INSTITUTE OF BUSINESS ADMINSTRATION, KARACHI
UNIVERSITY ROAD MAIN CAMPUS, KARACHI

VOLUME - I (CONDITION OF CONTRACT FOR CONSTRUCTION OF GIRLS HOSTEL PHASE - II, BLOCK I & II)

1- CONDITION OF CONTRACT

CLIENT:

Institute of Business Administration Karachi

Leadership and Ideas for Tomorrow

PLANNING & DEVELOPMENT OF PROJECT

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INVITATION FOR BIDS

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Tender Notice

The Institute of Business Administration (IBA), Karachi has arranged funds form its own resources and partly from Govt. of Sindh towards the cost of **Construction of Girls Hostel Phase-II** and is intended that the funds will be utilized to make eligible payments under the contract for the aforesaid construction work. Sealed bids are invited from Prequalified firms having valid registration with Pakistan Engineering Council in category C-4 or above and registered with relevant tax authorities (whichever is applicable) for the following tender.

Tender Title (Ref. No.)	Procedure	Bid Security	Project Estimated Cost	Completion Time
Construction of Girls Hostel Phase-II at IBA Staff Town, Karachi. (Project/05/21-22)	Single Stage Single Envelope	1%	130 Million	12 months
Tender Fee & Dates				
Fee: Rs.5,000/- The pre-bid meeting will be held on 8th April, 2022, at 11am with Manager Contracts (Project) Main Campus, IBA Karachi Issuance start date: 25th March 2022 at 9.00 AM Issuance end date & time: 27th April 2022 at 12.00 Noon Submission date & time: 08th April 2022 to 27th April 2022 at 12.00 Noon Opening date & time: 27th April 2022 at 12.30 Noon .				

Tender Document may be collected after submission of paid fee challan from the Office of **Head of Procurement, Fauji Foundation Building, IBA Main Campus, University Enclave, Karachi** on any working day (Monday to Friday). Alternatively, the tender document can be downloaded from the website. The Tender fee challan is to be generated from the IBA website https://www.iba.edu.pk/tenders/ which may be deposited in any branch of Meezan Bank Ltd. Sealed bids should be dropped in Tender Box placed at the Security Office, Gate # 4, IBA Main Campus University Enclave Karachi and will be opened on same date & venue in the presence of the bidders representatives who may wish to attend. In case of holiday the tender shall be opened / received on the next working day at same place and time. Bid Security in the form of Pay Order or Demand Draft has to be submitted in favor of "**IBA Karachi**" along with the Financial Proposal.

Kindly mention "Tender Number" at top left corner of the envelope.

N.B. IBA Karachi reserves the right to reject any bid or cancel the bidding process subject to relevant provision of SPP Rules 2010.

ADDRESS

Procurment Department
IBA, Main Campus, Univeristy Enclave, Karachi 75270
111-422-422 Fax (92-21) 99261508
Contact Person Senior Manager Contracts on 38104700 ext: 2517
Email nmalik@iba.edu.pk Website https://www.iba.edu.pk/tenders/

Evaluation/Qualification Criteria.

Evaluation Criteria is based on Technical Evaluation & Financial Evaluation. The Technical Evaluation is based on marks/score. The final selection will be on the basis marks obtained by the bidder on combined Technical & Financial Evaluation as per detail given in Evaluation Criteria.

1. Criteria based on Marks/Score.

Mandatory Provisions/Eligibility: Firms/Contractors must possess

(i) Valid registration certificate of PEC in the category C-4 or above and in Civil discipline for 2022 year;

(ii) (ii) valid registration certificate from income tax authority (NTN); and

(iii) (iii) is not black listed. *(Attach all certificates and affidavit of not black listing).*

A bid fail in Mandatory Provisions /Eligibility will be declared as non Responsive with out any further proceeding.

Technical Evaluation Criteria

Aggregate Qualifying Score is for Technical Evaluation is 60%, but it is mandatory to obtain at least 30% in each of the following sections.

(A) Company Profile.

i.	Period since Firm/Contractor is in construction business	**10 Marks**
	Up to 5 years	02 Marks
	Up to 10 years	05 Marks
	Above 10 years	10 Marks
	(Attach PEC license for each year)	
ii.	Office facilities	**05 Marks**
	In Karachi Only	03 Marks
	In any other City of Sindh Province	01 Marks
	In any other City of Pakistan	01 Marks

(B) General Experience Record **35 Marks**

i. Projects of similar nature and complexity 20 Marks

completed over last 05 years.

Academic Building G + 2 RCC Structure Min . Covered area 20,000 Sft and approx.

Academic Building cost of construction Rs. 100M or above for each individual Project.

(4 Marks for each project)

(Attach Completion certificates of the Project along with Work Order)

ii. Projects of similar nature and complexity in hand. 15 Marks

Academic Building G + 2 RCC Structure Min . Covered area 20,000 Sft and approx.

Estimated Cost of Construction 100 Million for each individual Project.

(5 Marks for each project having cost 100 Million or above).

(*Attach copies of work orders*)

(C) Personnel Capabilities required for this project

30 Marks

Sr. No.	Description/Position with qualification & experience	Number Required	Marks assigned	Remarks
1.	BSc (Civil Engg.) /BE(Civil) Engineers registered with Pakistan Engineering Council (PEC) with experience of 5 years or above.	1 Nos.	10	03 Marks for experience of 5 to 10 years. 05 Marks for above 10 years.
2.	BSc / BE (Mechanical / Electrical) Engineers registered with Pakistan Engineering Council (PEC) with experience of 5 years or above.	1 Nos.	10	03 Marks for experience of 5 to 10 years. 05 Marks for above 10 years.
2.	Diploma in Civil Engineering, with experience of 2years or above.	02	10	02 Marks for 02 years experience, 03 Marks for above 02 years.

(D) Equipment Capability **10 Marks**

(a)

S#	Description	Unit	Min. Qty	Marks
01	Mixer Machine (1beg capacity)	Nos.	01	03
02	Shuttering (Wooden / steel) with supports	Sq. ft	10,000	03
03	Scaffolding pipes & Joints	Rft	5,000	02
04	Bar cutting machine	Nos.	01	02

(b) High value equipment should be an option to own, lease or hire.

(c) Total equipment available with the applicant is to be listed along with its current mobilization on on-going projects.

(Details are to be provided in the attached form)

(E) Financial Soundness /Status **20 Marks**

For Financial Status assessment, the Applicants may be required to submit Audited Financial Statements for the last five years or any other document which verifies their Financial Status. Where necessary, the Procuring Agency will make enquiries with the firm's/contractor's bankers.

