reflector, complete with following components:

1. LED Lamp suitable for automation system.
2. Vertically & horizontally adjustable, plastic or porcelain lamp holder,
3. Color temperature 3000k
4. LED driver
5. Lamp compartment shall be IP-66

6. The light fixture should be fully comply with safety norms according to IEC 598/ ENEC 60598.
7. All imported and factory assembled, as per sample approved by the Engineer.
8. Minimum Lumen output 120 lumen/01watt
9. Power Factor not less than 0.9
10. The light fixture shall be posted on pole as shown in drawings.
11. All fixing screws, nuts, bolts shall be stainless steel.

Contractor shall submit certification of the fixture that reflector shall not get dull due to excessive heat in lamp compartment. 2% aging per year is the acceptable tolerance.

B. LED Driver

LED driver shall be of the removable type for operation at 230 volts, 50 Hz, power factor compensation at least 0.85. Minimum life of driver shall not be less than five years.

4.8.5.9 POWER SUPPLY / WIRING FROM TERMINAL BOX TO LIGHT FIXTURE

The wiring between the line conductor and light fitting shall be made with 2.5mm2 three core PVC/PVC insulated wire .The 6 amp SP breaker of 6 kA rating shall be used for lamp protection (for one lamp) and shall be installed in terminal box. The connection terminal shall be built-in type as shown in drawing. The conductor separate earth conductor shall earth the pole. Every pole of street light circuit shall be earth by rod driven into the ground as shown in drawings.

External lighting shall be controlled automatically or manually as specified and indicated on the drawings. Automatic control shall be installed comprising time switch, time relay, photo sensor, contactor, dimming controller etc.

4.9 SWITCHES & SOCKET

4.9.1 LOCAL SWITCHES

a. The local switches shall be 10/20 amp. Gang type , one-way, two-way, intermediate or double pole as indicated on the drawings. Where more than one switch is indicated at any position multiple gang units shall be used.

b. Switches shall be of the quick start make; slow break type specially designed for AC circuits to BS Standards. The operation of the switch shall not depend wholly on the action of the spring. The switches shall generally be of the rocker operated type.

c. All switch boxes shall be supplied with adjustable steel grids and earthing terminals.

d. Generally, switch units shall be of the adjustable grid pattern and to be secured to the adjustable grid by means of screws. For flush mounting switches the switch-plate shall overlap all edges of the box by not less than 7mm. For surface mounting switches the switch plate shall finish flush with the edges of the switch boxes. Switches for water heaters and fan coil units shall be complete with neon indicator lights.

e. In Plant rooms the switch units shall be surface or flush as required.

f. Local switches shall be arranged in convenient positions for switching the various circuits and generally as indicated on the drawings.

g. The switches shall be of the same manufacture for a particular type of switch throughout the installation. All accessories in wet and damp areas shall be of the splash-proof type to IP54 protection standard.

h. All switch boxes should be galvanized steel.

i. To ensure easy and correct connection of the conductors during installation, the necessary terminal shall be easily identified, grouped in line, upward facing, captive and backed out prior to the installation.

j. All dimmer switches shall be suitably rated to the lighting load being Controlled with 25% spare capacity and shall be adequate for tungsten and / or fluorescent lighting as specified.

4.9.2 POWER OUTLETS

a. The switch socket outlets, shall be in accordance with BS1363 Standard as appropriate and shall be of the three-pin grounding type.

b. Switch socket outlet in the different areas shall comply with section 607 BS7671 :2001

c. Live contact of the socket shall be completely shuttered such that it is not possible to engage any pin of the plug into a live contact whilst any other pin of the plug is exposed.

d. All floor mounted socket outlets shall be fixed as part of the under floor trunking service boxes.

e. These outlets shall be of the same manufacturer throughout the installation.

f. The sockets should provide a double earth terminal as per latest BS7671, 2001, Section 607.

4.9.3 FUSE CONNECTION UNITS / DP SWITCHES

a. 3.1 These shall be of flush or surface mounting type as manufactured in compliance with BS Standard as appropriate. The fuse connection units shall incorporate integral switch, neon indicator and 20-amp fuse links. The DP switches supplied for water heaters shall be incorporated with neon indicator lights, and these also shall be engraved 'Water Heater'.
b. 3.2 These shall be of the same manufacturer for a particular type of switch throughout the installation and shall be complete with the other accessories installed.
c. 3.3 Fuse selection shall be based on actual requirement of equipments.

4.9.4 G.I BOXES

GI boxes to be provided with brass earth terminal to facilitate earth wire connection. The boxes to have sufficient number of 20mm and 25mm knockout. The boxes thickness shall be 1.1mm minimum and shall comply with BS 4662. Boxes to have adjustable lug for proper installations of wiring accessories. Extension ring to be used along with GI boxes, in places where the box is deep inside the wall, marble or concrete.

4.9.5 ISOLATORS

All external isolators must have IP-65 protection with aluminum alloy or die-cast aluminum housing with bolt on drip proof canopy. Isolators must be de-rated for 50 deg. Ambient temperature. Internal isolators shall be IP 54 / IP 65 depending on the location with polycarbonate housing for non-armored cables.

4.9.6 Floor Service Boxes

Floor Service Boxes shall be two-compartment type of the size 300 x 300 x 75-90mm (or as specified in BOQ) and shall be constructed from high-pressure Zinc Alloy die casting base frame pillars. This shall be fixed on to heavy gauge galvanized steel base plate for support by support frame. Other materials adequate in strength and performance shall be used and these shall be protected against corrosion. The boxes shall be constructed with provisions for ducting or conduit access on all four sides. Unwanted entries shall be blanked off with detachable side blanks.

Cover for floor service boxes shall be made of high-pressure zinc alloy die casting provided with suitable hinges designed to enable the trap cover to open through 180 degrees and giving access at all times to the power and telephone outlets.

Covers for junction boxes shall be made of high-pressure Zinc Alloy die casting with 12mm recess to receive ceramic tiles or carpet tiles. Counter sunk screws shall secure the covers of boxes. All exposed portions of the boxes shall be epoxy coated in grey color.

All boxes shall have extra wide gaskets in order to minimize water seepage. Gaskets shall be made of material that is durable in order to withstand loads.

All boxes shall be adjustable in height independently of the ducting system to take account of difference in floor thickness.

Adequate segregation shall be provided between service runs within boxes by using cross-over bridges and rigid compartments.

Circuit protective conductors shall be provided between the covers and the boxes.

Cable emerging for service boxes shall be protected against damage by means of nylon cables exit grommets or equivalent and shall be reversible to close position when not in use.

4.9.7 ACCESSORIES PLATE FINISH

All the wiring accessories shall be vandal proof. The accessories plate shall have the following finishes depending on the location where it is installed and on the feeding arrangement.

Switches to comply with BS 3676:2000, and sockets to BS 1363, ceiling rose to BS67 : 1999.

a) All external outlets and outlets in pump room and parking shall be weatherproof to IP-66.

b) Weatherproof range should be suitable for semi recessed mounting and supplied with back boxes.

c) All outlets above false ceiling, store, etc. shall be white plastic.

d) Switches and outlets in apartments shall be white plastic slim type.

e) Main entrance, common area and lift lobbies shall be matt chrome steel face plate slim type.

f) Outlets in Electrical rooms, Mechanical floors, Tel. Rooms, etc shall be metal clad.

g) All switch plates including SSOs are to be coordinated with tiling layouts by prior agreement with the Architect on site.

4.9.8 MOUNTING HEIGHTS

The mounting heights for the electrical equipment and accessories shall be coordinated with the furniture layout and shall be as per site requirements to Engineer's / ID's instruction and approval. In general, the mounting heights from FFL to center of fixtures shall be as shown in legend.

4.10 LOW VOLTAGE POWER CABLE

PART 1 - GENERAL

4.10.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

4.10.2 DESCRIPTION OF WORK:

A. Work Included: Provide low voltage electrical conductor, cable, wire, and connector work as shown, scheduled, indicated, and as specified.

B. Types: The types of low voltage electrical conductor, cables, wire, and connectors required for the project include, but are not limited to, the following:

1. 600/1000 volt building wire and cable.

2. 600/1000 volt building wire and cable connectors.

4. 300/500 volt control/signal wire and cable.

5. 300/500 volt control/signal wire and cable connectors.

C. Application: The applications for cable, wire, and connectors required on the project are as follows:

1. Power distribution circuitry.

2. Lighting branch circuitry.

3. Appliance, receptacle and equipment branch circuitry.

4. Motor branch circuitry.

5. Control wiring.

6. Outdoor lighting and power.

4.10.3 STANDARDS:

A.Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

BS 6346 PVC insulated, armoured cables for voltages of 600/1000V and 1900/3300 V

BS6004 Polyvinyl Chloride (PVC) insulated and PVC over sheathed cables - up to 300/500V – for electric power and lighting.

BS6724 Thermosetting insulated armoured cables - 600/1000V to 1900/3300V - with low emission of smoke and corrosive gases when affected by fire.

B. Where application of applicable codes, Trade Association standards, or publications appears to be in conflict with the requirements of this Section, an interpretation shall be obtained from the Architect/ Engineer.

4.10.4 QUALITY ASSURANCE:

A. Manufacturers: Provide products complying with these specifications and produced by the manufactures provide in the list with BOQ.

4.10.5 SUBMITTALS:

A. Shop Drawing submittals shall include, but not be limited to, the following:

1. The Contractor shall submit to the Engineer for review, a list of the proposed manufacturers

of wire and cable, cable lugs, cable connectors and termination fittings listed herein. The Contractor may install wire and cable, cable lugs, cable connectors and termination fittings furnished by any manufacturer listed on the approved submittal.

2. Cut sheets on all 300/500 and 600/1000 volt conductors with manufacturers name, ratings and capacities, insulation characteristics, and available colors, clearly listed.

3. Cut sheets indicating all cable lugs, termination fittings and cable connectors.

4. Cut sheets indicating types of conductor identification bands.

4.10.6 DELIVERY, STORAGE AND HANDLING:

A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory-packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire, or connectors shall be removed from project site.

B. Store cable, wire, and connectors in their factory-furnished coverings, and in a clean, dry indoor space which provides protection against the weather.

PART 2 - EXECUTION

4.10.7 INSTALLATION

A. General: Install electrical cable, wire and connectors as shown, in accordance with the manufacturer's written instructions, the applicable requirements of "Standard of Installation", and recognized industry practices to ensure that products serve the intended functions.

B. Coordination:

1. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

2. Installer shall examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

C. 600 Volt Building Wire and Cable:

1. Mains and feeders are to be run their entire length in continuous pieces without joints or splices[, unless otherwise indicated or noted].

2. Conductors may be run in multiple on sizes inclusive, provided all multiple conductors are the same size, length, and type of insulation, and are so arranged and terminated as to ensure equal division of the total current between all conductors involved.

3. Before any wire is pulled into any conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material and to permit the wire itself to be pulled into a clean, dry conduit. All conductors shall be pulled into the conduit at the same time.

D. 300 Volt Control/Signal Cable and Wire:

1. Install all low voltage wiring in a suitable raceway except in areas with accessible (lay-in) ceilings unless otherwise noted on Drawings Where cable is routed without a raceway, bundle all cables and suspend to one foot above ceiling using loop rings on 5' centers. Do not run cable loose on top of suspended ceilings. Do not attach cables to suspended ceiling supports or any mechanical, plumbing, or sprinkler piping. Conceal conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.

2. Number code or color code conductors appropriately for future identification and servicing of the system. Refer to consultants advice for additional requirements.

4.10.8 TESTING:

A. Feeder Insulation Resistance Test: Each new [and reused existing] 600 volt feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination.

1. Tests shall be made using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 volt dc. Resistance shall be measured between phase, neutral, and ground conductors and from conductors to raceway (ground). Readings shall be taken after 30 seconds and 60 seconds of Megger operation at slip speed and insulation resistance shall not be less than the 1 MΩ

2. New conductors which do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.

3. Where reused existing feeders fail to meet the above insulation requirements, notify the Engineer in writing for direction prior to placing the existing feeders back in service.]

B. Neutral Testing: After all feeder and branch circuit conductors are terminated, neutral to ground testing shall comply with the following:

1. The resistance of the system's neutral to ground shall be greater than 10 kΩ with the system-bonding jumper disconnected.
2. Repeat neutral to ground test for neutrals of separately derived systems.

C. Pre-energization Check: Prior to energization, check all new [and reused existing] branch circuit cable and wire for continuity of circuitry and for short circuits. Correct malfunction when detected. No submittal is required for this test.

D. Voltage and Current Values: The voltage and current in each main feeder conductor shall be measured and recorded after all connections have been made and the feeder is under load.

E. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, test results, relative humidity, temperature, and weather conditions.

4.10.9 AS BUILT DRAWINGS

A. As-Built Drawings: Refer to Section, "Electrical General Provisions", for applicable requirements.

4.11 INDOOR UNITS

CEILING CONCEALED DUCT TYPE

Ceiling concealed duct type indoor unit shall be two pipe. Basic unit shall be single skinned construction from high quality 1.3mm thick galvanized steel with 11mm glass cloth laminated PU foam.

THE MAXIMUM HEIGHT FOR THE UNITS OF 4 TR SHALL NOT BE MORE THAN 380MM.

Unit to be equipped with factory installed brackets for hanging. Control box to be easy for replacement with an option of fixing on both side of the unit at site.

DRAIN

Wherever required, units to have optional drain pump to lift condensate water up to 700 mm height.

INDOOR AIR QUALITY

Units are to have accessible filters designed for obtaining optimum air quality.
Standard filters: units shall have antibacterial and washable permanent filter.
Electronic filter (Neo Plasma Filter): wherever applicable units should have an option of factory installed & tested high Efficiency plasma filter to remove all the microscopic contaminants, dust, odor molecules etc. to maintain high level of indoor air quality in areas as specified in the schedule

COILS

Coated with special "MAGIC" coating to avoid formation of condensate water droplets and thereby ensure dry coil conditions. This will prevent corrosion and reduce resistance to airflow.
Coils shall be made of staggered seamless copper tubing mechanically bonded to 0.12 mm aluminum fins. The evaporator coil shall be minimum two rows deep.

MOTORS

The motors shall be BLDC motor & have thermal overload protection. The motors shall be single phase and permanent split capacitor type. Further linear electronic adjustment of motor speed through remote controller It should be able to precisely balance airflow as per actual external static pressures.

CONTROLS

The units shall be equipped with Auto Restart function, which allows the unit to start in the same mode prior to the power failure

SMART CONTROLS

The units shall have the following state of the art features.
Twin thermistor sensor to sense temperature in the room and in the return air with an option of selecting

one or both depending on the application for uniform and precise temperature control.
Group control to control up to 16 units from single LCD wired remote controller.
Central control to control up to 128 units from a central location.
Optional Tele control to operate individual units via telephone line for units if required.
Flexible temperature control at Night mode.
Optional BMS gateway for connectivity to third party BMS system.
The controller should be capable to provide error or alert code for refrigerant leakage.
Energy monitoring for each system through indicating accumulated power consumption.

DIGITAL THERMOSTAT:

Units shall be controlled with user friendly, wall mounted microprocessor based LCD, wired remote controller. The wired remote controller shall be slim having the following features:

- 24 hour ON / OFF timer in 1 hour interval.
- Test run mode.
- Self-diagnosis function.
- Operation indication.
- Room temperature display.
- Weekly programming.
- Child-lock function.
- Speed fan control.
- Linear control of E.S.P/Airflow.

The wireless remote control should be available as an option, if required.

CEILING CASSETTE TYPE (4 WAY, 2 WAY & 1 WAY)

The Ceiling Cassette shall be factory assembled, wired and run tested. The unit shall have a self-diagnostic function, 3 minute time delay relay, auto restart function, and test run switch.
Four way grill shall be fixed to bottom of cabinet allowing, two or four way blow

FAN

The evaporator fan shall be an assembly with a turbo fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have three speeds; High, medium and Low. The controller shall have a selector switch to increase the rpm of the motor in case of the height of ceiling is increased.
The indoor unit shall have adjustable air outlet system offering 4-way, 2-way or 1-way airflow. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

FILTER:

Return air shall be filtered by means of a long life permanent filter. The option of plasma filter should be available for better filtering efficiency.

COIL

The tubing shall have inner grooves for high efficiency heat exchange. The pipe connection to the Indoor units shall be flare connection. Brazing at the pipe connection shall not be permissible. The condensate pump shall be able to raise the drain water 700 mm above the condensate pan.