Working Capital in hand for this project/work (Attach proof of Bank Statement/Credit Facilities)

i. Less than 15% of Estimated Cost of this Work (Upto 19Million) 02 Marks

ii. 16 - 25% of Estimated Cost of this Work (Upto 32Million) 04 Marks

iii. 26 - 40% of Estimated Cost of this Work (Upto 52Million) 08 Marks

iv. More than 40% of Estimated Cost of this Work (More then 52Million) 10 Marks

(F) Any other information:

Any other document/information desired by procuring agency which shall not discriminate among contractors/firms.

Contractors/firms who fail to qualify in any of the above sections shall be disqualified from the prequalification process.

Bids which fails to get 60 % aggregate marks in Technical Evaluation and 30 % in individual sections of the Technical Section will be declared as non responsive.

Scope of Contract:

1.1 Back Ground :

Institute of Business Administration Karachi is one of the oldest leading & Most prestigious Business School of the Country. Presently it is operating Two Campus with around four thousand students enrolled, One at Garden Road Campus known as City Campus spread over about 3.5 Acres with high rise academic buildings and the other one at Karachi University enclave Known as Main Campus. It is spread over about 23 Acres.

Institute of Business Administration intends to undertake Construction Of Girls Hostel Phase-II at IBA Staff Town Karachi University Enclave Karachi and has decided to carry out the bidding process for selection of the Bidders to whom the Project(s) may be awarded.

1.2 Scope of Work :

The Proposed Project is an Extension of the Existing IBA New Girls Hostel Phase-I and Comprises of the Following Components :

a) Block I Ground Plus Two Stories 8 Accommodation at each floor
b) Block II Ground Plus Two Stories 16 Accommodation at each floor
c) Tennis Court
d) Volley Ball Court
e) External Development
f) Horticulture

g) Roads , Paths & Parking

The Scope of Work includes the following works :

a) Building (Civil Works)

b) Plumbing, water supply, HVAC & Fire suppression Works

c) Electrical Works

d) Security and Net Working

e) Horticulture

f) Roads, Path & Parking

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INSTRUCTION TO BIDDERS

INSTRUCTIONS TO BIDDERS

A. GENERAL

IB.1 Scope of Bid

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

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

IB.2 Source of Funds

2.1 The Procuring Agency has enough funds to cater for the cost of project.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all interested bidders who are eligible under provisions of Sindh Public Procurement Rules as mentioned below and the criteria given in the Notice Inviting Tender (NIT)/ Bidding Document.

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

(a) Bidders may be excluded if;

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

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

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

(i) legally and financially autonomous, and

(ii) operate under commercial law.

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

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

(c) Bidders are:-

(i) pre-qualified with procuring agency for particular project/scheme;

(ii) Registered with Pakistan Engineering Council in particular category and discipline,

(iii) registered with relevant tax authorities

IB.4 One Bid per Bidder

4.1 Each bidder shall submit only one bid either by himself, or as a partner in a joint venture. 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 procuring agency will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

IB.6 Site Visit

6.1 The bidders are advised to visit and examine the Site of Works and its surroundings and obtain for themselves on their own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. All cost in this respect shall be at the bidder's own expense.

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

B. BIDDING DOCUMENTS

IB.7 Contents of Bidding Documents (SPP Rule-21)

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

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.

13. Addendum if any

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 (SPP Rule-23(1))

8.1 Any interested bidder requiring any clarification(s) in respect of the bidding documents may notify the procuring agency in writing at the procuring agency's address indicated in the Invitation for Bids/NIT. Procuring agency will respond to any request for clarification provided they are received at least five calendar days prior to the date of opening of bid.

Provided that any clarification in response to query by any bidder; shall be communicated to all parties who have obtained bidding documents.

IB.9 Amendment / Modification of Bidding Documents

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

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

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

C. PREPARATION OF BIDS

IB.10 Language of Bid

10.1 The bid and all correspondence and documents related to the bid exchanged by a

bidder and the Procuring Agency shall be in the bid language stipulated in the Bidding Data 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 previously submitted with the application for prequalification and continue to meet the minimum criteria. set out in the prequalification documents 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 pre-qualification;

(iv) Current litigation information; and

(v) Availability of critical equipment.

and

(c) furnish a technical proposal taking into account the various Appendices to Bid specially the following:

Appendix-E to Bid	Proposed Construction Schedule
Appendix-F to Bid	Method of Performing the Work
Appendix-G to Bid	List of Major Equipment
Appendix-K to Bid	Organization Chart for Supervisory Staff and other pertinent information such as mobilization programme etc;

11.2 **DELETED**

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 stated otherwise in the bidding documents, the contract shall be for the whole of the works as described in IB 1.1 hereof, based on the unit rates or prices submitted by the bidder or percentage quoted above or below on the rates of Composite Schedule of Rates (CSR), as the case may be.

12.2 The bidders shall fill in rates and prices for all items of the works described in the Bill of Quantities. Items against which no rate or price is entered by a bidder will not be paid for by the procuring agency when executed and shall be deemed to be 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 The bid price submitted by the contractor shall include all rates and prices including the taxes. All duties, taxes and other levies payable by the contractor under the contract, or for any other cause during the currency of the execution of the work or otherwise specified in the contract as on the date seven days prior to the deadline for submission of bids.

Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 70.2 of the General Conditions of Contract Part-I.

12.4 **DELETED**

IB.13 Currencies of Bid and Payment

13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the Works supplied from outside the Procuring Agency's country (referred to as the "Foreign

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

13.2 **DELETED**

IB.14 Bid Validity

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

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

IB.15 Bid Security

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

15.2 The bid security shall be at the option of the bidder, in the form of deposit at call, Pay order or a bank guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favor of the procuring agency, which should commensurate with the bid validity period. The bank guarantee for bid security shall be acceptable in the manner as provided at Annexure BS-1.

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

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

15.5 The bid security of the successful bidder shall be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.

15.6 The Bid Security may be forfeited:

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

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

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

(i) furnish the required Performance Security; or

(ii) sign the Contract Agreement.

IB.16 Alternate Proposals by Bidder

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

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

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

IB.17 Pre-Bid Meeting

17.1 Procuring agency may, on his own motion or at the request of any prospective

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

17.2 The bidders are requested to submit questions, if any, in writing so as to reach the Procuring Agency not later than seven (7) days before the proposed pre-bid meeting.

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

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

IB.18 Format and Signing of Bid

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

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

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

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

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

persons signing the bid.

18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the Procuring Agency, or as are necessary to correct errors made by the bidder, 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.

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) ONE ORIGINAL and ONE 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 shall be put in one sealed envelope and addressed as given in Sub- Clause 19.2 hereof.

19.2 The inner and outer envelopes shall:

(a) be addressed to the procuring agency at the address provided in the Bidding Data;

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

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

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

19.4 If the outer envelope is not sealed and marked as above, the procuring agency will assume no responsibility 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 procuring agency 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 Procuring Agency may, at his discretion, extend the deadline for submission of bids by issuing an amendment in accordance with Clause IB.9, in which case all rights and obligations of the procuring agency and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

IB.21 Late Bids

21.1

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

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

IB.22 Modification, Substitution and Withdrawal of Bids

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

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

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

22.4 Withdrawal of a bid during the interval between the deadline for submission of

bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the Bid Security in pursuance to Clause IB.15.

E. BID OPENING AND EVALUATION

IB.23 Bid Opening

23.1 Procuring agency 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 in attendance shall sign an attendance sheet.

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

23.3 No bid may be modified by a bidder after the deadline for submission of bids except in accordance with to sub - clauses IB 22.1 and IB 27.2.

23.4 Withdrawal of a bid during the interval between the deadlines 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.

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

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

decisions may result in the rejection of such bidder's bid. Whereas, any bidder feeling aggrieved, may lodge a written complaint as per Rule 31; however mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification of Bids (SPP Rule-43)

25.1 To assist in the examination, evaluation and comparison of bids, the Procuring Agency may, at 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 procuring agency 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 procuring agency will determine whether the bidder fulfills all codal requirements of eligibility criteria given in the tender notice such as registration with tax authorities, registration with PEC (where applicable), turnover statement, experience statement, and any other condition mentioned in the NIT and bidding document. If the bidder does not fulfill any of these conditions, it shall not be evaluated further.

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

26.3 A bid will be considered technically responsive if it (i) has been properly signed; (ii) is accompanied by the required bid security; and (iii) conforms to all the terms, conditions and specifications of the bidding documents, without material deviation

or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the procuring agency's rights or the bidder's obligations under the contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

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

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

(i) has been not properly signed;

(ii) is not accompanied by the bid security of required amount and manner;

(iii) stipulating price adjustment when fixed price bids were called for;

(iv) failing to respond to specifications;

(v) failing to comply with Mile-stones/Critical dates provided in Bidding Documents;

(vi) sub-contracting contrary to the Conditions of Contract specified in Bidding Documents;

(vii) refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage;

(viii) taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures;

(ix) a material deviation or reservation is one :

(a) which affect in any substantial way the scope, quality or performance of the works;

(b) Adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

(B) Minor Deviations

Bids that offer deviations acceptable to the Procuring Agency and which can be assigned a monetary value may be considered substantially responsive at least as

to the issue of fairness. This value would however be added as an adjustment for evaluation purposes only during the detailed evaluation process.

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

IB.27 Correction of Errors before Financial Evaluation.

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

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

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

27.2 The amount stated in the Form of Bid will be adjusted by the procuring agency in accordance with the above procedure for the correction of errors and with the concurrence of the 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 Financial Evaluation and Comparison of Bids

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

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

a. making any correction for errors pursuant to Clause IB.27;

b. excluding Provisional Sums and the provision, (if any), for contingencies in the Summary Bill of Quantities, but including competitively priced 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 Procuring Agency's estimate of the cost of work to be performed under the Contract, the procuring agency may require the bidder to produce detailed price analyses for any or all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the procuring agency may require that the amount of the Performance Security set forth in Clause IB.32 be increased at the expense of the successful bidder to a level sufficient to protect the Procuring Agency against financial loss in the event of default of the successful bidder under the Contract.

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

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

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

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

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

(v) **"Obstructive Practice"** means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in a procurement process, or affect the execution of a contract or deliberately

destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements before investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or acts intended to materially impede the exercise of inspection and audit rights provided for under the Rules

28.6 Evaluation Report (SPP Rule 45)

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

F. AWARD OF CONTRACT

IB.29 Award (SPP Rule-49)

29.1 Subject to Clauses IB.30 and IB.34, the procuring agency 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 procuring agency, 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 for the said project.

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 Procuring Agency's Right to accept any Bid or Annul/Cancellation the Bidding

Process (SPP Rule-25)

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

IB.31 Notification/ Publication of the Award of Contract (SPP Rule 25)

31.1 Prior to expiration of the period of bid validity prescribed by the Procuring Agency, the procuring agency will notify the successful bidder in writing ("Letter of Acceptance") that his Bid has been accepted. This letter shall name the sum which the Procuring Agency 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, Procuring Agency 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 procuring agency and the bidder till signing of the formal Contract Agreement.

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

31.5 Within seven days of the award of contract, procuring agency shall publish on the website of the Authority and on its own website, if such a website exists, the results of the bidding process, identify the bid through procurement identifying numbers, and the following information:

(1) Evaluation Report;

(2) Form of Contract and letter of Award;

(3) Bill of Quantities or Schedule of Requirement.

31.6 Debriefing (SPP Rule 51).

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

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

IB.32 Performance Security (SPP Rule 39)

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

32.2 Failure of the successful bidder to comply with the requirements of 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.

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

IB.33 Signing of Contract Agreement

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

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

33.3 A procurement contract shall come into force when the procuring agency requires signs contract, the date on which the signatures of both the procuring agency and

the successful bidder are affixed to the written contract. Such affixing of signatures shall take place within the time prescribed in the bidding documents.

Provided that the procuring agency may reduce the maximum time limit for signing of contract, as and when required, and shall be mentioned in the bidding documents.

33.4 **Stamp Duty.**

The formal Agreement between the Procuring Agency and the successful bidder shall be duly stamped at rate of as mentioned in bidding data of bid price (updated from time to time) stated in Letter of Acceptance

IB.34 General Performance of the Bidders

The Procuring Agency reserves the right to obtain information regarding performance of the bidders on their previously awarded contracts/works. The Procuring Agency may in case of consistent poor performance of any Bidder as reported by the Procuring Agency of the previously awarded contracts, interalia, 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 (SPP Rule 89)

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 (SPP Rule 34)

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

agency.