CONTROLS:

The units shall be equipped with Auto Restart function, which allows the unit to start in the same mode

prior to the power failure.
SMART CONTROLS:
The units shall have the following state of the art features:
Twin thermistor sensor to sense temperature in the room and in the return air with a option of selecting one or both depending on the application for uniform and precise temperature control.
Group control to control up to 16 units from single LCD wired remote controller.
PC Central control - 2048 units, Deluxe Central Control-256, SCC-128 units can be controlled from a central location.
ACP & AC Manager central controller shall be able to control upto 4096 indoor unit either through LAN or Wired.
DIGITAL THERMOSTAT:
Units shall be controlled with user friendly, wall mounted microprocessor based LCD, wired remote controller. The wired
Remote controller shall be slim having the following features:

- Test run mode.
- Self-diagnosis function.
- Operation indication.
- Room temperature display.
- Weekly programming.
- Child-lock function.
- Speed fan control.
- Linear control of E.S.P/Airflow.
- Auto swing
- Clean filter indication

The wireless remote control should be available as an option, if required.
The tenderer shall supply the following information**.**
(a) Capacity of unit.
(b) Power Consumption.
(c) Air Flow and static pressure of DX evaporator.
(d) Manufacturer's performance guarantee certificate. (e) Over all dimensions.

CENTRAL CONTROLLER (ACP)

The central controller shall be 7" touch screen module, wall mounted and should have the following feature:
Mode control, temperature control etc and monitoring of up to 64 unit (A/C & Ventilation) is possible by Zone/Group/Unit

i. You can monitor the operating status by Icon or List View so you can operate the controller very easily 2.AC Smart is directly connected to Outdoor unit (Internet A and B).
ii. Individual indoor Function control locking so that except administrator nobody can change the function. (Temperature, Mode, Fan Speed separately)
iii. Temperature Setting Range restriction on individual controller, so management is very powerful and energy saving is possible

Technical Specifications

iv. v) In schedule setup administrator can schedule the indoor Operating as well as the function locking

v. Operating and error history is saved in AC Smart

vi. It has Automatic control function, Auto changeover and temperature limit, Auto Changeover function is automatically change operating mode cool and heat, so no need of changing the mode in season change period Temperature limit function. Protect the building from freezing and overheat by auto operation and auto stop

vii. You can select the AC Smart displays language [English, Spanish, French, German, Dutch, Italian, and Russian]

viii. By using Emergency Stop Interlocking function. You can connect fire detect sensor to AC Smart, when fire happened, all air conditioner

ix. will be stop automatically

x. Easy upgrade the software by using USB

xi. Compatible with VRF System as well as single unit, also, connect with Simple Central controller

xii. By using Expansion Kit, Maximum 128 Indoor Unit can be connected

xiii. When not using Central Controller, AC Smart can display Digital Watch

xiv. In AC Smart Monitoring, report of each indoors operation time & operation ratio, is available.

xv. By using this, you can distribute the power consumption by referring to the information

xvi. In Temperature Limit control, the setting range of temperature was expanded, so you can use it for more comfortable function.

xvii. For example, In the hotel, when customer key out the hotel card key, Indoor temperature will be increased, then AC Smart will operate the indoor, and automatically turn off after temperature is decreased,

xviii. New Auto control of AC Smart, Time Limit control: You can set the time limit from1~4Hrs and set available day of week.

xix. In time limit function for available period, indoors can operate up to maxim setting time continuously. For example: Set as 2 Hr and available on Saturday & Sunday.

xx. When someone operates the indoor, AC Smart will check the continuous operating time. If the time is over 2hr, AC Smart will automatically stop the indoor operation.

xxi. Web Access Function is available basically, so you can access AC Smart anywhere by using Internet Explorer. Web Access level is distinguished to 2 Level: Administrator and User.

xxii. When logged in as administrator: Can register user ID & Password, and allocate accessible address for each user; can operate all indoor. When login to user: Can operate allocated indoor for each user.

xxiii. New e-mail function was applied: By using this function, you can register e-mail address. So when error occurs or some fixed time automatic e-mail will be executed, so customer can easily maintain all connected air conditioners status

ELECTRICAL WIRING

TRANSMISSION AND POWER CABLE

i. Transmission cable shall be shielding wire CVVS or CPEVS, diameter shall be over
ii. 1.25mm2, insulation material shall be PVC, Maximum allowable temperature shall be 60
iii. and Maximum allowable line
iv. Length shall be 1,000m.
v. Remote Control cable shall be 3-core type
vi. iii) Simple central control cable shall be 4-core type (Shielding wire), Diameter shall be over 0.75mm2 and insulation material shall be PVC.
vii. Separation of transmission and power lines to prevent interferences is required.

WIRING OF MAIN POWER SUPPLY AND EQUIPMENT CAPACITY

Use a separate power supply for the Outdoor Unit and Indoor Unit.
Power & Control wiring for the indoor & outdoors shall follow the arrangement proposed by the manufacturer of the equipment.

4.12 MAIN DISTRIBUTION BOARD (MDB) FOR PUMP ROOM

Description

The **Main Distribution Board (MDB)** for a pump room is an electrical panel that distributes and controls power to water pumps, control panels, and auxiliary electrical equipment. It ensures the safe and efficient operation of pumps by providing protection against overload, short circuits, and power surges. The MDB houses circuit breakers, switches, contactors, and meters to regulate the electrical supply.

Material

- **Panel Enclosure:**
  - Fabricated from **mild steel (MS) sheet**, minimum **14 SWG (2 mm thick)**, powder-coated for corrosion resistance.
  - Protection rating: **IP54/IP55 (Indoor use), IP65 (Outdoor use)** as per **IEC 60529**.
  - **Ventilation louvers** or cooling fans for heat dissipation.
- **Busbars:**
  - High-conductivity **electrolytic copper** or aluminum, **99.9% pure copper**.
  - **Current density:** 1.6 A/mm² for copper, 1.0 A/mm² for aluminum.
  - Color-coded with **heat-shrinkable sleeves** (Red, Yellow, Blue for phases, Black for Neutral, Green for Earth).
- **Circuit Protection Devices:**

Technical Specifications

  - **Air Circuit Breaker (ACB) / Molded Case Circuit Breaker (MCCB):** Rated as per pump load requirements.
  - **Miniature Circuit Breakers (MCB):** For small auxiliary loads.
  - **Residual Current Circuit Breaker (RCCB) / Earth Leakage Circuit Breaker (ELCB):** For protection against leakage currents.
  - **Surge Protection Device (SPD):** For voltage surge protection.
- **Control Components:**
  - **Pump Starter (DOL/Star-Delta/VFD Panel)** based on motor type.
  - **Relays and Contactors:** Heavy-duty, rated for motor loads.
  - **Digital Multifunction Meter (V, A, Hz, kW, kWh, PF).**
- **Wiring & Terminals:**
  - **Cables:** Flame-retardant, low-smoke **XLPE insulated copper cables** as per IS 7098.
  - **Terminals:** Heavy-duty, brass or copper-plated lugs.

Job Conditions

- **Environmental Considerations:** Temperature should not exceed **40°C**; humidity <95%.
- **Space & Accessibility:** Ensure sufficient clearance for easy operation and maintenance.
- **Ventilation:** Proper cooling or exhaust fans for heat dissipation in enclosed rooms.
- **Earthing System:** Dedicated earthing connection as per **IS 3043**.
- **Load Calculation:** MDB rating must be sized based on pump motor load demand and future expansions.

Installation

a. Preparation & Handling

- Inspect the panel for physical damage before installation.
- Verify MDB rating and components as per approved electrical design.
- Transport carefully to avoid damage to busbars and components.

b. Mounting & Positioning

- Install the **MDB at a suitable height (1.5m - 1.8m from the ground)** for easy operation.
- Fix securely on a **vibration-free foundation** using anchor bolts.
- Maintain **clearance space (minimum 1 meter in front and 600mm on sides)** for maintenance.

c. Wiring & Connections

- Ensure all connections are **torque-tightened** as per manufacturer guidelines.
- Separate **power and control wiring** to avoid electromagnetic interference.
- Use proper **gland and ferrule identification** for all cables.

d. Earthing & Testing

- Connect **earthing busbar** to the main earthing system (Earth resistance <5 ohms).
- Conduct **Insulation Resistance Test (Megger Test)** before energizing.

Technical Specifications

- Perform **load testing** to check the voltage drop and power factor.

Adjusting and Fixing

- **Voltage & Load Balancing:** Ensure uniform load distribution across all phases.
- **Breaker Calibration:** Adjust circuit breakers and relays as per motor startup current.
- **Protection Testing:** Simulate **overload, short circuit, and earth leakage faults** to verify protection settings.
- **Final Inspection:** Verify all electrical connections, labeling, and safety features before commissioning.

4.13 ENERGY SAVERS

Description

Energy savers are devices or systems designed to **optimize power consumption, reduce energy losses, and enhance efficiency** in electrical installations, including pump rooms. These systems help in **power factor correction, voltage stabilization, load balancing, and harmonic filtration**, ultimately lowering energy costs and extending the lifespan of electrical components. Common energy-saving technologies include:

- **Variable Frequency Drives (VFDs):** Regulate pump speed based on demand, reducing power wastage.
- **Power Factor Correction (PFC) Units:** Improve power factor to minimize reactive power losses.
- **Harmonic Filters:** Reduce harmonic distortions and improve power quality.
- **Automatic Voltage Regulators (AVR):** Maintain a stable voltage supply, preventing energy losses.
- **Energy Management Systems (EMS):** Monitor and control power consumption efficiently.

Material

- **Enclosure:**
  - Fabricated from **mild steel (MS) sheet**, **2 mm thick**, powder-coated for **corrosion resistance**.
  - Protection rating: **IP54/IP55 (Indoor use), IP65 (Outdoor use)** as per **IEC 60529**.
  - Equipped with **ventilation louvers or cooling fans** to prevent overheating.
- **Electrical Components:**
  - **Capacitors:** Low-loss, self-healing, oil-filled or dry type, rated as per **IEC 60831**.
  - **Contactors & Relays:** Heavy-duty, electrically controlled, rated for continuous operation.
  - **Microcontrollers/Processors:** For real-time energy monitoring and optimization.
  - **Current Transformers (CTs):** For accurate energy measurement and load monitoring.
- **Wiring & Terminals:**
  - **Cables:** Flame-retardant, low-smoke **XLPE insulated copper cables** as per **IS 7098**.
  - **Busbars:** High-conductivity **electrolytic copper**, 99.9% purity.
  - **Terminals:** Brass or copper-plated heavy-duty lugs.

Technical Specifications

Job Conditions

- **Environmental Considerations:**
  - Operating temperature: **0°C to 50°C**.
  - Humidity level: **<95% (non-condensing)**.
- **Space & Accessibility:**
  - Ensure proper clearance for easy maintenance.
  - Ventilation or cooling system must be in place to **dissipate heat** generated by the equipment.
- **Electrical Load Considerations:**
  - Energy saver devices must be sized based on **pump motor ratings and system load requirements**.

Installation

a. Preparation & Handling

- Inspect all components for **physical damage or manufacturing defects** before installation.
- Ensure proper grounding and **compliance with electrical safety standards**.
- Verify **device compatibility** with existing electrical infrastructure.

b. Mounting & Positioning

- Install the energy-saving system at an **accessible height (1.5m - 1.8m from the ground)**.
- Secure the unit on a **vibration-free foundation** using anchor bolts.
- Maintain a minimum clearance of **1 meter in front** and **600mm on sides** for easy maintenance.

c. Wiring & Connections

- Ensure **torque-tightened** connections to prevent overheating and electrical faults.
- Use **separate power and control wiring** to avoid electromagnetic interference.
- Label all terminals and cables with **ferrule identification** for easy troubleshooting.

d. Earthing & Testing

- Connect the **earthing busbar** to the main earthing system (**Earth resistance <5 ohms**).
- Conduct an **Insulation Resistance Test (Megger Test)** before energizing.
- Perform a **Load Test** to check power savings, power factor correction, and voltage regulation.

Adjusting and Fixing

- **Calibration & Load Balancing:**
  - Adjust settings to optimize **power factor and load distribution**.

Technical Specifications

    - Fine-tune **voltage stabilization and harmonic filtering** as per system needs.
- **Protection & Safety Testing:**
    - Simulate **overload and short circuit conditions** to verify the system's safety features.
- **Final Inspection & Commissioning:**
    - Ensure all connections, labeling, and safety measures comply with **electrical standards**.
    - Conduct **energy efficiency analysis** to verify power savings.

SECTION 5: PLUMBING WORKS

7 PLUMBING SYSTEM

SCOPE OF WORKS

The work covered by this section consists of providing all material and equipment and performing all the work necessary for the complete execution and completion, including testing and commissioning of all systems of Plumbing works as specified in this document and as shown on the Drawings or as directed by the Engineer.

All the above mentioned systems complete in all respects including connection of the internal systems with the external systems are included in the scope of work.

All the materials and equipment shall be of the specifications mentioned herein and shall be limited to products regularly produced and recommended by the manufacturers for the service intended. Contractor shall submit samples, necessary catalogue, sketches, the name of manufacturer and guarantee, if necessary, before installation for approval by the Engineer. All material and equipment shall be new and unused.

All other equipment and material shall be installed in strict accordance with manufacturer's instructions. These instructions shall be considered as part of specifications.

It is specifically intended and shall be agreed to by the Contractor that any material or labor which is usually furnished as a part of such equipment and which is necessary for its proper completion and best operation shall be furnished as a part of this contract without any additional cost whether or not shown in detail on the drawings or described in detail in the specifications.

The Contractor shall be responsible for his work until its completion and final acceptance and shall replace any of the same which may be damaged, lost or stolen without any additional cost to the Employer.

All openings left in floor for passage of ducts, pipes and cables etc. shall be covered and protected.

All open ends of pipes shall be properly plugged off to prevent any foreign material from entering the pipe during installation.

The Contractor shall allow in his bid for the cost of all cutting, making of holes and subsequently making good to the desired finish as approved by the Engineer. No separate payment shall be made for this item. Also the Contractor shall allow in his bid for the cost of providing protective painting or coating as specified in the relevant sections and no claim shall be entertained for this item.

The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings but the Engineer reserves the rights to change the locations. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping so installed, the Contractor shall be held liable for any injury caused to other work in the correction of piping. For any expedient change, the Contractor will correctly show it in shop drawings. A minimum distance between different services shall be maintained as shown in the contract documents or as approved by the Engineer.

All exterior openings provided for the passage of piping and ducting shall be properly sealed with snugly fittings collars of metal of other approved rat-proof material securely fastened in to place. Joints at the roof, around ducts and pipes, shall be made water-tight by the use of lead, copper, galvanized iron or other approved flashings of flashing material. Exterior wall openings shall be made water-tight.

Piping in ground shall be laid on a firm bed for its entire length. No separate payment shall be made for any earth work required in connection with laying of piping in ground. Piping shall be installed without undue strains and stresses. Vertical piping shall be securely held to keep the pipe in alignment and carry the weight of the pipe and contents. Horizontal piping shall be supported to keep it in alignment and prevent sagging. Hangers and anchors shall be of metal of sufficient strength to maintain their proportional share of pipe alignments and prevent ratting. Hangers and

anchors shall be securely attached to the building construction.
The Work shall conform in all respects to local Municipality, and any other authorities having jurisdiction.
The systems shall be in accordance with the requirements of the Civil Defense Department and National Fire Protection Association (NFPA).
These specifications are supplementary to the requirements above. All required approvals of shop drawings and materials shall be obtained by the Contractor from the appropriate authorities before proceeding with work on site.
All connections to/from city points of utilities supply/discharge shall be the mechanical Contractor's responsibility.

REGULATIONS

The Work shall accord strictly with all rules, regulations, By-laws and requirements of all authorities having jurisdiction.
Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the Contractor shall notify the Engineer in writing and obtain clarification before proceeding with the Work.

CODES AND STANDARDS

The installation shall comply with all relevant statutory instruments and regulations and in particular with the following:

1. The IEE regulations for electrical equipment in buildings.
2. Any Regulations under Electricity.
3. Local Health and safety at work regulations.
4. Local Control of Pollution Regulations.
5. ASHRAE standards.
6. ASME standards.
7. British Standard.
8. National Plumbing Code
9. Standards mentioned elsewhere in these documents

The Tender shall be based on regulations and standards current on the date of return of tenders. If these regulations are amended or new regulations are enacted after that date, the Engineer shall be notified immediately.
The materials, equipment and installations detailed in this specification are based on the standards and codes of practice indicated in the Contract Documents. In the event of a contradiction between this specification and any applicable standard or Code of Practice, this specification shall govern and the Engineer shall be notified immediately.
Where material and equipment are specified under a particular standard and supplied under an equivalent standard, a certificate of compliance shall be provided to the Engineer at his request.