BIDDING DATA

BIDDING DATA

1.1	**Name and address of the Employer:**	**Institute of Business Administration (IBA), Main Campus University Road Karachi 75270**
1.1	**Name of the Project:**	**Construction of Girls Hostel Phase-II IBA Staff Town, Karachi**
2.1	**Name of the Borrower/Source of Financing /Funding Agency:**	IBA
2.1	**Amount and type of financing:**	IBA resource
.		
3.1	**Time limit for clarification:**	15 days
10.1	**Bid language:**	English

11.1 (a) Pre-Qualification information to be updated:

1. Name of the Firm, Address and valid contact numbers.
2. Date of incorporation of firm.
3. Valid Pakistan Engineering Council Certificate in category C-4 or above.
4. Valid NTN Number:
5. Valid S.S.T Number:
6. Bank statement at least three years.
7. Last three years audited balance sheets.
8. Similar works executed within 5 Years along with documentary Evidence at least three works.
9. Works in hand along with documentary Evidence
10. Total Experience should not be less than 10 Years with supporting documents.
11. List of Technical Staff along with their Signed CV's

12. An affidavit duly singed and stamped that company is not black listed / litigation by any Government, Semi Government, Autonomous or by private organization

11.1(b) Furnish Technical Proposal:

The bidder to submit a technical proposal in sufficient detail to demonstrate the adequacy of the bid in meeting requirements for timely completion of the Works.

14.1	**Period of Bid Validity:**	90 days from the date of opening of the bids.

15.1 **Amount of Bid Security:**

Minimum 1% of the total bid price, in the form of a Pay Order/Demand Draft payable to the Institute of Business Administration, Karachi or in the form of Bank Guarantee issued by a Scheduled Bank of Pakistan.

17.1	**Venue, time, and date of the pre-Bid meeting:**	Aman CD Building G/Floor Meeting Room, University Road, Karachi Date; ====== , 2021 Time: === am
18.4	**Number of copies of the Bid to be completed and returned:**	one original and one copy
19.2(a)	**Employer's address for the purpose of Bid submission**	Head of Procurement Fauji Building First Floor Main Campus University Road, Karachi
19.2(b)	**Name and Number of the Contract:**	IBA NEW GIRLS HOSTEL Phase-II, **IBA/MC/DP/01/2021**
20.1(a)	**Deadline for submission of bids:**	Date as announced in 'Invitation for Bid'.
23.1	**Venue, time, and date of Bid opening:**	Meeting Room, AMAN CD Building Ground Floor, Main Campus, University Road, Karachi. Date as announced in

'Invitation for Bid'.

32.1 **Standard form and amount of Performance Security acceptable to the Employer:**

Performance Bond in the form of a bank guarantee from a Scheduled Bank for an amount equal to 5% of the bid Price.

32.4 **Stamp Duty:**

This contract agreement is required to be written on Stamp Paper of appropriate value, as per applicable law. To the best of our knowledge, the present "appropriate value" is 0.35% of the value of the contract.

The Stamp Paper will be purchased by the successful bidder at his own cost and provided to Procuring Agency for preparation of the contract agreement.

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, and 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_____

Appendix-A to Bid
SPECIAL STIPULATIONS

		Clause	Conditions of Contract
1.	IBA Engineer's Authority to issue Variations in an **emergency**	2.1	2% of the Contract Price stated in the Letter of Acceptance.
2.	Amount of Performance Security	10.1	5% of Contract Price stated in the Letter of Acceptance.
3.	Time for Furnishing Programme	14.1	Within 15 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 which shall be issued within fourteen (14) days after signing of Contract Agreement.
6.	Time for Completion	43.1, 48.2	12 Months period from the date of receipt of Engineer's Notice to Commence.
7.	Amount of Liquidated Damages	47.1	Liquidated damages for **each** day of delay in completion of the whole of the works shall be a sum equal to 10% of the total cost of the works (or the accepted bid price, whichever is higher) divided by one-fourth of the number of days specified as completion time.
8.	Defects Liability Period	49.1	12 Months from the effective date of Taking Over Certificate.

9.	Valuation of Variations	52.1	Contractor's mark-up on all additional items will be 25% inclusive all taxes tax. Mark-up on all additional sub-contractors' and supplier's items will be 15% inclusive all taxes.
10.	Percentage of Retention Money	60.2	10 % of the amount of Interim Payment Certificate.
11.	Limit of Retention Money	60.2	5 % of Contract Price stated in the Letter of Acceptance.
12.	Minimum amount of Interim Payment Certificates (Running Bills)	60.2	3% of contract amount
13.	Time of Payment from delivery of Engineer's Interim Payment Certificate to the Procuring Agency.	60.10	30 days.
14.	Financial assistance to the Contractor	60.11 60.12	Secured advance on materials as per Clause 60.11 and Mobilization Advance as per Clause 60.12 of the Conditions of Contract.
15	Difference in Basic Price	--	The difference (if any) in basic price of material, for those items of BOQ, where basic market price of any material is already indicated, will be added to or deducted from contractor's bill for the material so approved by the Engineer which might be of different value.

Appendix-B to Bid

FOREIGN CURRENCY REQUIREMENTS

1. The Bidder may indicate here in below his requirements of foreign currency (if any), with reference to various inputs to the Works.
2. Foreign Currency Requirement as percentage of the Bid Price excluding Provisional Sums _____%.

3. Table of Exchange Rates

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

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Appendix-C to Bid

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:

Cost Element	Description	Weightages	Applicable index
1	2	3	4
(i)	Fixed Portion	0.35	
(ii)	Local Labor	0.25	
(iii)	Cement – in bags	0.15	Government of Pakistan (GP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin
(iv)	Reinforcing Steel	0.10	" " "
(v)	High Speed Diesel (HSD)	0.10	" " "
(vi)	Bricks /Blocks	0.05	" " "
(vii)	Bitumen	****	" " "
	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.

Appendix-D to Bid

BILL OF QUANTITIES

---------- Please refer to Volume-II attached with this bid----------

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 Procuring Agency'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	12 Months

Note: The Construction Schedule will be submitted by the contractor either as a bar chart or CPM, specifying various activities, their sequence and the number of days required for completion of each activity.