ABBREVIATIONS

Generally, the following abbreviations are used in this Division

a) ANSI : American National Standards Institute
b) ASHRAE : ASHRAE
c) ASME : American Society of Mechanical Engineers.
d) ASTM : American Society for Testing and Materials
e) AWWA : American Water Works Association

f)	bhp	:	boiler horsepower or brake horsepower
g)	BS	:	British Standard
h)	Btu/hr	:	British thermal units per hour
i)	BWG	:	British Wire Gauge
j)	CFM	:	cubic feet per minute
k)	CI	:	cast iron
l)	CSA	:	Canadian Standards Association
m)	Dia	:	diameter
n)	EEMAC	:	The Electrical and Electronics Manufacturers' Association of Canada
o)	° F	:	degree Fahrenheit
p)	° K	:	degree Kelvin
q)	ft	:	feet
r)	gpm	:	gallons per minute
s)	hp	:	high pressure or motor horsepower
t)	lbs	:	Pounds
u)	lbs/ft3	:	pounds per cubic feet
v)	NBS	:	National Bureau of Standards
w)	N.C.	:	Noise criterion as define by graph in ASHRAE.
x)	NFPA	:	National Fire Protection Association
y)	NPSH	:	Net positive Suction Head
z)	No.	:	Number
aa)	O.S. & Y	:	outside screw and yoke
ab)	ph	:	hydrogen ion concentration
ac)	ppm	:	parts per million
ad)	psi	:	pounds per square inch
ae)	rpm	:	revolutions per minute
af)	SMACNA	:	Sheet Metal and Air Conditioning Contractors National Association
ag)	SS	:	Stainless steel
ah)	UL	:	Underwriters' Laboratories
ai)	ULC	:	Underwriters' Laboratories of Canada
aj)	W	:	Watts
ak)	KW	:	Kilo Watts
al)	w.g.	:	water gauge
am)	w.p.	:	working pressure
an)	Lit	:	Liter
ao)	m3	:	Cubic Meter
ap)	L/s	:	Liters per sec

DRAWINGS, CHANGES AND INSTALLATION

The drawings shall be considered to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operative installation.

The location, arrangement and connection of equipment and material as shown on the drawings represent a close approximation to the intent and requirements of the Contract. The right is reserved by the Engineer to make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Contract.

All piping and duct work in finished areas shall be concealed in ceiling spaces and shafts or chased into walls. No exposed piping or duct work shall be installed in such areas unless specifically accepted by the Engineer.

Any pipe or mechanical equipment mounted on roof, or housing for such equipment, shall not be closer to the edge of roof than a distance equal to the height of the pipe, hood or equipment; unless specifically accepted by the Engineer.

The actual location of sensing devices, thermostats, switches, etc., shall be reviewed by the Engineer before installation.

The location and size of existing services shown on the drawings are based on the best available information. The actual location of existing services shall be verified in the field before work is commenced.

Changes and modifications necessary to ensure coordination and to avoid interference and conflicts with other trades, or to accommodate existing conditions, shall be made at no extra cost to the Contract.

The Contractor shall ensure that all plant to be supplied by him can be installed in the available space and that there is adequate access to admit all plant to its position and enable maintenance to be carried out on the plant without difficulty.

Special care shall be taken in areas where pour-gaps take place. Coordinate the work schedule with the Contractor.

RECORD DRAWINGS

The Contractor shall clearly mark, as the job progresses, all changes and deviations from that shown on contract drawings on two sets of prints. After inspection and acceptance of service lines in trenches, the Contractor shall take 'as-built' measurements. Definite measurements shall be taken for each service line. Drawings shall be kept up-to-date during construction. On completion of the building, the Contractor shall forward to the Engineer, drawings (quantities as specified elsewhere) indicating all such changes and deviations. This Contractor shall include all existing information on the final record drawings.

The cost of furnishing above prints and preparing these record drawings shall be borne by the Contractor and shall be included in the Contract Price. When all revisions showing the work as finally installed are made, the corrected sepias shall be submitted for review by the Engineer, and delivered to the Consultants before final payment for the completed work will be made.

SHOP DRAWING

Shop Drawings shall indicate clearly all services and the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity operating characteristics and performance.

Each shop drawings for non-catalogue items shall be prepared specifically for this project.

Material submissions and brochures for catalogue items shall be marked clearly to show the Items being supplied.

This Contractor shall prepare all shop drawings related to the particular material submittal and shall submit both the shop drawings and the material submittal simultaneously.

Ensure that electrical coordination is complete before submitting drawings for review.

Installation of any equipment shall not be commenced until after the shop drawings have been reviewed by the Engineer.

When requested, shop drawings shall be supplemented by data explaining the theory of operation. The Engineer may also request that this information be added to the maintenance and operating manual.

DRAWING SUBMISSIONS

Builder's work drawings shall show fully dimensioned, all foundation, bases plinths, sumps, holes and sleeves details required and the overall size and weights of the plant concerned.

With the agreement of the Engineer, smaller holes, built-in fixings, etc., other than in plant rooms, may be marked out on site instead of on drawings.

Fully dimension plant room drawings shall detail for each plant room the location of each unit, pipe routes and connections with valves and fittings, duct routes and connection with accessories, drain connections, electrical connections and controls. All drawings shall include explanatory

notes and shall show the required sizes of pipes and ducts with and without insulation as applicable.

If abbreviations are employed for the designation of components, an integral schedule shall be provided on the drawings to explain the meanings of the abbreviations.

Individual equipment drawings from the various manufacturers will not be accepted in lieu of these composite plant room drawings.

COORDINATION, INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

Coordination, Installation, interference and setting drawings dimensioned and to scale, shall be submitted for the Engineer's review to make clear the work intended and to, show its relation to adjacent work and to the work of other trades. Three copies of such drawings shall be submitted for review, of which one will be retained by the Engineer.

The drawings must be comprehensive showing all details, dimensions, equipment, supports for services and sections through critical areas to properly coordinate all services and work of other trades. Unless accepted by the Engineer, all drawings must be to 1/8" : 1' scales for IP Units or 1:100 scales for SI Units.

Site services drawing shall be prepared to show all existing services, modification to existing services and all new services within the entire construction area. Location of all existing services shall be carefully detailed and dimensioned on the drawings showing all sizes and invert elevations.

Drawings shall be prepared with due regard to the construction schedule and shall be submitted to the Engineer, allowing reasonable time for examination and review.

Work shall not proceed in areas involved until after final approval of all such drawings has been obtained.

These drawings shall include all existing information.

EXAMINATION OF SITE

Before submitting tenders, each trade shall examine the site to determine the conditions which may affect the proposed work. No claims for extra payment will be considered, because of failure to fulfill this condition.

CONTRACTOR'S TECHNICAL RESPONSIBILITIES

This Contractor shall provide detailed calculations for flow and head requirements for all Pipes, pumps and etc. These calculations shall be done prior to ordering the equipment and shall be submitted to the Engineers for review prior to ordering such equipment. This Contractor shall bear full responsibility for the final equipment sizing and selection.

The cost of furnishing above calculations shall be borne by the Contractor and shall be included in the Contract Price.

EXCAVATIONS AND BACK FILLING

Excavations

Excavation for the drains in open trenches shall be to the line and depths indicated on the drawings or as directed. Great care shall be taken to excavate only to such depths as are correctly required for regular gradients. Grips for joint as required shall be formed, trench bottom shall have sufficient width to allow adequate working space for the pipe jointed and should in no case be less than 24 inches or the internal diameter of the pipe plus 18 inches. Trenches are to be kept clear of water including any necessary pumping. Perform all tunneling for pipe when required. Wherever soft places in excavated areas are encountered, the Contractor shall excavate such soil to hard foundation and replace with granular material before any drain are laid. In the event of the excavation being made deeper than necessary by error they shall be filled to proper level with cement concrete 1:4:8 at the Contractor's expense. Cement concrete 1:4:8 is to be laid before the pipes are placed in position.

1.13.2 Back Filling

No filling or back filling shall be carried out until debris, trash and other foreign material from

trenches have been removed and drains, manholes, etc. have been tested and approved by the Engineer-Incharge. Fill material shall be free from timber, rocks 3 inches or large, organic material and other unsuitable material as determine by the Engineer. Earth filling to the bottom of the trenches and to a height of 12 inches above the top of the pipes shall be of selected materials, hand backed, watered if necessary and well rammed on either side of the pipe. Special care shall be exercised where pipes are laid direct on the earth or on beds without benching or covers. The remainder of the earth filling shall be in 6 inches layers, each layer watered if necessary, and well rammed. Mechanical rammers are not to be used until atleast 24" of consolidated material has been returned over the pipes. Where vegetable soil has been removed, it shall be replaced at top of the trench and similarly consolidated. Heading shall be filled with the excavated materials, packed tightly in layers and rammed by hand (or concrete of mix.1:3:6) or broken rock or hard core kept to a stepped face as the work proceeds. Surplus earth shall be disposed of as directed. The trenches under pavings shall be back filled by local sand, well compacted. Existing pavements, roadways, walkways, curbs and landscaped areas disturbed during the programme of the excavation and backfill work shall be restored to original condition.

Planking Strutting and Staging

Excavated materials shall not be deposited within 1'-6" of the edge of the trench and sides of the excavation shall be supported by planking and strutting if necessary to ensure a proper and speedy execution of the work.

Blasting

No blasting shall be allowed near the rocks. The rocks shall be excavated by chiseling.

Buried Services

All pipes, ducts, cables, main and other service exposed by all excavation shall be effectively supported by timber or other means.

BEDDING AND ENCASTING PIPES

The concrete beds shall be of ratio 1:3:6 (6 inches thick for pipes more than 8" dia) and not less than 12 inches wider than the external diameter of the pipe. These shall be provided at all buried bends.

Where cast iron or steel (or concrete) pipes are specified to be haunched, the concrete shall be carried by from the outside edge of the bed to meet the pipe barrel tangentially, where the pipes are specified to be surrounded, the concrete shall be carried up from the beds in square section with a minimum of 6 inches in thickness over the barrel of the pipe.

The rest bend in the ground at the set of all soil, rain water, ventilating and other vertical pipes, to be embedded in solid concrete 6 inches thickness

PLUMBING AND DRAINAGE SERVICES CONNECTION

The cost of all service connections required for the plumbing and drainage system shall, be the responsibility of the Contractor. This includes the supply and installation of the water meter and all associated fitting, piping, etc.

Make any adjustments to piping systems necessary to suit the local requirements.

Coordinate routing and final points of connection with the external services layout and satisfaction of authorities having jurisdiction. Manholes and covers shall be installed to the municipality requirements.

Install water meters in meter cabinets and isolation valves to the local authority standards.

GAUGES AND METERS FOR PLUMBING SYSTEMS

GENERAL

CODE & COMPLIANCE

All materials and workmanship described herein shall be in accordance with the latest editions and addenda of the codes and standards listed below and all State, and local codes, and/or

specifications, the more stringent shall be govern.
ASHRAE, ASME, ASPE, ASTM, BS, IPC, NFPA

QUALITY ASSURANCE

All materials and equipment to be used for this contract shall be standard products of a reputable manufacturer regularly engaged in the production of same. All material of the same type shall be provided from the same manufacturer. Any work or materials found to be defective or which do not meet the requirements of these specifications, shall be replaced by the Vendor at his own expense. All materials shall be new, unused and free of defects and imperfections.

COORDINATION

In selecting the units, the tenderer shall carefully check and confirm that the units can be installed and conveniently serviced and maintained within the respective spaces indicated on the drawings for unit installation.

SUBMITTALS

Submit manufacturer's technical product data, installation instructions and dimensioned drawings.

DELIVERY, STORAGE & HANDLING

Unit shall be delivered factory assembled with protective crating and covering and their delivery coordinated in sufficient time to allow movement into building. Vendor shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and applications. Adequate protection shall be provided against mechanical damage and atmospheric corrosion in transit and for a 6 month period of outdoor storage at job site prior to installation. Miscellaneous parts shall be tagged or marked with the equipment item number for which they are intended.

WARRANTY

Vendor shall guarantee and provide a written statement as proof that the unit shall perform as specified on the Data Sheets. All equipment shall be guaranteed for satisfactory performance and shall be warranted against faulty design, defective or improper materials. The Material and Workmanship Guarantees shall be extended for a period of eighteen months from the date of shipment or one year from the date the equipment is placed in service whichever occurs first.

PRODUCT

The Contractor shall supply and install all necessary indicating thermometers, pressure gauges etc. for easy checking of operation of the complete plant. Amongst others, the following instruments and measuring points shall be included but duplication of instruments and points is to be avoided. The selected scale range of instruments shall suit the anticipated operational range. The suggested ranges are 10-35°, 0-50°, 0-70°, 0-100° and 0-200°C for thermometers and 990mBarvacuum - 2Bar, 0-4, 0-7, 0-10 and 0-20 Bar for pressure gauges.
Insertion type duct mounted 75mm diameter dial thermometer shall be provided in each return air inlet and on the leaving side of each cooling and heating coil of air handling units, fresh air inlet and supply air of zones.
Industrial type pipe insertion thermometers at least 100mm diameter dial scale with external recalibration or 230mm long stem scale, separable copper wells and sockets with extension neck for insulated piping, shall be provided at each water inlet and outlet of water chiller, condenser, absorber, hot water boiler, heat exchanger, cooling coil, heating coil and pumps. Where only thermometer wells have been shown in the drawings only these shall be supplied.
Compound/pressure gauges, at least 100mm diameter with Bourdon tube type element and internal mechanism with individual bearings to give best accuracy under fluctuating pressure and

vibrations shall be provided at suction and discharge of all water pumps, inlet and outlet of water chiller, condenser, absorber, hot water boiler, heat exchanger and cooling coil and heating coil. Where only gauge cocks have been shown in the drawings, only these shall be supplied.
At the chilled/hot water supply and return branch take-off from the main piping, a thermometer copper well and pressure gauge connection with cock, and a pressure gauge connection with cock across each pressure reducing valve should be provided so that when required the Operator can install thermometers and gauges for taking readings. The gauge connection shall further be capped.
The gauge cocks shall be of brass with lever handle and for steam gauges, a siphon filled with water shall be installed between the cock and gauge to prevent steam from entering the Bourdon tube.

EXECUTION

Furnish and install gauges and thermometers (including wells) as per manufacturer's recommendation as shown on drawings and as specified.
Instruments should be installed such that they are easily readable and parallax errors are minimized due to difficult locations of instruments.

7.1 VALVES

GENERAL

CODE & COMPLIANCE

All materials and workmanship described herein shall be in accordance with the latest editions and addenda of the codes and standards listed below and all State, and local codes, and/or specifications, the more stringent shall be govern.
ASHRAE, ASME, ASPE, ASTM, BS, IPC, NFPA

QUALITY ASSURANCE

All materials and equipment to be used for this contract shall be standard products of a reputable manufacturer regularly engaged in the production of same. All material of the same type shall be provided from the same manufacturer. Any work or materials found to be defective or which do not meet the requirements of these specifications, shall be replaced by the Vendor at his own expense. All materials shall be new, unused and free of defects and imperfections.

COORDINATION

In selecting the units, the tenderer shall carefully check and confirm that the units can be installed and conveniently serviced and maintained within the respective spaces indicated on the drawings for unit installation.

SUBMITTALS

Contractor shall produce and submit for approval detailed schedule of all valves covered by this Section indicating type of devices, dimensions, materials of construction, pressure/temperature ratings and attachment methods, for each pipe size and type of service. Temperature ratings specified are for continuous operation.

DELIVERY, STORAGE & HANDLING

Material shall be delivered factory assembled with protective crating and covering and their delivery coordinated in sufficient time to allow movement into building. Vendor shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and applications. Adequate protection shall be provided against mechanical damage and atmospheric corrosion in transit and for a 6 month period of outdoor storage at job site prior to installation. Miscellaneous parts shall be tagged or marked with the equipment item number for

which they are intended.

WARRANTY

Vendor shall guarantee and provide a written statement as proof that the unit shall perform as specified on the Data Sheets. All equipment shall be guaranteed for satisfactory performance and shall be warranted against faulty design, defective or improper materials. The Material and Workmanship Guarantees shall be extended for a period of eighteen months from the date of shipment or one year from the date the equipment is placed in service whichever occurs first.

PRODUCT

MATERIALS

Generally, all valves of the same type shall be of the same manufacturer. All gate, globe, angle, and swing check valves as a group shall be of the same manufacturer. All valves 50 mm and smaller shall be threaded and have bronze bodies. All valves 65 mm and larger shall be Iron Body Bronze Mounted (IBBM) type, i.e. with bronze trim, and shall be flanged (or grooved for grooved coupling joints). All valves 100 mm and larger mounted in excess of 2.15 m above the floor in mechanical rooms shall be equipped with chain operators. Extend chains to within 2 m of floor. Each valve shall be marked (engraved, stamped, or cast on each valve or metal tag, permanently attached to the valve) at the factory with the following minimum information:

a) Manufacturer's Name.

b) Catalogue or Figure No.

c) Size and Pressure Class.

Arrows to indicate direction of flow on check, globe, angle, non-return, and eccentric plug valves.

GATE VALVES

Furnish valves 300 mm and smaller designed for minimum PN16 (or PN20 as specified) non shock water, oil and gas working pressure. Valves 350 mm through 610 mm, shall be designed for minimum PN10.

Size 50 mm and Smaller.

Furnish bronze valves with screwed-in bonnet, non-rising stem, solid wedge disc, and threaded ends. Pressure rating PN20.