Appendix-F to Bid

METHOD OF PERFORMING THE WORK

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

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

2. Mobilization 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.]

Appendix-G to Bid

LIST OF MAJOR EQUIPMENT – RELATED ITEMS

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

LIST OF MAJOR EQUIPMENT

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

Appendix-H to Bid

CONSTRUCTION CAMP AND HOUSING FACILITIES

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

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

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

1. Site Preparation (clearing, land preparation, etc.).
2. Provision of Services.
   a) Power (expected power load, etc.).
   b) Water (required amount and system proposed).
   c) Sanitation (sewage disposal system, etc.).
3. Construction of Facilities
   a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).
   b) Warehouses and Storage Areas (area required, type of construction and layout).
   c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).
4. Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).
5. Other Items Proposed (Security services, etc.).
6 ***As the Construction Site is Located in IBA Staff Town , bidder must his proposed security plan which will be subject to approval of IBA,s security department.***

Appendix-I to Bid

LIST OF SUBCONTRACTORS

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

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

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

Appendix-J to Bid

ESTIMATED PROGRESS PAYMENTS

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

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

Appendix-K to Bid

ORGANIZATION CHART FOR THE SUPERVISORY STAFF AND LABOUR

(Attached separate sheet as necessary)

Appendix-L to Bid
(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC.

PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN

CONTRACTS WORTH RS. 10.00 MILLION OR MORE

Contract No._____ Dated _____

Contract Value: _____

Contract Title: _____

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

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

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

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

Notwithstanding any rights and remedies exercised by GoS in this regard, [name of Supplier] agrees to indemnify GoS for any loss or damage incurred by it on account of its corrupt business practices

and further pay compensation to GoS in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoS.

Name of Buyer: ……	Name of Seller/Supplier: ……
Signature: ……	Signature: ……
[Seal]	[Seal]

FORMS

BID SECURITY
PERFORMANCE SECURITY
CONTRACT AGREEMENT
MOBILIZATION ADVANCE GUARANTEE/BOND

BID SECURITY
(Bank Guarantee)

Security Executed on _____
(Date)

Name of Surety (Bank) with Address: _____
(Scheduled Bank in Pakistan)

Name of Principal (Bidder) with Address _____
_____

Penal Sum of Security Rupees. _____(Rs. _____)

Bid Reference No. _____

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Bid and at the request of the said Principal (Bidder) we, the Surety above named, are held and firmly bound unto _____
(hereinafter called the 'Procuring Agency') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Bidder has submitted the accompanying Bid dated _____ for Bid No. _____ for_____(Particulars of Bid) to the said Procuring Agency; and

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

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

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

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

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

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

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

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

SURETY (Bank)

WITNESS:

1. _____
_____

Corporate Secretary (Seal)

2. _____

_____
Name, Title & Address

Signature _____
Name _____
Title _____

Corporate Guarantor (Seal)

FORM OF PERFORMANCE SECURITY

(Bank Guarantee)

Guarantee No._____

Executed on _____

Expiry date _____

[Letter by the Guarantor to the Procuring Agency]

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 Procuring Agency) in the penal sum of the amount stated above for the payment of which sum well and truly to be made to the said Procuring Agency, 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 Procuring Agency'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 Procuring Agency, 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 defences under the Contract, do hereby irrevocably and independently guarantee to pay to the Procuring Agency without delay upon the Procuring Agency's first written demand without cavil or arguments and without requiring the Procuring Agency to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Procuring Agency'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 Procuring Agency’s designated Bank & Account Number.

PROVIDED ALSO THAT the Procuring Agency 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 Procuring Agency 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. _____

_____
Corporate Secretary (Seal)

2. _____

_____
Name, Title & Address

Signature _____

Name _____

Title _____

_____
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 "Procuring Agency") of the one part and _____ (hereafter called the "Contractor") of the other part.

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

NOW this Agreement witnesseth as follows:

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

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

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

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

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

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 Procuring Agency
_____	_____
(Seal)	(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:	Witness:
_____	_____
(Name, Title and Address)	(Name, Title and Address)

Notes: 1. This contract agreement is required to be written on Stamp Paper of appropriate value, as per applicable law. To the best of our knowledge, the present "appropriate value" is 0.35% of the value of the contract.

2. The Stamp Paper will be purchased by the successful bidder at his own cost and provided to Procuring Agency for preparation of the contract agreement.

MOBILIZATION ADVANCE GUARANTEE/BOND

Guarantee No._____ Date _____

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

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

AND WHEREAS, the Procuring Agency 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 Procuring Agency)
(hereinafter called the "Guarantor") at the request of the Contractor and in consideration of the Procuring Agency agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

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

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

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

The Guarantor's liability under this Guarantee shall not in any case exceed the sum of

Rupees _____(Rs _____).

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

GUARANTOR

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

WITNESS

1. _____
_____
Corporate Secretary (Seal)

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

INDENTURE FOR SECURED ADVANCES.

(For use in cases in which is contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time).

This INDENTURE made the …….. day of .....

……. 20…… BETWEEN (hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and THE GOVERNOR OF SINDH (hereinafter called "the Government" of the other part).

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

(Here enter (the description of the works).1

AND WHEREAS the contractor has applied to the …….. ……..for an advance to him of Rupees ……..……

(Rs. .....) on the security of materials absolutely belonging to him and brought by him to the site of the said works the subject of the said agreement for use in the construction of such of the said works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labor and other charge) AND WHEREAS the Government has agreed to advance to the Contractor the sum of Rupees, (Rs. .....) on the security of materials the quantities and other particulars of which are detailed in Part II of Running Account Bill (B). the said works signed by the contractor

Fin R.Form.l7.A

On ……. and on such covenants and conditions as are hereinafter contained and the Government has reserved to itself the option of marking any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

NOW THIS INDENTURE WTTNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees…….

(Rs. ……) on or before the execution of these presents paid to the Contractor by the Government (the receipt whereof the Contractor doth hereby acknowledge) and of

such further advances (if any) as may be made to him as aforesaid (all of which advances are hereinafter collectively referred to as the said amount) the Contractor doth hereby assign unto the Government the said materials by way of security for the said amount

And doth hereby covenant and agree with the Government and declare ay follow :-

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

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

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

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

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

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

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

That the Contractor hereby charges all the said materials with the repayment to the Government of the said sum of Rupees .... (Rs. .....) and any further sum or sums which may be advanced as aforesaid and all costs charges damages and expenses payable under these present PROVIDED ALWAYS and it is hereby agreed and declared that not,

withstanding anything in the said agreement and without prejudice to the powers contained therein if and whether the covenant for payment and repayment hereinbefore contained shall become enforceable and the money owing shall not be paid to accordingly.

Once there with the Government may at any time thereafter adopt all or any of following courses as it may deem best ;-

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

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

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

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

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

enforcement of this security or otherwise by reason of (he default of the Contractor and any moneys so becoming due and payable shall constitute a debt due from the Contractor

to the Government and the Contractor hereby covenants and agrees with the Government to repay and the same respectively to it accordingly.

Singed, sealed and delivered by*	Singed, sealed and delivered by*
In the presence of	In the presence of
SEAL	SEAL
1st witness	2nd witness

Institute of Business Administration Karachi
Leadership and Ideas for Tomorrow

CONDITIONS OF CONTRACT

The conditions of contract comprise two parts and are based on Pakistan Engineering Council's "Standard Form of Bidding Documents":

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

PART I: GENERAL CONDITIONS OF CONTRACT

The General Condition of Contract as a part of Civil Engineering Contracts is a document prepared by the International Federation of Consulting Engineers (Federation International des Ingenieurs-Conseil, or FIDIC) whose address is as follows:

FIDIC Secretariat
P.O. Box 86
1000 Lausanne 12
Switzerland
e-mail: fidic.pub@fidic.org – FIDIC.org/bookshop

The aforesaid document is also known as The FIDIC Conditions of Contract. It is a copyright material and therefore cannot be made available here as a part of Tender Documents. Interested bidders are advised to obtain a copy of the document from the address given above.

In the following Part II: Particular Conditions of Contract, any reference to General Conditions of Contract or the FIDIC Condition of Contract **assumes that the bidder submitting this bid has read and is fully conversant with it.**

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PART II - PARTICULAR CONDITIONS OF CONTRACT

1.1 Definitions

(a) (i) The "Procuring Agency" is synonymous with "Procuring Agency is the **Institute of Business Administration, Main Campus, University Road, Karachi.**

(a) (iv) The Engineer is "The Project & Development Department Institute of Business Administration Karachi and the Project shall be Managed by Project Department of IBA Karachi or any other competent person appointed by the Procuring Agency, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineers is to formulate his certifications/recommendations in relation to all outstanding matters, disputes and claims relating to the execution of the Works during his tenure.

The following paragraphs are added:

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

(a)(vii) "Project Manager" means a person or firm appointed by the Procuring Agency to manage the construction project on his behalf and provide detailed supervision during the construction phase of the project.

(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.

(g)(iv) Add the words "and e-mail, CD or DVD"

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 Procuring Agency before carrying out his duties in accordance with the following Clauses:

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

2.2 Engineer's Representative

The following paragraph is added:

The Procuring Agency or the Project Manager appointed by him 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 or Project Manager 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 Procuring Agency intends to replace the Engineer, the Procuring Agency 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 Procuring Agency shall not replace the Engineer with a

person against whom the Contractor raises reasonable objection by notice to the Procuring Agency, 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; and
(10) The Specifications

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 Procuring Agency, Engineer and Project Manager for review 3 copies of all shop and erection drawings along with CD applicable to

this Contract as per provision of relevant Sub-Clause of the Contract.

Review and approval by the Engineer and/or the Project Manager 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.

IBA shall make no additional payment in this regard

6.7 As-Built Drawings

At the completion of the Works under the Contract, the Contractor shall furnish to the Engineer 3 copies and one reproducible of all drawings amended to conform with the Works as built. The contractor will also provide to the Procuring Agency a softcopy (CD, etc.) of the drawings. The price of such Drawings and CD shall be deemed to be included in the Contract Price. ***IBA shall make no additional payment in this regard.***

8.3 Project Requirements

The Contractor shall make the following arrangements for the Client's deputed Project Staff at Site :

a) Site Office : Two Furnished rooms with attached bath and properly insulated roof min. size 12'-0"x18'-0" & 12'-0"x14'-0" minimum clear height 10-0" with CC floor & distemper paint on walls with proper lighting & ventilation and 1.0 Ton AC in each room. The maintenance of the office shall be the responsibility of the contractor.

b) No additional payment for the Project office shall be made separately by IBA .

8.4 MATERIAL TESTING AT SITE

THE Contractor shall make full arrangement of equipment for field density test, Cube/ Cylinder casting arrangement, slump test etc. The cubes/ Cylinders shall be tested in designated lab as directed by the Engineer in the presence of Engineer's representatives. No additional payment shall be made and the cost shall be deemed to be included in the rates of the BOQ items.

10.1 Performance Security

The text is deleted and substituted with the following:

The Contractor shall provide Performance Security to the Procuring Agency 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 be in the form of bank guarantee from any Scheduled Bank in Pakistan.

The cost of complying with requirements of this Sub-Clause shall be borne by the Contractor. Validity of the Performance shall be till completion of the maintence period of the contract.

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 along with soft copy within 15 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, or

ii) a CPM identifying the critical path/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 and the Project Manager 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 or the Project Manager.

(b) During the period of the Contract, the Contractor shall submit to the Engineer or the Project Manager not later than the 8th day of the following month, two 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 and/or the Project Manager 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 and/or the Project Manager 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. Fortnightly meetings will be held on site to review progress and coordination issues. Representatives of Architect, Consultants, Project Manager, Client, Contractor and Sub-contractor (if any) are to attend the meetings on regular basis.

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 authorised representative at Site shall be authorised 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:

15.4 Contractor's Staff

The Contractor Shall ensure the minimum exclusive Staff is available at Site :

a) Project Manager : BE (Civil) Minimum experience 10 Years registered PEC

b) Site Engineer : BE (Civil) 5 Years / DAE with 10 Years Site Experience

c) Site Supervisor DAE (Civil) 5 Year Site Experience

d) Site Supervisor DAE (Elect./ Mech) 5 Years Site Experience

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 is 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 appoint a full time safety inspector and shall take 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. However, no work will be carried out at night without prior approval of the Procuring Agency.

20.4 Procuring Agency's Risks

The Procuring Agency'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 Procuring Agency 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

In Clause 21.1(b), read 25%, instead of 15%.

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 Procuring Agency.

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 Procuring Agency at and in the vicinity of the Site and also shall provide adequate precautionary facilities not to make himself a nuisance to local residents, other contractors and students and faculty of the Procuring Agency.

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 Procuring Agency 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 Procuring Agency or the Engineer or the Project Manager; except with the prior written consent of the Procuring Agency, the Engineer or the Project Manager, as the case may be.

34.4 Housing for Labour

Save insofar as the Contract otherwise provides, the Contractor shall provide, if not provided for otherwise elsewhere in these documents, 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 Procuring Agency or if the Procuring Agency 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 & Power

The Contractor shall, arrange water and power required for execution and working labour and staff at site from his own resources and IBA shall make no additional payment in this regard.