Size 65 mm and Larger.

Furnish Iron Body Bronze Mounted (IBBM) valves, i.e. cast iron body bronze trim valves, with bolted bonnet, non-rising stem, solid wedge disc, flanged ends, and renewable seat

GLOBE VALVES

Size 50mm and Smaller.

Furnish valves designed for minimum PN20 nonshock water, oil, and gas working pressures. Valves shall have union bonnets, integral seats, and renewable teflon discs. Valves shall permit disc and bonnet replacement without removing valves from piping.

Size 65 mm and Larger.

Furnish valves designed for minimum PN16 water, oil, and gas working pressure. Valves shall have bolted bonnets, guided bronze or bronze faced disc, outside screw and yoke, (0 S and Y) and flanged ends. Discs and seats shall be renewable without removing valves from line.

DOUBLE REGULATING VALVES

Size 50mm and smaller.

Furnish bronze double regulating valve designed for minimum PN20. Parabolic and slotted disk double regulating device. Screwed bonnet, rising stem, hand wheel operated with micrometer

style indicator.

Size 65mm and larger.

Furnish cast iron double regulating valve for minimum PN16. Fitted with EPDM coated regulating disk, double regulating device and indicator, flanged to BS 4504 PN16. Inside screw, non-rising copper alloy stem, back seating feature.

Balancing valves shall comprise a metering station and a close coupled double regulating valve. The metering station, containing an orifice shall be fitted with test points so that the pressure drop across the orifice can be measured. The commissioning set shall provide ±5% accuracy and should be installed with a minimum of 5 times pipe diameter uninterruped upstream length of straight pipe.

CHECK VALVES

Water, Oil, and Steam, size 50 mm and smaller.

Furnish swing valves designed for minimum PN20 non shock water, oil, and gas working pressures. Valves shall have renewable discs and side plugs and regrindable, integral seats. Discs shall be renewable and seats regrindable without removing valves from the line.

Size 65 mm and Larger Water Check Valves.

Valves shall be silent type spring loaded of the double door or wafer style. Valves shall be designed for minimum PN16 non shock water working pressure.

Double door valves shall have cast iron body, aluminum bronze or stainless steel disc, stainless steel spring and hinge pin, and Butyl rubber sheet. Wafer style valves shall have cast iron or semi-steel body, bronze disc, stainless steel spring, and Butyl rubber sheet.

BUTTERFLY VALVES

Furnish valves designed for minimum PN16 and 120 degrees C. water service. Valves shall have extended necks. Operator shall be 10-position lever lock for sizes 50 - 100 mm and totally enclosed and sealed worm gear actuators with 4-arm or wheel handle for sizes 150 mm and larger. Infinite adjustment and memory stop options shall be included. Valves shall be bi-directional suitable for drop-tight shut-off at full rated pressure with flow in either direction.

Materials.

Body: Cast or ductile iron.

Disc: Bronze, aluminum bronze or stainless steel.

Stem - Type 416 stainless steel.

Seat - Ethylene Propylene Diene Terpolymer (EPDM).

PRESSURE REDUCING VALVES

Pressure reducing valves shall be pilot controlled, hydraulically operated, diaphragm type with a low by-pass capability. The low-flow by-pass capability shall be achieved by using a balanced direct acting PRV as an integral part of the main valve. At very low flows when the main valve is almost completely closed, to percent the possibility of cavitation the direct acting valve shall by-pass the main valve and maintain flow. PRVs shall be bronze construction including the trim. The pressure reducing valves shall be suitable for maximum working pressure that exist within the system and downstream pressure should be site adjustable between 2 and 4 bar. Refer to Schematic drawings for the minimum locations at which PRV's shall be required.

RELIEF VALVES

Domestic Water Temperature and Pressure Relief Valve.

On hot water storage tanks provide an ASME rated thermostatic, self-closing, temperature and pressure relief valve, located in the relief valve openings of tanks. Valve shall have a minimum thermal discharge capacity equal to the input capacity of the heater standard pressure setting of 600 kPa and standard temperature setting of 100 degrees C. Relief valve pipe to discharge to floor drain.

Technical Specifications

BALL VALVES

General

Valves shall be non-blowout stem design. Quarter turn of handle shall fully open or close valve. Handle position shall indicate whether valve is open or closed. Handle stops shall be a permanent, integral part of the body.

Size 50 mm and Smaller.

a. Valves shall be standard port, 2-piece construction with screwed ends. Valves shall be designed for minimum PN25.

b. Valves shall have bronze or brass body, chromium plated or stainless steel ball, steel handle with vinyl grip, and replaceable Teflon seats.

Size 65 mm and Larger.

a. Valves shall be standard port, BS 5159 with flanged ends. Valves shall be designed for minimum PN16 working pressure.

b. Valves shall have steel body, chrome or nickel plated steel or stainless steel ball, replaceable Teflon seats, and steel stem and handle.

Where required for installation in the fire protection system, the ball valves shall be FM approved.

FLOAT VALVES

Float valves shall be installed as indicated in the drawings to provide consistent level control in reserve supply water storage tanks. The valve shall meet the requirements of the Water Byelaws for air gaps and shall be constructed throughout in approved materials and shall prevent back siphoning. Inlet flow shall be co-axial with the piston movement, to ensure high discharge capacity and smooth, quiet operation. The valve shall have 'O' ring piston seals, resilient seated disk, Dezincification resistant bronze fabricated approved solder and shall be hydraulically tested to ensure buoyancy and constructed in accordance with BS1968. Bronze equilibrium float valves 80 and above shall be flanged end, flat faced and drilled to suit BS4504 PN16. Bronze equilibrium float valves up to 50 shall be screwed end BS2779 parallel and shall be provided complete with back nut. Floats for valve sizes 80mm and above shall be of copper.

SOLENOID VALVES

Electrically operated solenoid valves shall be single phase 220V and shall be rated for the system pressure.

BIB TAPS

Bib-cocks shall be in accordance with BS 1010 : 1973. They shall be provided with hose union nosepiece and hand wheel operated.

AUTOMATIC AIR VALVES

Automatic air valves shall have a bronze body with bolted cover and a 9mm top outlet. They shall each incorporate a suitable float mounted on a stainless steel spindle terminating in a needle valve for closure against a stainless steel seating at the outlet. For low pressure systems the valve shall be provided with a test cock and a brazed float, but for medium and high pressure systems the float shall be of stainless steel. Automatic air valves for low pressure systems shall, incorporate an internal ball check valve at inlet to prevent air entry to the system. Automatic air valves for cold water services shall be to the approval of the local water authority.

STRAINERS

Up to and including DN50 strainers shall be manufactured from bronze and shall be of the 'Y' type with bolted cap, PN25 temperature/pressure rating. Strainers above DN50 shall be manufactured from cast iron and shall be of the 'Y' type with bolted cap, PN16 temperature/pressure rating and shall be complete with drilled and tapped caps complete with

drain cocks. Strainers shall be provided with a medium grade screen sized such that in their clean condition the maximum pressure drop at the design flow rate shall not exceed 6kPa. For chilled water the mesh shall be stainless steel and for water services the mesh shall be of copper.

EXECUTION

PREPARATION

Provide valves at each piece of equipment to isolate equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers. Strainers shall be installed ahead of all automatic valves and elsewhere as indicated on Drawings. Provide a ball valve and 1.5 m of rubber hose in the blow off opening of each strainer. Unions shall be provided adjacent to each screwed type valve and shall be on the outlet side of the valve.

INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position or where large valves are provided with chain wheel operators. Where valves 50-65mm and larger are located more than 4m above mechanical room floors, install valve with stem in the horizontal position and provide a chain wheel operator. Valves installed with the stems down, will not be accepted. Prior to flushing of piping systems, place all valves in the full-open position. Flanged valves shall be installed between flanges.

Shut-Off Valves

Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for isolation or repair.

Balancing Valves

Provide balancing valves for all major equipment and at each major branch takeoff and at the discharge of each pump as indicated on drawings and details.

Calibrated balance valves:

Install where indicated on the drawings and details for balancing of hydronic systems.

Drain Valves

Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, equipment locations specified or other locations required for drainage of systems.

Safety Relief Valves

a. Use air pressure to clean piping prior to installation of safety relief valves.

b. Install relief valves in locations indicated on drawings, downstream of all pressure reducing valves.

c. Install valves in the vertical position, with drain holes, including those from dip pan elbows, piped to the nearest drain. Inlet and outlet piping connecting to valves must be the same size as valve

d. Install drip pan elbow as detailed at first vertical rise of the vent pipe. Keep pipe between safety valve and drip pan elbow as short and straight as possible. Support piping and drip pan elbow independently to prevent stress at connections to safety valves. Install vent pipe so that its weight does not rest on the drip pan elbow. Extend drain line from drip pan elbow and relief valve to nearest drain. Pipe discharge from water system relief valves to nearest drain.

Spring Loaded Check Valves
Install a spring loaded check valve in each pump discharge line where two pumps operate in parallel and no combination shutoff, check and balancing valve is being used.

Swing Check Valves
Provide swing check valves where specified, detailed. In such cases, provide isolation valves to allow repair or replacement of check valve.

Combination Shut-Off, Check, And Balancing Valves
Contractor may use combination shut-off, check and balancing valves where separate shut-off valve, check valve, and balancing valve are specified or detailed in pump discharge piping.

Pressure Reducing Valves

a. Provide gate valve and strainer at inlet. Provide gate valve at outlet. Install pressure gauges to indicate inlet and outlet pressure at each pressure reducing valve.
b. Use concentric reducers at inlet and outlet of reducing valves where connections are not the same size as adjacent piping.

ADJUSTMENT AND CLEANING

Valves and stops shall be adjusted, packed, and repacked as may be required to eliminate leaks and produce proper flow.

7.2 FACILITY SEWAGE DRAIN MANHOLES

GENERAL

CODE & COMPLIANCE

All materials and workmanship described herein shall be in accordance with the latest editions and addenda of the codes and standards listed below and all State, and local codes, and/or specifications, the more stringent shall be govern.
ASHRAE, ASME, ASPE, ASTM, BS, IPC, NFPA

QUALITY ASSURANCE

All materials and equipment to be used for this contract shall be standard products of a reputable manufacturer regularly engaged in the production of same. All material of the same type shall be provided from the same manufacturer. Any work or materials found to be defective or which do not meet the requirements of these specifications, shall be replaced by the Vendor at his own expense. All materials shall be new, unused and free of defects and imperfections.

COORDINATION

In selecting the units, the tenderer shall carefully check and confirm that the units can be installed and conveniently serviced and maintained within the respective spaces indicated on the drawings for unit installation.

SUBMITTALS

Submit manufacturer's technical product data, installation instructions and dimensioned drawings, pressure/temperature ratings.

DELIVERY, STORAGE & HANDLING

Material shall be delivered factory assembled with protective crating and covering and their delivery coordinated in sufficient time to allow movement into building.
Vendor shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and applications.
Adequate protection shall be provided against mechanical damage and atmospheric corrosion in

transit and for a 6 month period of outdoor storage at job site prior to installation. Miscellaneous parts shall be tagged or marked with the equipment item number for which they are intended.

WARRANTY

Vendor shall guarantee and provide a written statement as proof that the unit shall perform as specified on the Data Sheets. All equipment shall be guaranteed for satisfactory performance and shall be warranted against faulty design, defective or improper materials. The Material and Workmanship Guarantees shall be extended for a period of eighteen months from the date of shipment or one year from the date the equipment is placed in service whichever occurs first.

PRODUCT

Manholes shall have the minimum inside dimensions shown on the Drawings. Manhole walls shall be of poured-in-place reinforced concrete or as shown in drawings. Top section must be cast such as to suit elevation and accommodate size of manhole frame and cover. Manhole floor shall be of reinforced concrete and inverts stream lined with cement and mortar into a semi-circular path with sanitary turns and have their corners filled and sloped towards the water path to prevent any settlements of solids as detailed on the Drawings. Concrete foundation and benching for manholes shall be constructed in accordance with details as shown on the Drawings.
All pipes or castings to be embedded in the manhole walls shall be accurately set, and if so required, headers shall be laid round the casting so embedded. All work must be carried out in a manner to ensure watertight work, and any leaks shall be caulked, repaired, or the entire work shall be removed and rebuilt. Attention is particularly called to the necessity of keeping the water level below all parts of the foundation and walls until the concrete has obtained adequate setting.
The Contractor shall furnish and set level and to the proper grade, a cast iron frame and cover or frame and grating of the form and dimensions shown on the Drawings. The concrete shall be neatly and accurately brought to the dimensions of the base of the frame. The frames shall be thoroughly embedded in mortar. All covers and frames shall be heavy-duty quality.
The nominated sub Contractor shall supply and fix cast iron manhole covers and frames bitumen coated as follows:

Situation	**Grade of Cover (BS 497)**	**Specification**	**Clear Opening**
Road, car parks, public footpaths	A2	Double Triangular, Heavy Duty, D.I	600x600
Private footpaths	C	Single seat air tight solid top heavy duty	600x600
Inside building	C	Double seat double cover air tight recess top screw down tight duty	600x600

The invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the inside of 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 or branch shall have true curves of as large a radius as the size of the manholes will permit.
Manholes shall be provided with built-in steps of galvanized, wrought iron. The rungs shall be

not less than 250mm in width and spaced approximately 300mm apart, and alternate rungs shall be staggered or offset 150mm. Bars or rods when used for steps shall not be less than 25mm diameter.

Manhole frames and covers shall be in accordance with the requirements shown on the drawings. The manhole frames and covers shall be so set that the top of the cover will be flush with the finished grade.

Concrete foundations for manholes shall be constructed of 1000 kg concrete, proportioned 1 cubic meter cement, 2 cubic meter sand, 3½ cubic meter stone, not less than 22 bags of cement per cubic metre of concrete in place and maximum water content of 90 litres/m³ (quantity includes water in aggregates). The manhole walls shall be constructed from 200mm thick concrete internally rendered on a 200 concrete base.

Heavy duty C.I. covers or grating as per requirement with frame shall be provided. The weight of the cover with frame shall not be less than 1 Cwt. The dimensions shall be as indicated on the drawings. If no dimension are provided in drawing and BOQ a minimum if 450mm x 450mm cover shall be installed.

EXECUTION

Install systems to the approval of the local Drainage Department. Manholes and gully-traps shall be vented in accordance with local authority and/or BS requirements.

7.3 FACILITY STORM DRAINAGE MANHOLES AND CATCH BASIN

GENERAL

CODE & COMPLIANCE

All materials and workmanship described herein shall be in accordance with the latest editions and addenda of the codes and standards listed below and all State, and local codes, and/or specifications, the more stringent shall be govern.
ASHRAE, ASME, ASPE, ASTM, BS, IPC, NFPA

QUALITY ASSURANCE

All materials and equipment to be used for this contract shall be standard products of a reputable manufacturer regularly engaged in the production of same. All material of the same type shall be provided from the same manufacturer. Any work or materials found to be defective or which do not meet the requirements of these specifications, shall be replaced by the Vendor at his own expense. All materials shall be new, unused and free of defects and imperfections.

COORDINATION

In selecting the units, the tenderer shall carefully check and confirm that the units can be installed and conveniently serviced and maintained within the respective spaces indicated on the drawings for unit installation.

SUBMITTALS

Submit manufacturer's technical product data, installation instructions and dimensioned drawings, pressure/temperature ratings.

DELIVERY, STORAGE & HANDLING

Material shall be delivered factory assembled with protective crating and covering and their delivery coordinated in sufficient time to allow movement into building. Vendor shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and applications. Adequate protection shall be provided against mechanical damage and atmospheric corrosion in transit and for a 6 month period of outdoor storage at job site prior to installation. Miscellaneous parts shall be tagged or marked with the equipment item number for which they are intended.

WARRANTY

Vendor shall guarantee and provide a written statement as proof that the unit shall perform as specified on the Data Sheets. All equipment shall be guaranteed for satisfactory performance and shall be warranted against faulty design, defective or improper materials. The Material and Workmanship Guarantees shall be extended for a period of eighteen months from the date of shipment or one year from the date the equipment is placed in service whichever occurs first.