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 recognised 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 Subcontractor

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.

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 "or the Project Manager, in writing" are added.

52.1 Valuation of Variations

In the tenth line, after the words "Engineer shall" the following is added:

within a period not exceeding one-eighth of the completion time subject to a minimum of 56 days from the date of disagreement whichever is later.

53.4 Failure to Comply

This Sub-Clause is deleted in its entirety.

54.3 Customs Clearance

This Sub-Clause is deleted in its entirety.

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.

57.1 Method of Measurement

The following paragraph is added at the end:

Measurements for the purpose of billing shall be recorded on a Measurement Book (MB). No other documents shall be considered valid for payment.

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 Procuring Agency 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 Procuring Agency, the amount which the nominated Subcontractor was directly paid by the Procuring Agency.

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 Procuring Agency to the Contractor within 30 working days after such Interim Payment Certificate has been jointly verified by Procuring Agency 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 Procuring Agency 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.

The following Sub-Clause 60.11and 60.12 are added:

60.11 Secured Advance on Materials

(a) The Contractor shall be entitled to receive from the Procuring Agency Secured Advance against an Indemnity Bond acceptable to the Procuring Agency of such sum as the Engineer may consider proper in respect of non-perishable materials brought at the Site but not yet incorporated in the Permanent Works provided that:

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

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

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

shall be available for inspection by the Engineer;

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

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

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

(c) Recovery of Secured Advance:

(i) Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the rules not more than three months (even if unutilized); other conditions.

60.12 Financial Assistance to Contractor (Mobilization Advance)

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 by way of Mobilization Advance on following conditions:

(i) on submission by the Contractor of a Mobilization Advance Guarantee for the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan to the Procuring Agency;

(ii) This Advance shall be recovered in 5 equal installments 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.

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 Procuring Agency against the Contractor under this Clause, the Procuring Agency may also refer the case of default of the Contractor to Pakistan Engineering Council for punitive action under the Construction and Operation of Engineering Works Bye-Laws 1987, as amended from time to time.

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 Karachi, 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 Procuring Agency and the Engineer by registered post, the address of his principal place of business or any change in such address during the period of the Contract.

68.2 Notice to Procuring Agency and Engineer

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

a) The Procuring Agency:

Institute of Business Administration (IBA), Main Campus, University Road, Karachi 75270

b) The Engineer:

Project Manager, Planning & Development Department Institute of Business Administration Karachi

70.1 Increase or Decrease of Cost

Sub-Clause 70.1 is deleted in its entirety.

The following subclauses 73.1,73.2,74.1,75.1,76.1,77.1 and 78.1 are added :

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:-

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

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 70.1 (a), and with Paragraphs 70.1 (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, 79.1are 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

The Procuring Agency is not in any way liable to pay any customs duty and taxes payable or paid by the contractor.

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 Procuring Agency shall be entitled to:

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

(b) terminate the Contract; and

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

The termination under Sub-Para (b) of this Sub-Clause shall proceed in the manner prescribed under Sub-Clauses 63.1 to 63.4 and the payment under Sub-Clause 63.3 shall be made after having deducted the amounts due to the Procuring Agency under Sub-Para (a) and (c) of this Sub-Clause.

75.1 Termination of Contract for Procuring Agency's Convenience

The Procuring Agency shall be entitled to terminate the Contract at any time for the Procuring Agency'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 Procuring Agency 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 Procuring Agency 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 Procuring Agency 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 Procuring Agency.

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 Procuring Agency 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.

79.1 Safety Requirements

The Institute of Business Administration (IBA) obliged to provide and maintain, so far as is practicable, an environment for its employees, students and public, that is safe and without risk to health. As a condition of this contract, the IBA requires that any Contractors or subcontractors that may be engaged will at all times identify and exercise all reasonable and necessary precautions for the health and safety of all persons. This includes Contractor employees, IBA employees and public who may be affected by the works or services.

The Contractor will forthwith comply with any and all directions by the Engineer relating to occupational health and safety. This includes the right to carry out site inspections by Engineer.

a). Legislative Compliance: The Contractor must comply with and ensure that its employees, subcontractors and agents comply with local laws and by-laws, Codes of Practice, and the IBA's HS policy and procedures that are in any way applicable to this contract or the performance of the work / services under this contract.

b). Incident Notification: The Contractor must promptly notify the Engineer of any accident, injury, property or environmental damage that occurs during the carrying out of the contract works. All lost time incidents shall be immediately notified to Engineer. The Contractor must and within 3 working days of any such incident provide a report giving complete details of the incident, including results of investigations into its cause, and any recommendations or strategies for prevention in the future.

c). Non Compliance: If during the performance of works under the contract the Engineer informs the Contractor in writing that it is the opinion of the Engineer that

the Contractor is:

- not conducting the work in compliance with the Contractor's Health and Safety Plan, health and safety management procedures, or
- conducting the work in such a way as to endanger the health and safety of Contractors employees or the IBA's employees or its Contractors' and subcontractors' employees, plant, equipment or materials,

the Contractor shall promptly remedy that breach of health and safety.

The Engineer may direct the Contractor to suspend the work until such time as the Contractor satisfies the Engineer that the work will be resumed in conformity with applicable health and safety provisions.

During periods of suspension referred to above, the Engineer shall not be required to make any payment whatsoever to the Contractor.

If the Contractor fails to rectify any breach of health and safety for which the work has been suspended, or if the Contractors performance has involved recurring breaches of health and safety, the Engineer may as its option terminate the work forthwith, without further obligation to the Contractor. In this event, the Procuring Agency's liability shall be limited to payment for the work performed and costs incurred by the Contractor up to the time of termination or an earlier suspension of works.

d). Disputes on Health and Safety Matters: Where there is a dispute on health and safety matter between the Procuring Agency and the contractor, then after a reasonable period for negotiation (depending upon the nature and seriousness of the matter), the matter will be referred to the relevant government authority. Only written opinions from the relevant government authority will be accepted.

e). Health and Safety Plan: Prior to commencing the works under the contract the Contractor shall submit to the Engineer a Health and Safety Plan specific to the contract and works. The Health and Safety Plan shall consider and respond to the specific OHS hazards and issues relevant to the contract works and shall document the systems and methods to be implemented for the term of the contract. The Health and Safety Plan shall be reviewed by the Engineer and formal approval to

commence the contract shall be provided subject to acceptance of the Health and Safety Plan.