PRODUCT

Manholes shall have the minimum inside dimensions shown on the Drawings. Manhole walls shall be of poured-in-place reinforced concrete or as shown in drawings. Top section must be cast such as to suit elevation and accommodate size of manhole frame and cover. Manhole floor shall be of reinforced concrete and inverts stream lined with cement and mortar into a semi-circular path with sanitary turns and have their corners filled and sloped towards the water path to prevent any settlements of solids as detailed on the Drawings.
Concrete foundation and benching for manholes shall be constructed in accordance with details as

shown on the Drawings.
All pipes or castings to be embedded in the manhole walls shall be accurately set, and if so required, headers shall be laid round the casting so embedded. All work must be carried out in a manner to ensure watertight work, and any leaks shall be caulked, repaired, or the entire work shall be removed and rebuilt. Attention is particularly called to the necessity of keeping the water level below all parts of the foundation and walls until the concrete has obtained adequate setting.
The Contractor shall furnish and set level and to the proper grade, a cast iron frame and cover or frame and grating of the form and dimensions shown on the Drawings. The concrete shall be neatly and accurately brought to the dimensions of the base of the frame. The frames shall be thoroughly embedded in mortar. All covers and frames shall be heavy-duty quality.
The nominated sub Contractor shall supply and fix cast iron manhole covers and frames bitumen coated as follows:

Situation	**Grade of Cover (BS 497)**	**Specification**	**Clear Opening**
Road, car parks, public footpaths	A2	Double Triangular, Heavy Duty, D.I	600x600
Private footpaths	C	Single seat air tight solid top heavy duty	600x600
Inside building	C	Double seat double cover air tight recess top screw down tight duty	600x600

The invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the inside of 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 or branch shall have true curves of as large a radius as the size of the manholes will permit.

Manholes shall be provided with built-in steps of galvanized, wrought iron. The rungs shall be not less than 250mm in width and spaced approximately 300mm apart, and alternate rungs shall be staggered or offset 150mm. Bars or rods when used for steps shall not be less than 25mm diameter.
Manhole frames and covers shall be in accordance with the requirements shown on the drawings. The manhole frames and covers shall be so set that the top of the cover will be flush with the finished grade.
Concrete foundations for manholes shall be constructed of 1000 kg concrete, proportioned 1 cubic meter cement, 2 cubic meter sand, 3½ cubic meter stone, not less than 22 bags of cement per cubic metre of concrete in place and maximum water content of 90 litres/m³ (quantity includes water in aggregates). The manhole walls shall be constructed from 200mm thick concrete internally rendered on a 200 concrete base.
Heavy duty C.I. covers or grating as per requirement with frame shall be provided. The weight of the cover with frame shall not be less than 1 Cwt. The dimensions shall be as indicated on the drawings. If no dimension are provided in drawing and BOQ a minimum if 450mm x 450mm cover shall be installed.

EXECUTION

Install systems to the approval of the local Drainage Department

7.4 PVC WATER STOPPER

Description

PVC Water Stopper is a flexible, extruded sealing element used in concrete structures to prevent the passage of water through construction and expansion joints. It is commonly used in water retaining structures such as dams, reservoirs, tunnels, basements, swimming pools, and sewage treatment plants. The water stopper provides a watertight seal and accommodates minor structural movements.

Material

- Material: High-grade Polyvinyl Chloride (PVC)
- Tensile Strength: Minimum 12 MPa (as per ASTM D412)
- Elongation at Break: Minimum 250% (as per ASTM D412)
- Hardness: Shore A 60–80 (as per ASTM D2240)
- Water Absorption: Less than 0.5% (as per ASTM D570)
- Chemical Resistance: Resistant to alkalis, acids, and most chemicals
- Operating Temperature Range: -10°C to 60°C

Job Conditions

- The installation area should be clean and free from debris, oils, and other contaminants.
- Temperature and humidity should be within the recommended range to ensure proper adhesion.
- The concrete pour should be planned to avoid excessive displacement of the water stopper.
- The water stopper should be stored in a cool, dry place away from direct sunlight.

Installation

- **Positioning:** Place the PVC water stopper in the center of the joint, ensuring equal embedment on both sides.
- **Fixing Method:** Secure the water stopper in place using metal clamps, wire ties, or factory-made eyelets attached to reinforcement bars.
- **Concrete Pouring:** Carefully pour concrete in layers to prevent displacement of the water stopper. Vibrate concrete adequately to ensure proper bonding around the stopper.
- **Junctions & Splicing:** Heat welding or factory-made junction pieces should be used for connecting multiple lengths to maintain continuity.
- **Inspection:** Ensure proper alignment and full embedment in concrete before proceeding with the next construction phase.

Adjusting and Fixing

- In case of displacement, carefully reposition the water stopper before the concrete sets.
- Ensure tight joints between two sections using heat welding for a continuous water barrier.
- Any damage to the water stopper should be repaired or replaced before final concrete placement.

Technical Specifications

QUALITY ASSURANCE (QA) & QUALITY CONTROL (QC) TESTS FOR PVC WATER STOPPERS

To ensure that **PVC water stoppers** meet industry standards and perform effectively in waterproofing applications, various tests are conducted. These tests evaluate their **physical, mechanical, and chemical properties** for durability, flexibility, and resistance to environmental factors.

TESTS					
Physical Tests	**Mechanical Tests**	**Chemical Tests**	**Heat and Cold Resistance Tests**	**Bonding & Adhesion Tests**	**Electrical Test**
(a) Visual Inspection	a) Tensile Strength Test (ASTM D412)	a) Water Absorption Test (ASTM D570)	a) Heat Aging Test (ASTM D573)	a) Bond Strength Test (ASTM C836)	a) Electrical Resistance Test (ASTM D257
(b) Dimensional Accuracy Test	b) Elongation at Break Test (ASTM D412)	b) Chemical Resistance Test (ASTM D543)	b) Cold Flexibility Test (ASTM D746)	b) Joint Efficiency Test *(ASTM D3833)*	
	c) Hardness Test*(ASTM D2240)*	c) UV Resistance Test (ASTM G154)			
	d) Tear Resistance Test (ASTM D624)				
	e) Compression Set Test (ASTM D395				

7.5 RCC PIPES

Description

Reinforced Cement Concrete (RCC) Pipes are used for underground drainage, sewage, stormwater management, culverts, and irrigation systems. These pipes are manufactured using a centrifugal or vibrated casting process to ensure high strength, durability, and water-tightness. They are designed to withstand heavy loads, external pressures, and varying environmental conditions.

Material

- **Cement:** Ordinary Portland Cement (OPC) conforming to IS 269 or equivalent.
- **Aggregates:** Crushed stone aggregates, free from organic impurities, meeting IS 383.
- **Reinforcement:** High-strength steel wire or bars as per IS 432 / IS 1786.
- **Water:** Clean, potable water, free from impurities.
- **Concrete Grade:** Minimum M40 for pressure pipes and M30 for non-pressure pipes as per IS 458.

Job Conditions

- The trench or foundation should be prepared as per design specifications before pipe laying.
- Proper dewatering should be done in case of high water table conditions.
- Pipes should be handled carefully to avoid damage during transportation and installation.
- RCC pipes should be stored on level ground with adequate support to prevent cracks or deformation.

Installation

a. Trench Preparation

- The trench should be excavated to the required depth and width, ensuring a firm and stable foundation.
- A bedding layer (sand, granular material, or concrete) should be provided as per the design.
- The trench bottom should be well-compacted and free from loose materials.

b. Pipe Laying

- Pipes should be placed in position using proper lifting equipment to avoid damage.
- The spigot end should be inserted into the socket end of the adjacent pipe.
- Proper alignment should be maintained during installation to ensure a smooth flow.

c. Jointing

- **Collar & Socket Joint:** Use cement mortar (1:2 ratio) or rubber rings for watertight sealing.
- **Reinforced Collar Joint:** Use a concrete collar and reinforcement cage to provide additional strength.
- **Flush Joint:** Suitable for non-pressure drainage pipes, sealed with mortar or bituminous material.

d. Backfilling

- Initial backfill should be done with fine soil or sand up to a specified height to prevent direct load on pipes.
- Subsequent layers should be compacted in stages to avoid pipe displacement.
- Heavy machinery should not be used for compaction directly over the pipes until sufficient cover is achieved.

Adjusting and Fixing

- **Alignment Check:** Ensure pipes are in proper alignment before final joint sealing.
- **Leakage Test:** Conduct a hydraulic or air pressure test to check for leaks before backfilling.
- **Damaged Pipes:** Any pipe found with cracks or defects should be replaced immediately.
- **Final Inspection:** Ensure all joints are properly sealed and backfilled before allowing traffic or structural loads.

7.6 MILD STEEL (MS) PIPES

Description

Mild Steel (MS) pipes are widely used for water supply, sewage systems, fire-fighting networks, structural applications, and industrial pipelines. They are made from low-carbon steel, offering high strength, ductility, and ease of welding. MS pipes are available in seamless or welded forms, with protective coatings like galvanization or epoxy to prevent corrosion.

Material

- **Steel Grade:** Mild Steel (Low Carbon Steel) as per IS 1239 / IS 3589 / ASTM A53 / API 5L.
- **Carbon Content:** Typically less than 0.25%.
- **Tensile Strength:** Minimum 330 MPa (as per IS standards).
- **Yield Strength:** Minimum 210 MPa.
- **Coatings (if required):**
  - Galvanized (Hot-dip) for corrosion resistance.
  - Epoxy/Paint Coating for underground or marine applications.
  - Bituminous Coating for buried pipelines.

Job Conditions

- Ensure pipes are stored in a dry, covered area to prevent rusting before installation.
- Pipes should be transported carefully to avoid dents or damage.
- The trench or foundation should be prepared before installation for underground pipelines.
- Ensure proper alignment and support for above-ground installations.

Technical Specifications

Installation

a. Preparation & Handling

- Inspect pipes for any defects or damages before installation.
- Clean pipe ends to remove rust, dirt, and debris.
- Ensure correct pipe alignment before welding or jointing.

b. Jointing Methods

- **Welded Joints:** Preferred for permanent connections using arc or gas welding.
- **Flanged Joints:** Used for easy disassembly, secured with gaskets and bolts.
- **Threaded Joints:** Used for small-diameter pipes, sealed with Teflon tape or sealant.
- **Grooved Coupling:** Used for quick assembly and disassembly in fire-fighting or HVAC systems.

c. Pipe Laying

- For underground pipelines, ensure proper bedding (sand/cement cushion) to prevent damage.
- For above-ground installations, use proper supports and clamps to avoid sagging.
- Ensure slope and gradient as per design specifications for drainage or sewage systems.

d. Corrosion Protection (if applicable)

- Apply protective coatings (galvanized, epoxy, or bituminous) for pipes exposed to moisture or chemicals.
- Wrapping with protective tape for buried pipelines.

Adjusting and Fixing

- **Alignment Check:** Ensure pipes are correctly aligned before welding or fixing joints.
- **Leakage Testing:** Conduct hydrostatic or pneumatic pressure tests as per design requirements.
- **Support & Anchoring:** Install pipe supports, hangers, or clamps to prevent movement.
- **Repair & Replacement:** Replace damaged pipes or apply necessary repairs (e.g., welding patches for minor cracks).
- **Final Inspection:** Ensure proper joint sealing and alignment before commissioning the system.

7.7 PLUMBING FITTINGS

Description

Plumbing fittings are components used to connect, redirect, control, and regulate the flow of water, gas, and waste in a plumbing system. These fittings are available in various materials such as PVC, CPVC, PEX, brass, copper, stainless steel, and galvanized iron, depending on the application. They include elbows, tees, couplings, reducers, valves, and traps for use in residential, commercial, and industrial plumbing networks.

Technical Specifications

Material

Plumbing fittings are manufactured from different materials based on the intended use and environmental conditions:

- **PVC (Polyvinyl Chloride):** Used for cold water supply and drainage, resistant to corrosion.
- **CPVC (Chlorinated Polyvinyl Chloride):** Suitable for both hot and cold water applications.
- **PEX (Cross-linked Polyethylene):** Flexible, used for water supply lines.
- **Brass:** Corrosion-resistant, used for potable water and gas supply.
- **Copper:** Durable, widely used for both hot and cold water supply.
- **Stainless Steel:** High strength and corrosion resistance, used in industrial applications.
- **Galvanized Iron (GI):** Used in older plumbing systems, but prone to corrosion over time.

Job Conditions

- Plumbing work should be performed under dry conditions to prevent contamination.
- Pipework should be free from debris, dust, and moisture before fitting installation.
- Ensure compatibility between the pipe and fitting materials to avoid corrosion or leakage.
- Proper tools should be used for cutting, threading, and jointing to avoid damage.
- Adequate space should be available for easy installation and maintenance access.

Installation

a. Preparation & Handling

- Inspect fittings for any defects or damage before installation.
- Clean pipe ends and fittings to remove dirt, oil, and rust.
- Cut pipes to the required length and deburr edges to ensure a smooth fit.

b. Jointing Methods

- **Threaded Joints:** Used for brass, GI, and stainless steel fittings with Teflon tape or sealant.
- **Solvent Cement Welding:** Used for PVC and CPVC fittings, requiring proper cleaning and glue application.
- **Compression Fittings:** Used for PEX and copper pipes, secured with compression rings.
- **Soldering/Brazing:** Used for copper fittings, requiring heat and solder for a leak-proof connection.
- **Push-Fit (SharkBite) Fittings:** Used for PEX, copper, and CPVC, providing quick installation.

c. Installation Process

- Ensure correct alignment and orientation of fittings before final connection.
- Use appropriate support clamps and brackets to prevent stress on the fittings.
- Do not overtighten fittings to prevent cracks or deformation.
- Allow adequate curing time for solvent-cemented joints before testing.

Technical Specifications

Adjusting and Fixing

- **Leak Testing:** Conduct pressure tests to check for leaks before covering pipes with walls or flooring.
- **Alignment Check:** Ensure fittings are properly aligned to avoid undue stress on the plumbing system.
- **Support & Anchoring:** Secure fittings and pipes with appropriate clamps or hangers.
- **Repair & Replacement:** If leaks or damage occur, fittings should be adjusted, resealed, or replaced as necessary.
- **Final Inspection:** Ensure all fittings are properly installed and functioning before system commissioning.

7.8 CATCHPIT RCC GRATING

Description

Catchpit RCC (Reinforced Cement Concrete) Grating is a durable and high-strength drainage cover designed for stormwater drainage, sewer systems, and surface water management. It is used to prevent debris from entering drainage systems while allowing water to flow efficiently. These gratings are typically installed in roads, pedestrian areas, industrial zones, and parking lots to ensure proper drainage and prevent clogging.

Material

- **Concrete Grade:** Minimum **M30 or M40** as per ASTM C94/C94M.
- **Reinforcement:** High-strength steel reinforcement conforming to ASTM A615/A615M.
- **Cement:** OPC 43/53 grade conforming to ASTM C150.
- **Aggregates:** Well-graded crushed stone aggregates as per ASTM C33/C33M
- **Water:** Potable, clean water free from impurities.
- **Surface Finish:** Smooth finish with anti-slip texture for pedestrian safety.

Job Conditions

- The site should be prepared with proper leveling before installation.
- The catchpit should be free of debris, dirt, and stagnant water before placing the RCC grating.
- Ensure proper alignment of the grating with the catchpit opening for efficient drainage.
- Suitable lifting equipment should be used to handle heavy RCC gratings to prevent damage.

Installation

a. Preparation & Handling

- Inspect the grating for cracks or defects before installation.
- Clean the installation area and ensure the surface is level.
- Check the dimensions of the grating to match the catchpit opening.

Technical Specifications

b. Placement & Fixing

- **Positioning:** Carefully place the RCC grating over the catchpit opening, ensuring a firm and even fit.
- **Seating Bed:** A cement mortar (1:3 mix) or precast concrete seating should be used to hold the grating in place.
- **Alignment:** Adjust the grating to align with the drainage flow direction.
- **Load Distribution:** Ensure even contact with the support structure to prevent cracking under load.

c. Anchoring (If Required)

- If additional securing is needed, RCC gratings can be fixed with anchor bolts or embedded in concrete frames.
- For heavy-duty traffic areas, reinforced edging should be provided to prevent movement.

Adjusting and Fixing

- **Level Check:** Ensure the grating is flush with surrounding surfaces to prevent tripping hazards.
- **Load Testing:** Check the load-bearing capacity, especially in vehicular traffic areas.
- **Cleaning & Maintenance:** Ensure easy removal for periodic cleaning and maintenance of the drainage system.
- **Replacement:** If any grating is damaged, it should be replaced immediately to maintain drainage efficiency.

8 MATERIAL TESTING

8.1 GENERAL

Notwithstanding the requirements stated in the detailed specifications for individual items, the following minimum tests shall be performed in the laboratories (NED University Laboratory or Karachi Shipyard & Engineering Works Laboratory) or as directed by the Engineer.
Contractor's Materials Engineer will be responsible for liaison and coordination with the Site laboratory, the Engineer, field sampling/testing staff and off-Site laboratories to ensure that all sampling, specified tests and inspections are carried out in a timely manner.
No inspection or approval by the Engineer shall relieve the Contractor of any of his duties and obligations under the Contract.
All test types and quantities described in the following Sub-sections are considered "Normal Testing" and anything beyond that in type and quantity is considered as "Special Testing". The Engineer may increase the frequency of testing as per requirement.

8.2 TESTS

8.2.1 BRICKS

For each consignment not exceeding 100,000 bricks, minimum 6 (six) bricks shall be tested to ascertain:

i. Dimensions and unit weight
ii. Compressive strength
iii. Water absorption
iv. Efflorescence

8.2.2 COARSE AGGREGATE

The tests mentioned below shall be carried out for each day's casting or per 15 cubic meter of concrete whichever provides the greater number of tests.

i. Gradation
ii. Unit weight
iii. Water absorption
iv. Specific gravity
v. Abrasion loss/Crushing loss

8.2.3 FINE AGGREGATE

The tests mentioned below shall be carried out for each day's casting or per 15 cubic meter of concrete whichever provides the greater number of tests.
Gradation

i. Fineness Modulus (F.M.).
ii. Specific Gravity
iii. Water absorption
iv. Surface moisture

8.2.4 CEMENT

For each consignment of a particular brand not exceeding 25 tons, at least 3 (three) samples collected random shall be tested prior to the cement be incorporated in to the works to ascertain:

i. Consistency
ii. Setting time
iii. Compressive strength
iv. Fineness

8.2.5 REINFORCEMENT

For each consignment not exceeding 10 (ten) tons or as directed, 3 (three) representative samples of each size of M.S. bar shall be tested for:

i. Cross sectional area
ii. Unit weight
iii. Measurement of deformation
iv. Yield strength
v. Tensile strength
vi. Elongation
vii. Bending

Only Test Certificates issued by NED University Laboratory or Karachi Shipyard & Engineering Works Laboratory shall be accepted by the Engineer.

8.2.6 TEST FOR WATER

Water will be tested to ensure that it remains free of oil, salt, acid, alkali, sugar, vegetable or other injurious substances

8.2.7 WORKABILITY TEST FOR CONCRETE

The Slump Test shall be carried out as frequently as required by the Engineer and not less than one per hour during placing of concrete

8.2.8 STRENGTH TEST FOR CONCRETE

The compressive strength of the concrete shall be determined by Cylinder Test. The Cylinder molds shall be 150mm in diameter and 300mm long. Each class of concrete shall be represented by at least six Cylinders. Not less than one group of six test Cylinders shall be made for each 30 cubic meter of structural concrete, but there shall be at least one group of six test Cylinders for each day's concrete work. For columns and girders, one set of test Cylinders would be made from each batch of concrete not exceeding one cubic meter. Samples from which compression test specimen are molded, shall be obtained in accordance with the Method of Sampling Fresh Concrete (ASTM C 172). The concrete samples would be collected from a point just before final placement or as directed by the Engineer. Cylinders may be collected from any batch (load) including the first. Specimens made to check the adequacy of the proportions for strength of concrete or as a basis for acceptance of concrete shall be made and cured in accordance with methods and curing, concrete compression and flexure test specimens in the field (ASTM C 31 or equal). Strength tests shall be made in accordance with the method of test for compressive strength of molded concrete cylinders (ASTM C 39 or equal).
Six Cylinders would form a set of sample for strength determination. Three Cylinders shall be tested at seven days and three cylinders shall be tested at twenty-eight days. Every twenty-eight days Cylinders

shall attain the minimum specified compressive strength. The Contractor shall perform trial mix of his own to determine the characteristic strength or mean strength that has to be attained.
The twenty-eight days' strength tests shall be used as a basis for acceptance of the concrete. Seven days' tests are made to obtain advance information on the adequacy of strength development. Age- strength relationships shall be pre-established for the materials and proportion used.

9 QUALITY ASSURANCE

A. Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Engineer and the Employer.

DELIVERY, STORAGE AND HANDLING

Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

PRODUCTS TIMBER

- Timber shall be well seasoned and free from decay, insect attack except pinhole borers, and knots wider than half of the width of the section.
- Timber shall be kiln dried to a maximum moisture content of 12% by weight.
- Timber required to be treated with preservatives or fire retardant shall be seasoned and kiln dried before treatment, and re-dried after treatment.
- Softwood shall be free from decay and insect attack, except pinhole borers, with no knots wider than half the width of the section. Softwood shall comply with BS EN 942 softwood spices to be used in external locations are to be recommended for the purpose.
- Hardwood shall comply with BS EN 942. Hard wood to be used in internal locations are to be recommended for the purpose.

Wood used for exterior applications or for interior applications in wet areas shall be factory treated to prevent moisture absorption.

SOFTWOOD

- To be either:
- Douglas Fir (Standard Grade)
- European Redwood
- Or as suggested by the Architect.

HARDWOOD

- Teakwood
- White American Oakwood
- Or as suggested by the Architect.

10 OFFICE SPACE AND FACILITIES FOR ENGINEER

10.1 FIELD OFFICE (Not Applicable)

In addition to the office space required for his own use, the Contractor shall provide and maintain Field Office with toilet facilities, furniture and office equipment for the use of the Engineer and his staff.
Field Office for the Engineer shall mean a building having a minimum 150 square feet net clear internal floor area exclusive of walls and partitions, staircase and toilet and have number of rooms as required by the Engineer. It shall be constructed in 250mm thick brick wall in appropriate cement mortar with C.I. sheet roofing and a protective ceiling made of hard board and timber to the satisfaction of the Engineer. The floor shall be 75mm thick lean concrete with 30mm thick mortar on the top with a neat cement finish to give a smooth look. The foundation of this building shall be sound to the satisfaction of the Engineer. The building shall have required number of doors and windows. Uninterrupted power supply facility, if necessary, shall be made available by means of arranging a stand-by generator.
Access road to the Field Office, sufficient parking accommodation and hard standing sheds for vehicles along with boundary fencing shall be constructed by the Contractor.
The Contractor shall provide, for each office, one office table and four chairs of standard, approved by the Engineer. Safety helmets in adequate numbers be always made available for use of the staff and the visitors.
Offices shall be maintained watertight and shall be provided with ventilation. All doors shall be fitted with approved locks. Windows shall be provided with separate screens and blinds and shall have interior locking devices too.
All offices, complete with furnishings, fittings, access roads and hard standings, shall be ready, for occupation by the Engineer within four weeks of the date when the Contractor first occupies the Site.
All offices shall be regularly and properly cleaned as long as they are in use.
All access roads and hard standings shall be maintained in a convenient trafficable condition throughout the Contract period.
The general location of the Field Office shall be decided by the Engineer in consideration of the Contractor's Work Plans. The Field Office shall be situated at locations that shall be free from flooding.
The Contractor shall submit for the approval of the Engineer, along with the Tender, Plans and Drawings showing the details for the building including plans and designs for foundations, access roads, sheds, etc. Plans shall also be submitted showing architectural and structural details and the proposed layout of electrical and running water supply, roads and hard standings thereto. The Engineer may require revision of the said plan prior to the approval for construction.
Prior to the occupation of the office, the Engineer may specify to the Contractor the defects in the work whereupon he may occupy the office and withhold payment for the work in this item until the Contractor remedies and makes good the said defects to the satisfaction of the Engineer.
On completion of the Contract the Field Office including furnishings shall become the property of the Employer.

10.2 OFFICE EQUIPMENT AND STATIONARY ARTICLE

The Contractor shall require to purchase and supply the following Office equipment and consumables to the Engineer:

i. One Laptop core I3 sixth Generation of approved brand with printer, internet facilities.

ii. One Mobile Phones with monthly billing limit upto 5,000 PKR/phone.

iii. Minor items of field office equipment such as file trays, punches, staplers etc. in reasonable number/quantities as requested by the Engineer.

iv. Consumables such as papers, pens, files etc. in reasonable number/quantities as requested from time to time by the Engineer.

10.3 VEHICLE FACILITY (Not Applicable)

The Contractor shall provide 1 new Suzuki Swift DLX Automatic with fuel limit of 20,000 PKR/month or similar with comprehensive insurance and driver for the duration of the contract. They shall be available for the full time use of the Consultant's Representative and his staff. The contractor shall maintain, repair and service the vehicles regularly and provide immediately, at his own expense, an equivalent or better replacement when a vehicle becomes unusable for any reason.

10.4 SURVEY EQUIPMENT

As per requirement of the program, survey equipment shall be provided on each contract Site for use by the staff of the Contractor and the Engineer. A tentative list of such survey equipment is given below:

Optical Square	1 no.
Spirit level (metal 1m long)	1 no.
Steel measuring tape 25m long	1 no.
Steel measuring tape 5m long	1 no.
Levelling staff 3m long	1 no.
Ranging Poles	5 nos.
Surveyor's plumb bob	1 no.
Wild T-1A Theodolite with tripod (or equivalent)	1 no.
Wild NA-2A Automatic Level with tripod (or equivalent)	1 no.
Total Station with Tripod	1no.
Traversing targets with tripods	1 no.
Magnetic Compass	1 no.

Miscellaneous tools and minor items of survey equipment such as umbrellas, hammers, knives etc. shall be made available at Site in reasonable numbers at all times for use by the staff of the Contractor and the Engineer.

Consumables such as pegs, stakes, string lines, paint, marking crayons, etc., shall be made available at Site in reasonable numbers and quantities at all times for use by the staff of the Contractor and the Engineer.

Upon completion of the Contract, the survey equipment listed above shall remain the property of the Contractor

10.5 OFFICES AND EQUIPMENT

The Contractor shall provide and maintain an inventory of all furnishings and equipment and shall replace any equipment, which is lost or irreparably damaged subject to the condition that the Engineer shall ensure his staff to take all reasonable precautions in the handling, operation and transportation of such equipment.

The Contractor shall pay all expenses in respect of water, electricity (where available), garbage cleaning etc. necessary for running the Office and maintaining conducive environment.

The Contractor shall place all necessary support staff such as office boys, cleaners, messengers, road-men, chain-men etc. in required number to the Engineer and his personnel in smooth performing of his responsibilities.

10.6 SIGNBOARDS

The Contractor shall supply, erect and maintain in good condition at least two Identification Signboards of sizes to be specified by the Engineer to be fixed one at each end of the Work at a place clearly visible

to the public. The Signboards shall be mounted on steel pipe frames with the required sizes at a height 2m above the ground and shall be sufficiently strong to withstand the wind forces. The board shall be fabricated from steel angle and plates and painted with suitable colors and written in English as per direction of the Engineer.
Each board shall display:

i. The name of the Project
ii. The name of the Work
iii. The name of the Employer
iv. The name of the Consultant
v. Contract value
vi. Date of commencement of work
vii. Date of completion of work
viii. Other particulars, which will be asked by the Engineer.

10.7 PROGRESS IN PHOTOGRAPHS AND VIDEOS

Photographs and videos showing the progress of works and special photographs showing particular features or other matters of interest in connection with the Work or their surroundings shall be taken every month by an approved qualified photographer/cameraman to the choice of the Engineer. Number of photographs/video clips will not exceed 10 (ten) per month.
Four color un-mounted prints of a size 250mm on approved photographic paper of every such photograph inscribed with its serial number, date of shooting and a short title shall be furnished to the Engineer every month.
All negatives and video clips shall be numbered, filed and retained at the Site. On completion of the Contract, those shall become the properties of the Employer and shall be handed over to the Employer by the Contractor.
6 (six) complete sets of color prints of the finished permanent Work, not exceeding 20 (twenty) photographs in number, shall be taken when and as directed by the Engineer prior to finally granting the Contractor the Certificate of Completion and shall be suitably mounted, titled and supplied to the Engineer.

10.8 MEASUREMENT AND PAYMENT

Provisions for Office space and facilities for the Engineer shall not be measured.
Payment for all the items as stated below shall be for the full period of the Contract including any extension, if allowed. At the end of contract period all items listed will be Client's Property.
Payment for all equipment, signboards, photographs, video clips, services etc. of the Field Office detailed in this Sub-section shall be made as described below, where price and payment shall be the full compensation for complying with this Section of the Specification and the Conditions of the Contract.
Payment of rates for the pay items shall be the full compensation for supplying, erecting and maintaining the Field Office for the Engineer including all furniture, fixtures and fittings, access roads, office equipment, signboards, photographs, video clips etc. all in full compliance with the requirements of this Section.
No separate payment shall be made to the Contractor for providing the requisite tools, minor items and the consumables. Compensation for these items shall be deemed to be included in the other pay items of the BOQ.

Item of Payment	Unit
Supply , erection and maintenance of Signboards	Lump sum
Providing, erection and maintenance of office	

for the Engineer including all office equipment and consumables	Lump sum
Providing Vehicles	Lump Sum
Providing photographs	Lump sum

11 SITE PREPARATION

11.1 SITE PREPARATION

11.1.1 DESCRIPTION

This item of work shall consist of clearing the Site, undertaking general type of earthworks, setting out, etc. as shown on the Drawings, stated in the BOQ and/or as instructed by the Engineer.

11.1.2 COMMENCEMENT

The Contractor shall give the Engineer at least 7 (seven) days written notice of his intention to commence work on any part of the Site. Works shall not be commenced until written approval has been received by the Contractor from the Engineer.

11.1.3 DRAWINGS

The works are to be carried out in accordance with the Drawings and as directed by the Engineer. It may become necessary or desirable, during the progress of the Work, to change any feature shown on the Drawings in accordance with the actual field conditions. Whenever this may occur, the Contractor shall perform the required works to the revised dimensions in accordance with the written instructions of the Engineer.

11.1.4 SETTING OUT

Prior to the commencement of the Work, the Contractor shall study the Drawings and fully understand all aspects of the Work and co-relate the same with the dimensions shown on the Structural Drawings and shall fix up the alignment, set the Bench Mark (B.M) pillars, levels, pegs etc.
The Contractor shall check all the vital measurements of the layout plan of the building and submit a report to the Engineer the deviation, if required any from the dimensions shown in the approved Drawings for the building before starting construction works. In case of any deviation of unacceptable amount, the Engineer will inform the Contractor of the remedial measures, which may be necessary under a particular situation.
Cutting or filling charts, prepared by the Engineer, will be given to the Contractor to sign as a token of his agreement

11.1.5 EARTHWORKS, GENERAL

Earthwork shall be undertaken to the lines and levels shown on the Drawings unless directed otherwise by the Engineer. In carrying out the earthworks, the Contractor shall take all necessary precautions to avoid damage to or deterioration of the earthwork materials and existing ground

11.1.6 CLEARING OF SITE

The Site shall be cleared as required to remove all stumps, roots, vegetable and other objectionable materials specifically within the areas for construction of structure, appurtenance and any other facilities indicated on the Drawings or designated by the Engineer. The cleared materials shall be deposited on the approved off-Site areas or burnt as directed by the Engineer.

11.1.7 MEASUREMENT

The works on Site preparation shall not be measured.

11.1.8 PAYMENT

No direct payment shall be made for works required under this Section. Costs for such works shall be deemed included in the related items of the BOQ.

12 LIST OF APPROVED MANUFACTURER

CIVIL WORKS

S.NO	ITEM DESCRIPTION	APPROVED MANUFACTURER
1	Water Dispenser	a) Dawlance b) Homage
2	RCC PIPES	a) Banu Mukhtar
4	UPVC Windows & Door System	a) Excel Profile b) Alfapen c) RKITECT UPVC
7	Floor Mounted/ Wall Cabinet	a) AH Enterprises b) Dimension Office c) Wood art

ELECTRICAL WORKS

1.	Distribution Board and Load Break Switch	a) Hussain & Co b) Ra Engineering c) Or Approved Equivalent
2.	Molded Case Circuit Breakers. (M.C.C.B.)/ Miniature Circuit Breakers. (M.C.B.)	a) Schneider Electric b) Siemens c) Ge d) Abb e) Terasaki f) Or Approved Equivalent
3.	Voltmeter. / Ammeter.	a) Revalco b) Saci c) Or Approved Equivalent
4.	C.T.(Current Transformer)	a) Revalco b) Fico c) Circutor d) Or Approved Equivalent

Technical Specifications

5.	Auto-Off-Manual Selector Switchs. / A.S.S. / V.S.S.	a) Breter b) Kraus & Naimer c) Bremas d) Or Approved Equivalent
6.	Indication Lights. / ON. / OFF. Push Buttons.	a) Schneider Electric b) Maruyasu c) Lovato d) Or Approved Equivalent
7.	Light Fixture	a) Philips b) Eae c) Pierlite d) Or Approved Equivalent
8.	Single and Multicore LT cables.	a) Pakistan Cables b) Newage Cables c) Fast Cables d) Or Approved Equivalent
9.	PVC Conduits & Accessories. / uPVC Pipes & accessories.	a) Dadex b) Jeddah Polymer c) Civic d) Or Approved Equivalent
10.	Earthing.	a) Furse b) Erico c) Or Approved Equivalent
11.	Wiring Accessories.	a) Clipsal b) Mk c) Or Approved Equivalent
12.	Back Box.	a) Hussain & Co b) Ezzi Engineering c) Or Approved Equivalent
13.	Fire resistant cable	a) Prysmian b) Cavicel / Firecell c) Or Approved Equivalent

PLUMBING WORKS

1. Subject to compliance with requirements, provide products by one of the following manufacturers.
2. This list supersedes any Brand name which may appear in the specification section.

Description	**Approved Manufacturer**
Motor Control Centre (MCC)	• Sunbeam • Libra • Siemens • Taj Engineering

Technical Specifications

Molded Case Circuit Breakers (MCCB's)	• Terasaki • Legrand • ABB • General Electric
Miniature Circuit Breakers (MCB's)	• Terasaki Hage • Legrand • ABB • General Electric
Meters and CT's	• Revalco, Italy.
Magnetic Contractor	• ABB • National Green Power Japan
Wires, cables, conduits and cable tray	
Lt cable and wires	• Pakistan Cable (Pakistan) • Newage Cables
Steel conduit	• Hilal (Pakistan) • Premier (Pakistan)
PVC conduit	• Galco • Beta • Dadex • Civic
Expansion fittings & loops for plumbing piping	• Metraflex
Gauges and meters for plumbing systems	• Trerice • Ashcroft • Mueller • Weiss

Technical Specifications

	• Weskler manufacture.
Valves	• Hattersley • Crane • Owentrop • Schon • Econosto
Hangers and supports	
Vibration and Seismic Controls for Plumbing Piping and Equipment	• COOPER B-Line or approved equal.
Painting and identification works	• Jotun, Nippon paints
Facility sewage drain manholes	• Envicrete
Facility Storm Drainage Manholes and Catch Basin	• Envicrete
Through-penetration firestopping for MEP systems	• Hilti • 3M • Nullifire
Plumbing equipment insulation	• George Fischer • Terrain • Hepworth • Dadex • Marley Or approved quality
Plumbing piping insulation	• George Fischer • Terrain

Technical Specifications

	• Hepworth • Dadex • Marley Or approved quality
Level sensors	• Danfoss • Honey well • National (Japan) or approved equivalent.
Automatic air vents	• George Fischer • Terrain • Hepworth • Dadex • Marley • Or approved quality
Facility water distribution piping and fitting (UPVC class E)	• George Fischer • Terrain • Hepworth • Dadex • Marley • Or approved quality
Transfer pump piping and fittings (G.I)	• ILL or approved equivalent.
Domestic water piping and fittings for cold water and hot water (PPR)	• Polydex Dadex • Firat • Retti • Pilsa • Vesbo
Water booster unit	• ITT Lowara, Italy • Bell & Gossett, USA

Technical Specifications

	• Ebara, Japan • Grundfoss • Aurrora, USA • KSB, Germany • Willo, Germany
Domestic water inline pump-motor	• ITT Lowara, Italy • Bell & Gossett • Ebara, Japan • Grundfoss • Aurrora • KSB • Willo
Domestic water transfer end suction pump-motor	• ITT Lowara, Italy • Bell & Gossett • Ebara, Japan • Grundfoss • Aurrora • KSB • Willo
Facility external sanitary sewage piping and fittings (UPVC class D)	• George Fischer • Terrain • Hepworth • Dadex • Marley • Or approved quality
Soil, waste and vent	• George Fischer • Terrain

Technical Specifications

piping inside building (UPVC Class B)	• Hepworth • Dadex • Marley • Or approved quality
Cleanouts	• Local equivalent to Jay Smith
Floor drains	• Local equivalent to Josam
Grease trap	Master Sanitary pipes & fittings
Gully traps	Master Sanitary pipes & fittings
Sump pump discharge piping and fittings (UPVC class D)	• George Fischer • Terrain • Hepworth • Dadex • Marley or approved quality
Sump pit for sanitary sewage system	Master Sanitary pipes & fittings
Sanitary sewage pumps	• ITT Lowara, Italy • Bell & Gossett • Ebara, Japan • Grundfoss • Aurrora • KSB • Willo
Facility external storm drainage piping UPVC class D	• George Fischer • Terrain • Hepworth • Dadex

Technical Specifications

	• Marley or approved quality
Facility external storm drainage piping RC	• Razia or approved quality
Rain water leaders and piping UPVC class B piping	• George Fischer • Terrain • Hepworth • Dadex • Marley • Or approved quality
Sump pump discharge piping UPVC class D	• George Fischer • Terrain • Hepworth • Dadex • Marley • Or approved quality
Roof drains	• Local equivalent to Josam
Facility area drains	• Local equivalent to Josam
Facility trench drain	• Frost • Freedrain • ACO • Ancon • Cresent • Eccles • Josam
Sump pump	• ITT Lowara, Italy • Bell & Gossett • Ebara, Japan

Technical Specifications

	• Grundfoss • Aurrora • KSB • Willo
Sump pit with sand trap for storm drainage	
Natural gas piping	• PE pipe shall be of Dadex or approved equal
Hot water Geyser	• SINGER or approved quality
Plumbing fixtures	• Rak Ceramics • Toto • Ideal Standards • Twyford • Doulton • Ceramag • Kohler • American Standard • Valery and Boch
PVC water stopper	• Aqua Tech

OFFICE OF THE MEDICAL SUPERINTENDENT

(Email:)

ANNUAL PROCUREMENT PLAN FOR THE FINANCIAL YEAR 2025-26

S.No.	Description of Procurement	Quantity (Where applicable)	Estimated Unit Cost (where applicable)	Estimated Total Cost	Funds Allocated (Rs.) Million	Source of Funds (ADP/Non ADP)	Proposed Procurement Method	Timing of Procurement				Remarks
								1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	
01	Phase 01 - REHABILITATION/AUGMENTATION/CLEANING OF SEWERAGE & STORM WATER DRAIN SYSTEM WITH ALLIED FACILITIES AT CMC (TEACHING BLOCK) LARKANA.	On need basis	Nil	Nil	110 M	Regular Budget	Competitive Bidding amongst Contractors			To be procured	To be procured	
02	RENOVATION OF OPERATION THEATER BLOCK	On need basis	Nil	Nil	138 M	Regular Budget	Competitive Bidding amongst Contractors			To be procured	To be procured	

OFFICE OF THE MEDICAL SUPERINTENDENT

(Email:)

04	HIRING OF CONSULTANCY SERVICES FOR COMPREHENSIVE MASTER PLAN & REDEVELOPMENT AIMED FOR MODERNIZATION, INFRASTRUCTURE UPGRADATION, AND CLINICAL TRANSFORMATIO N AT CMC HOSPITAL (TEACHNIG BLOCK), LARKANA	On need basis	Nil	Nil	22 M	Regular Budget	Competitive Bidding amongst Contractor			To be procured	To be procured	

Founded by Shaheed Salmaan Taseer

A2 Maritime security exercise Sea Guard-2026 commences

A3 Punjab allows kite-making material in five districts for Basant

A8 Libyan commanders, CDF Munir discuss regional security dynamics

B2 Pakistan team lands in Sri Lanka for T20 World Cup

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OFFICE OF THE MEDICAL SUPERITENDENTCHANDKA MEDICAL COLLEGE LARKANA

(TENDER # CMC/Works/M&R/ /2026-2027/001)

CORRIGENDUM

Reference is made to the Notice Inviting Tender (NIT) published on 14 January 2026 refer advertisement reference INF KRY/0178/2026 for the work titled "Renovation / Repair / Augmentation / Strengthening of Operation Theater Blocks along with Allied Facilities at Chandka Medical College Hospital (Teacher Block), Larkana (Phase-I)".

It is hereby notified for the information of all prospective bidders that the submission deadline for electronic bids through I PADS has been extended as under:

Previous Submission Deadline 05 February 2026 at 02:00 PM
Revised Submission Deadline 23 February 2026 at 02:00 PM

The bid opening shall accordingly take place on 23 February 2026 at 03:00 PM at the same venue as mentioned in the original NIT.

All other terms, conditions, eligibility criteria, and provisions of the original Notice Inviting Tender shall remain unchanged.

Prospective bidders are advised to take note of the above extension and submit their bids accordingly.

MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE LARKANA
Shah Nawaz Bhutto Rd, Larkana, 77280, Phone: +92-74-9410715
PABX:+92-74-9410750.

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SC(MC)989 رجسٹرڈ نمبر

TUESDAY, FEBRUARY 3, 2026

پاکستان کے 11 شہروں سے بیک وقت شائع ہونے والا واحد اخبار

جلد 28 شمارہ 150 | منگل 14 شعبان المعظم 1447ھ 3 فروری 2026ء صفحات 12 قیمت 40 روپے

دفتر میڈیکل سپرنٹنڈنٹ چانڈکا میڈیکل کالج لاڑکانہ

(ٹینڈر نمبر CMC/Worls/M&R/2026-27/001)

تصحیح

بحوالہ چانڈکا میڈیکل کالج اسپتال (ٹیچر بلاک)، لاڑکانہ (فیز-I) میں متعلقہ سہولیات کیساتھ آپریشن تھیٹر بلاکس کی تزئین و آرائش/مرمت/پچنگی/استحکام کے عنوان سے کام کیلئے اشتہار ریفرنس INF/KRY/0178/2026 کیلئے مورخہ 14/جنوری 2026 کو شائع شدہ ٹینڈر طلبی نوٹس (این آئی ٹی)۔

تمام ممکنہ بولی دہندگان کی معلومات کیلئے بذریعہ ہذا مطلع کیا جاتا ہے کہ ای پی اے ڈی ایس کے ذریعے الیکٹرونک پیشکشیں جمع کرانے کی آخری تاریخ میں درج ذیل کے مطابق توسیع کردی گئی ہے:

سابقہ جمع کرانے آخری تاریخ 05/فروری 2026 بوقت دوپہر 02:00 بجے

نظر ثانی شدہ جمع کرانے کی آخری تاریخ 23/فروری 2026 بوقت دوپہر 02:00 بجے

پیشکش کا کھلنا جیسا کہ اصل این آئی ٹی میں درج ہے، اسی مقام پر 23/فروری 2026 کو بوقت سہ پہر 03:00 بجے اس حوالے سے رکھا جائیگا۔

تمام دیگر شرائط، ضوابط، معیار اہلیت، اور اصل ٹینڈر طلبی نوٹس کی شقیں غیر تبدیل شدہ رہیں گے۔

ممکنہ بولی دہندگان کو بالا توسیع نوٹ فرمالینے اور اس حوالے سے اپنی پیشکشیں جمع کرانے کی ہدایت کی جاتی ہے۔

میڈیکل سپرنٹنڈنٹ

چانڈکا میڈیکل کالج لاڑکانہ

شاہ نواز بھٹو روڈ، لاڑکانہ 77280، فون: +92-74-9410715

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ڪاوش

Wednesday, 04 February, 2026

(جلد 36) اربع 04 فيبروري 2026ع بمطابق 15 شعبان المعظم 1447ھ (شمارو 185) قيمت 40 رپيا

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آفيس آف دي ميڊيڪل سپرنٽينڊنٽ چانڊڪا ميڊيڪل ڪاليج لاڙڪاڻو

(TENDER#CMC/Works/M&R/2026-2027/001)

تصحيح

هن آفيس جي گهرايل ٽينڈر نمبر جيڪو تاريخ 14 جنوري، 2026 تي اشتهار نمبر INF/KRY No.0178/2026 جي ڪمن لاءِ عنوان ۾ "رينوويشن/مرمت/ آگمنٽيشن/اسٽرينٿننگ جي لاءِ ڏنو ويو هو جنهن ۾ بلاڪس گڏ سهولتون چانڊڪا ميڊيڪل اسپتال (ٽيچر بلاڪ) جي فيز-I ۾ ڏنيون هيون.

تنهن ۾ سمورن متوقع واڪ ڏيندڙ جي معلومات لاءِ ڏجي ٿو ته اليڪٽرانڪ واڪن جي EPADS وسيلي پيش ڪرڻ جي تاريخ ۾ هيٺين ريت واڌارو ڪيو ويو آهي.

اڳوات پيش ڪرڻ جي آخري تاريخ 05 فيبروري، 2026 منجهند 02:00 وڳي تائين هئي.

روائيزڊ پيش ڪرڻ جي آخري تاريخ 23 فيبروري، 2026 تي منجهند 02:00 وڳي آهي.

واڪ اهڙي طرح 23 فيبروري، 2026 تي منجهند 03:00 وڳي تائين اڳوات ڏنل اشتهار جي ساڳئي هنڌ تي کوليا ويندا.

ٻيا سمورا شرط ۽ ضابطا، اهليت جو معيار ۽ اڳوات ڏنل اصل ٽينڈر ۾ ساڳيا رهندا.

متوقع واڪ ڏيندڙن کي هدايت ٿي ڪجي ته اهي مٿي ڄاڻايل واڌاري موجب پنهنجا واڪ پيش ڪن.

ميڊيڪل سپرنٽينڊنٽ

چانڊڪا ميڊيڪل ڪاليج لاڙڪاڻو

شاهنواز پٽو روڊ، لاڙڪاڻو، 77280

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INF/KRY No.0378/2026

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Founded by Shaheed Salmaan Taseer

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Daily Times

Karachi Edition

TUESDAY,
February 3, 2026
Shaban 14, 1447

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OFFICE OF THE MEDICAL SUPERITENDENTCHANDKA MEDICAL COLLEGE LARKANA

(TENDER # CMC/Works/M&R/ /2026-2027/001)

CORRIGENDUM

Reference is made to the Notice Inviting Tender (NIT) published on 14 January 2026 refer advertisement reference INF KRY/0178/2026 for the work titled "Renovation / Repair / Augmentation / Strengthening of Operation Theater Blocks along with Allied Facilities at Chandka Medical College Hospital (Teacher Block), Larkana (Phase-I)".

It is hereby notified for the information of all prospective bidders that the submission deadline for electronic bids through I PADS has been extended as under:

Previous Submission Deadline 05 February 2026 at 02:00 PM
Revised Submission Deadline 23 February 2026 at 02:00 PM

The bid opening shall accordingly take place on 23 February 2026 at 03:00 PM at the same venue as mentioned in the original NIT.

All other terms, conditions, eligibility criteria, and provisions of the original Notice Inviting Tender shall remain unchanged.

Prospective bidders are advised to take note of the above extension and submit their bids accordingly.

MEDICAL SUPERINTENDENT
CHANDKA MEDICAL COLLEGE LARKANA
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روزنامہ ایکسپریس کراچی

SC(MC)989 رجسٹرڈ نمبر

TUESDAY, FEBRUARY 3, 2026

پاکستان کے 11 شہروں سے بیک وقت شائع ہونے والا واحد اخبار

جلد 28 شمارہ 150 | منگل 14 شعبان المعظم 1447ھ 3 فروری 2026ء صفحات 12 قیمت 40 روپے

دفتر میڈیکل سپرنٹنڈنٹ چانڈکا میڈیکل کالج لاڑکانہ

(ٹینڈر نمبر CMC/Worls/M&R/2026-27/001)

تصحیح

بحوالہ چانڈکا میڈیکل کالج اسپتال (ٹیچر بلاک)، لاڑکانہ (فیز-I) میں متعلقہ سہولیات کیساتھ آپریشن تھیٹر بلاکس کی تزئین و آرائش/مرمت/پچنگی/استحکام کے عنوان سے کام کیلئے اشتہار ریفرنس INF/KRY/0178/2026 کیلئے مورخہ 14/جنوری 2026 کو شائع شدہ ٹینڈر طلبی نوٹس (این آئی ٹی)۔

تمام ممکنہ بولی دہندگان کی معلومات کیلئے بذریعہ ہذا مطلع کیا جاتا ہے کہ ای پی اے ڈی ایس کے ذریعے الیکٹرونک پیشکشیں جمع کرانے کی آخری تاریخ میں درج ذیل کے مطابق توسیع کردی گئی ہے:

سابقہ جمع کرانے آخری تاریخ 05/فروری 2026 بوقت دوپہر 02:00 بجے

نظر ثانی شدہ جمع کرانے کی آخری تاریخ 23/فروری 2026 بوقت دوپہر 02:00 بجے

پیشکش کا کھلنا جیسا کہ اصل این آئی ٹی میں درج ہے، اسی مقام پر 23/فروری 2026 کو بوقت سہ پہر 03:00 بجے اس حوالے سے رکھا جائیگا۔

تمام دیگر شرائط، ضوابط، معیار اہلیت، اور اصل ٹینڈر طلبی نوٹس کی شقیں غیر تبدیل شدہ رہیں گے۔

ممکنہ بولی دہندگان کو بالا توسیع نوٹ فرمالینے اور اس حوالے سے اپنی پیشکشیں جمع کرانے کی ہدایت کی جاتی ہے۔

میڈیکل سپرنٹنڈنٹ

چانڈکا میڈیکل کالج لاڑکانہ

شاہ نواز بھٹو روڈ، لاڑکانہ 77280، فون: +92-74-9410715

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روزانه

ڪاوش

Wednesday, 04 February, 2026

(جلد 36) اربع 04 فيبروري 2026ع بمطابق 15 شعبان المعظم 1447ھ (شمارو 185) قيمت 40 رپيا

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آفيس آف دي ميڊيڪل سپرنٽينڊنٽ چانڊڪا ميڊيڪل ڪاليج لاڙڪاڻو

(TENDER#CMC/Works/M&R/2026-2027/001)

تصحيح

هن آفيس جي گهرايل ٽينڈر نمبر جيڪو تاريخ 14 جنوري، 2026 تي اشتهار نمبر INF/KRY No.0178/2026 جي ڪمن لاءِ عنوان ۾ "رينوويشن/مرمت/ آگمنٽيشن/اسٽرينٿننگ جي لاءِ ڏنو ويو هو جنهن ۾ بلاڪس گڏ سهولتون چانڊڪا ميڊيڪل اسپتال (ٽيچر بلاڪ) جي فيز-I ۾ ڏنيون هيون.

تنهن ۾ سمورن متوقع واڪ ڏيندڙ جي معلومات لاءِ ڏجي ٿو ته اليڪٽرانڪ واڪن جي EPADS وسيلي پيش ڪرڻ جي تاريخ ۾ هيٺين ريت واڌارو ڪيو ويو آهي.

اڳوات پيش ڪرڻ جي آخري تاريخ 05 فيبروري، 2026 منجهند 02:00 وڳي تائين هئي.

روائيزڊ پيش ڪرڻ جي آخري تاريخ 23 فيبروري، 2026 تي منجهند 02:00 وڳي آهي.

واڪ اهڙي طرح 23 فيبروري، 2026 تي منجهند 03:00 وڳي تائين اڳوات ڏنل اشتهار جي ساڳئي هنڌ تي کوليا ويندا.

ٻيا سمورا شرط ۽ ضابطا، اهليت جو معيار ۽ اڳوات ڏنل اصل ٽينڈر ۾ ساڳيا رهندا.

متوقع واڪ ڏيندڙن کي هدايت ٿي ڪجي ته اهي مٿي ڄاڻايل واڌاري موجب پنهنجا واڪ پيش ڪن.

ميڊيڪل سپرنٽينڊنٽ

چانڊڪا ميڊيڪل ڪاليج لاڙڪاڻو

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INF/KRY No.0378/2026

iWORK FOR SINDH www.iwork4sindh.com JOB PORTAL BY INFORMATION DEPARTMENT

RENOVATION/ REPAIR/AUGMENTATION/ STRENGTHENING OF OPERATION THEATER BLOCKS ALONG WITH ALLIED FACILITIES AT CHANDKA MEDICAL COLLEGE HOSPITAL (TEACHER BLOCK) LARKANO, (PHASE-I)

HEALTH DEPARTMENT, GoS

BILL OF QUANTITIES (BOQ)

MAIN SUMMARY

SR.NO	DESCRIPTION	AMOUNT
A	**New Construction (Phase-I)**	
A1	**Civil Works**	
1	SCHEDULE ITEMS	
a	Civil Works	19,619,954.00
b	Cost of Cartage Materials	1,319,165.00
c	Boundary Wall 600 Rft	5,052,293.00
	Above/Below Premium _____ %	
	Total	
2	NON SCHEDULE ITEMS	
	Civil Works	
	Total	
	Total	
A.2	**Electrical Works**	
1	SCHEDULE ITEMS	
	Electrical Works	7,852,693.55
	Above/Below Premium _____ %	
	Total	
2	NON SCHEDULE ITEMS	
	Electrical Works	
	Total	
	TOTAL of A1,A2	
	Add 5% SRB	
	GRAND TOTAL	

Medical Superintendent
CMC/SZW Hospital Larkano

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Bill O Quantities (BOQ)

RENOVATION/ REPAIR & STRENGTHENING OF EXISTING O.T BLOCK TO MODULAR O.T COMPLEX AT CHANDKA MEDICAL HOSPITAL, LARKANA. (PHASE-1)

	CIVIL WORKS				Schedule Items
Sch.No.Ref.	ITEMS DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT (RS)
S-13 Pg 19	Dismantling brick work in lime or cement mortar.	P.Cft	59.41	6422.00	381,531.00
S-18 pg 17	Excavtion in foundation of Building Bridges and other structures including dagbelling dressing,refilling around structrure with excavated earth Watering and ramming lead upto 5 ft. , lead upto one chain (30 metre) and lift upto 5 ft. (1.5 metre).				-
	(b) Ordinary Soil	P.Cft	11.88	46682.00	554,582.00
S-21, Pg 17	Filling, watering and ramming earth under floor with new earth (Excavated from outside) lead upto one chain and lift upto 5 feet.	P.Cft	47.02	137001.00	6,441,787.00
S-91, pg 84	Providing Anti-termite treatment by spraying /sprinkling /spreading Neptachler 0.5% Emulsion as an overall pre construction treatment in slab type construction along external foundation trenches of the building over complete parameter of the foundation trench etc, as per directions of Engineer Incharge.	PRft	11.46	3548.00	40,660.00
S-38, Pg 43	Providing and laying single per layer of polythene sheet 0.13 mm thick for water proffing as per specification and Instructions of Engineer incharge.	P.Sft	24.01	853	20,481.00
S-28, Pg 28	Damp proof course with (cement sand and shingle concrete 1:2 :4) including 2 coats of asphaltic mixture.	Sft	126.97	139.00	17,649.00
	(a) 2" thick				-
S-4, Pg 24	Cement concrete plain including placing compacting, finishing and curing, comlete (including screening and washing at stone aggregate without shuttering.				-
	(a) 1:4:8	P.Cft	388.67	1502.00	583,782.00
S-6,Pg 25	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately. This rate also includes all kinds of forms moulds: lifting shuttering and curing (including screening and washing of shingle.)				-
	R.C.C work in roof slab, beams, column, rafts, lintels and other structural members laid in situ or precast laid in position complete in all respects				-
	(I) Ratio 1 : 2: 4 90 Lbs of cement, 2 Cft sand and 4 Cft shingle 1/8" to 3/4" gauge.	P.Cft	717.59	1896.00	1,360,551.00
	II) Ratio 1 : 1-1/2 : 3 90 Lbs of cement, 1- 1/2 Cft sand and 4 Cft shingle 1/8" to 3/4" gauge	P.Cft	787.71	578.00	455,296.00
S-19,Pg 27	Erection and removal of centering for R.C.C or plain cement concrete works				-
	Partal Wood	P.Sft	106.52	1372.00	146,145.00
S-8 ,Pg26	Fabrication of deformed steel reinforcement for cement concrete including cutting,bending, laying in position, making joints and fastenings including cost of binding wire (also includes removeal of rust from bars.a) Deformed bar				-
	a) Deformed bar	P.Cwt	18934.02	148.44	2,810,566.00
S-5,Pg 30	Pacca brick work in ground floor in (including striking of joints) : (e) Cement sand mortar 1:4	P.Cft	381.18	7725.00	2,944,616.00
S-33, Pg 21	(a) Removing door with chowket.	Per. No	574.26	23.00	13,208.00

Medical Superintendent
CMC Hospital / SZW Hospital
LARKANO

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RENOVATION/ REPAIR & STRENGTHENING OF EXISTING O.T BLOCK TO MODULAR O.T COMPLEX AT CHANDKA MEDICAL HOSPITAL, LARKANA. (PHASE-1)

	CIVIL WORKS	Schedule Items			
Sch.No.Ref.	ITEMS DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT (RS)
S-83,Pg 83	Supplying & fixing in position Aluminum channels framing for hinged doors or made with 5 mm thick tinted glass glazing (Belgium) and Alpha (Japan) locks l/c handles, stoppers etc.				-
	(a) Deluxe model (White)	P.Sft	1656.83	294.00	487,108.00
S-112,Pg 86	Providing and fixing in position UPVC channels framing for Door of unplasticized polyvinyl chloride (UPVC) with fly screen in/c handles stoppers looking arrangement etc complete Deluxe model etc complete as per direction Engineer / Incharge.	P.Sft	3267.66	105.00	343,104.00
S-52, Pg.22	Removing cement plaster from wall..	P.Sft	5.39	4648.00	25,053.00
S-13, Pg 52	Cement plaster 1:6 upto 12' upto 20 ft height				-
	(a) 1/2" thick	P.Sft	37.01	25243.00	934,243.00
S-55,Pg 22	Dismantling glazed or encaustic tiles etc.	P.Sft	31.19	5476.00	170,796.00
S-25,Pg 46	Laying floors of approved coloured glazed tiles 1/4" thick floor of approved color & size jointing in white cement and laid over 1:2 cement sand mortor 3/4" thick including grouting with matching color and finishing.	P.Sft	325.4	2482.00	807,643.00
S-40, Pg 54	Preparing the surface and painting with plastic emulsion paint of approved make l/c rubbing the surface with sand Paper, filling the voids with chalk / plaster of paris and then painting etc. complete.				-
	A Three Coat	P.Sft	38.71	20958.00	811,284.00
S-38A, Pg 54	Preparing the surface and painting with weathercoat l/c rubbing the surface with rubbing brick/sand paper, filling the voids with chalks /plaster of paris and then painting with weather coat of approved make(SI38.A/56)	P.SFT	62.98	4285.00	269,869.00
	TOTAL (CIVIL WORKS)				**19,619,954.00**
	MISC ELECTRICAL WORK				
	ELECTRICAL WORKS (SCH ITEMS)				
	Following sizes of Single / multi core PVC insulated and PVC sheathed, unarmoured, copper conductor, 600/1000 Volts grade cables in already installed surface mounted/concealed GI/PVC conduit or in cable trays, for power and miscellaneous wiring including all accessories:				
S-93, Pg 235	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheeted with 4 core Armoured copper conductor 600/1000 volts size 35mm2	Per Rft	2594.09	1299.00	3,369,723
S-99, Pg 236	Providing & laying (MAIN or SUB MAIN) PVC insulated & PVC sheeted with 4 core Armoured copper conductor 600/1000 volts size 240mm2	Per. Rft	14671.85	400.00	5,868,740.00
	TOTAL (ELECTRICAL WORK)				**9,238,463.00**
	Premiun 15% Less				**1,385,769.45**
	TOTAL ELECTRICAL WORKS				**7,852,693.55**

Medical Superintendent
CMC/SZW Hospital Larkano

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ABSTRACT COST

CIVIL WORKS
SCHEDULE RATES 2024

S.No	Description	Unit	Qty	Rate	Amount
	Building Works Proposed (Compound Wall)				
1	Excavation in foundation of Building bridges and other structures including dagbelling dressing, refilling around structure with excavated earth Watering and ramming lead upto 5 ft in ordinary soil. (CSR Sr#.18b)	P.CFT	2,400.00	11.88	28,512.00
2	Dry rammed brick or stone ballast 1 1/2" to 2" gauge. (CSR Sr#.2)	P.CFT	600.00	104.97	62,982.00
3	Cement concrete plain including placing compacting, finishing and curing comlplete (including screening and washing at stone aggregate without shutting. Ratio1:4:8 (SI.5i/16)	P.CFT	396.00	348.83	138,136.68
4	Pacca brick work in foundation and plinth in: (e) Cement sand mortar 1:6	P.CFT	2,187.00	359.20	785,570.40
5	Reinforced cement concrete work including all labour and material except the cost of steel reinforcement and its labour for bending and binding which will be paid separately . This rate also Includes all kind of forms moulds: lifting shuttering curing rendering and finishing the exposed surface (including screening and wash of shingle.)(a) R.C work in roof slab, beams columns rafts, lintels and other structural members laid in situ or precast laid in position complete in all respects. (i) Ratio (1:2:4) 90 Lbs. cement 2 Cft. Sand 4 Cft. Shingle 1/8" 1/4" gauge (Ch/4 S.I 6(a) (I)	P.CFT	756.00	717.59	542,498.04
6	Cement plaster 1:4 upto 12' height. 1/2" thick (CSR Sr#.11b/52)	P.SFT	5,400.00	37.01	199,854.00
7	Cement plaster 1:4 upto 12' height. 3/8" thick (CSR Sr#.11a/52)	P.SFT	5,400.00	37.78	204,012.00
8	Cement pointing struck joints on walls. (a) Ratio 1:2	P.SFT	4,680.00	41.23	192,956.40

Medical Superintendent
CMC Hospital / SZW Hospital
LARKANO

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ABSTRACT COST

CIVIL WORKS
SCHEDULE RATES 2024

S.No	Description	Unit	Qty	Rate	Amount
10	Preparing the surface and painting with weathercoat l/c rubbing the surface with rubbing brick/sand paper, filling the voids with chalks /plaster of paris and then painting with weather coat of approved make(SI38.A/56)	P.SFT	4,680.00	86.58	405,194.40
11	Pacca brick work other than building including striking of joints upto 10ft. (3 meter) height (e) Cement sand mortar. 1:6	P.CFT	3,150.00	362.88	1,143,072.00
12	Providing and laying deformed (Grade - 60) reinforcement bars including the cost of straightening, cutting, bending, binding, wastage, and such overlaps as are not shown in the drawings, placing in position on cement Concrete 1:2:4 precast spacer or M.s. chairs and tying with binding wire etc. complete in all respects as per drawings and in accordance with the specifications. :- (Horizontal and Vertical members).	Cwt	45.41	18,934.02	859,854.62
	TOTAL				**4,562,643.00**

Medical Superintendent
CMC/SZW Hospital Larkano

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Bill O Quantities (BOQ)

RENOVATION/ REPAIR & STRENGTHENING OF EXISTING O.T BLOCK TO MODULAR O.T COMPLEX AT CHANDKA MEDICAL HOSPITAL, LARKANA. (PHASE-1)

CIVIL WORKS

S.NO.	ITEMS DESCRIPTION	UNIT	UNIT PRICE	QTY	ESTIMATED COST IN PKR
1	Contractor is responsible for the Clearing of area before any construction activity at site, either its related to Barication of Site, Removal of Furniture/ Structures. Contractor is fully responsible for the safety and stability of existing installed equipment and structure during the works.	Job		1	0
2	Dismantling and making new drainage for the subject OT Complex complete in all respect.	Job		1	0
3	Dewatering system during and after excavation of foundation including pumps, flexible pipe and power panel including laying of flexible pipe upto the nearest manhole.	Job		1	0
5	Fixing of slab dowels in the existing Slab, including drilling, filling of epoxy using Fischer FIS EM+ epoxy, fixing of reinforcement, excluding the cost of reinforcement.	Job		1	0
6	Supply and fixing of washroom fixtures.	Job		3	0
7	Medical Grade Clean Room Ceiling made of GI 0.5mm thickness, antimicrobial powder coating IMPORTED	SFT		5439.00	0
8	Homogenous Conductive Dissipative Flooring IMPORTED	SFT		5439.00	0
9	Automatic Sliding Door, SS 304, with respected sensor IMPORTED	EACH		6	0
10	Hinged Doors / Swing Door, SS 304 IMPORTED (3'-6"x7'-0")	EACH		8	0
	TOTAL CIVIL WORK				

MISC ELECTRICAL WORK (NON-SCHEDULE)

S.NO.	ITEMS DESCRIPTION	UNIT	UNIT PRICE	QTY	ESTIMATED COST IN PKR
1	Dismantling of all cables and conduits in the complete area in all aspects including lifting and shifting of debris to the nearby dumping area allocated by Client.	Job		1.00	
2	MCC Panels:				
	a)MAIN DB -1(FOR AHU ROOM)	No.		1.00	
	a)MAIN DB-2(for MOT BLOCK)	No.		1.00	
	a)MAIN DB-3(FOR CSSD)	No.		1.00	
3	Perforated Cable tray made of 20 swg hot dip galvanized sheet metal of different sizes including all hangers and supports.				
	a)100 mm wide with cover	Rft.		600.00	
	b)150 mm wide with cover	Rft.		600.00	
	c)200 mm wide with cover	Rft.		2,400.00	
4	Following sizes of Single / multi core PVC insulated and PVC sheathed, unarmoured, copper conductor, 600/1000 Volts grade cables in already installed surface mounted/concealed GI/PVC conduit or in cable trays, for power and miscellaneous wiring including all accessories:				
	a)Single Core, 2.5 sq.mm. Cu/PVC/PVC	Rft		151.00	
	b)4 Core, 04 sq.mm. Cu/PVC/PVC	Rft		105.00	
	c)4 Core, 2.5 sq.mm. Cu/PVC/PVC	Rft		57.00	
	d)Single Core, 04 sq.mm. Cu/PVC/PVC	Rft		22.00	
	e)Single Core, 6 sq.mm. Cu/PVC/PVC	Rft		15.00	
5	PVC Conduiting including all accessories for fitting complete in all aspect.	Job		1.00	
6	Provision and laying of CAT 6 Cable	Rft		100.00	
7	13amp 3 pin Flat Duplex Switched Socket	Each		100.00	

Medical Superintendent
CMC Hospital / SZW Hospital
LARKANO

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RENOVATION/ REPAIR & STRENGTHENING OF EXISTING O.T BLOCK TO MODULAR O.T COMPLEX AT CHANDKA MEDICAL HOSPITAL, LARKANA. (PHASE-1)					
8	LED Cleanroom Luminaires IP 55/65 IMPORTED	Each		76.00	
TOTAL (ELECTRICAL WORK)					

Medical Superintendent
CMC/SZW Hospital Larkano

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