f). Risk Assessment: The Contractor shall prepare and submit a risk assessment prior to commencing the works under the contract. The risk assessment may be in the form of a Job Safety Assessment (JSA) or Safe Working Method Statement (SWMS). The risk assessment shall record the risk assessment and risk control methods to be employed by the Contractor. The completed risk assessment shall be submitted to the Engineer for review and approval prior to commencement of works under the contract.

g). Health & Safety Performance Reporting: The Contractor must when requested by the Engineer provide evidence of ongoing performance of the Contractor's HSP management system. If requested by the Engineer, the information shall apply to all the contractor's operations not just those pertaining to the Engineer. Without limiting the requirements of this obligation, the Contractor shall provide the following information on a monthly basis in the form of a Contractor Health & Safety Performance Report:

a. Number of lost time injuries
b. Working days lost due to injury
c. Current status of any injured personnel, damaged property or environmental damage or pollution
d. Status of the implementation and outcomes of corrective actions undertaken as a result of HS inspections and risk assessments
e. Status of HS management system audits undertaken

The HS Performance Report shall be submitted by the Contactor using the Contractor Monthly HS Performance Report Form. The Contractor shall when requested by the Engineer provide reports on HS inspections, audits or assessments undertaken during the course of the contract.

h). Other Parties and Contractors sharing the contract location: Where the health and safety of other parties or other contractors may be affected by this contract, the contractor is required to ensure adequate communication and coordination

occurs on health and safety matters. Where there are matters of issue or concern they must be raised as soon as practicable with the Procuring Agency through the Engineer.

j). Personal protective equipment: Where adequate protection against the risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means, suitable personal protective equipment and protective clothing, having regard to the type of work and risks, shall be provided and maintained by the Contractor, without cost to the workers.

INSTITUTE OF BUSINESS ADMINSTRATION, KARACHI
UNIVERSITY ROAD MAIN CAMPUS, KARACHI

VOLUME - IIB (TECHNICAL SPECIFICATIONS FOR CONSTRUCTION OF GIRLS HOSTEL BLOCK I & II)

1- TECHNICAL SPECIFICATIONS FOR MEP WORKS

CLIENT:

Institute of Business Administration Karachi

Leadership and Ideas for Tomorrow

PLANNING & DEVELOPMENT OF PROJECT

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DIVISION - 26 05 11

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 – General

1.1 Related Documents:

Drawings and general provisions of Contract, including General and Special Conditions apply to this Section.

1.2 Summary:

a) This Section includes the following basic mechanical materials and methods to complement other Sections.

i) Piping materials and installation instructions common to most piping systems.

ii) No shrink grout for equipment installations.

iii) Field-fabricated metal and wood equipment supports.

iv) Installation requirements common to equipment specification sections.

v) Mechanical demolition

vi) Cutting and patching

vii) Touch-up painting and finishing

viii) Pipe and pipe fitting materials are specified in piping system Section.

1.3 Definitions:

a) Pipe, pipe fittings and piping include tube, tube fittings and tubing.

b) Finished spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, spaces above ceiling, crawl spaces and tunnels.

c) Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

d) Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

e) Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

1.4 Quality Assurance:

a) Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code – Steel."

b) Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications."

i) Comply with provisions of ASE B31 Series "Code for Pressure Piping."

ii) Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

c) ASME A13.1 for lettering size. Length of color field, colors and viewing angles of identification devices.

d) Equipment Selection: Equipment of greater or larger power, dimensions, capacities and ratings may be furnished, provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors bases and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

e) For products manufactured for 50 Hz use, that do not carry or qualify for UL labels, a manufacturer's certification is required that the product meets the minimum requirements of Internationally Recognized Testing Laboratories (IRTL) meeting the requirements of International Electro Commission (IEC), which are deemed equal to UL and other U.S. testing laboratories.

1.5 Delivery, Storage and Handling:

a) Deliver pipes and tubes with factory-applied endcaps. Maintain endcaps through shipping, storage, and handling to prevent pipe-and damage and prevent entrance of dirt, debris and moisture.

b) Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

c) Protect flanges, fittings and piping specialties from moisture and dirt.

1.6 Sequencing and Scheduling:

a) Coordinate mechanical equipment installation with other building components.

b) Arrange for chases, slots and openings in building structure during progress of construction, to allow for mechanical installations.

c) Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

d) Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

e) Coordinate connection of mechanical systems with utilities and services. Comply with requirements of governing regulations, service companies, and consultants.

f) Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

g) Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

1.7 Shop Drawings:

a) Shop drawing detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

b) Coordination drawings for access panel and door locations.

c) Prepare coordination drawings to a 1:50 scale or larger. Detail major elements, components and systems of mechanical equipment and materials in relationship with other systems, installations and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the work. Include the following:

Proposed locations of piping, ductwork, equipment and materials. Include the following:

i) Planned piping layout, including valve and specialty locations and valve stem movement.

ii) Planned duct systems layout, including elbows radii and duct accessories.

iii) Clearances for installing and maintaining insulation.

iv) Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.

v) Equipment services connections and support details.

vi) Wall penetrations.

vii) Fire-rated wall and floor penetrations.

viii) Sizes and location of required concrete pads and bases.

ix) Scheduling, sequencing, movement and positioning of large equipment into the building during construction.

x) Floor plans, elevations and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.

d) Reflected ceiling plans to coordinate and integrate installations, air outlets, and inlets, light fixtures, communications systems components, sprinklers and other ceiling-mounted items.

PART 2 – Products

2.1 Pipe and Pipe Fittings

a) Refer to individual piping system specification Sections for pipe and fitting materials and jointing methods.

b) Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipefittings.

2.2 Joining Materials

a) Refer to individual piping systems specification Sections in Division 15 for special joining materials not listed below.

b) Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

c) ASME B16.21, non-metallic, flat, asbestos-free, 3.2mm maximum thickness, except where thickness or specific material is indicated.

i) Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.

ii) Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.

d) ASME B16.20 for grooved, ring-joint, steel flanges.

e) AWWA C110, rubber, flat face, 3.2mm thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

f) Flange Bolts and Nuts: ASME B18.2.1 Carbon steel, galvanized, except where other material is indicated.

g) Solder Filler Metal: ASTM B 32.

h) Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent), and silver (approximately 5%), having 0.10-percent lead content.

i) Brazing Filler Metals: AWS A5.8.

j) Bag1: Silver alloy.

k) Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

l) Flanged, Ductile-Iron Pipe Gasket, Bolts and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

PART 3 – Execution

3.1 Direction of Metal Supports and Anchorage

a) Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment.

b) Field Welding: Comply with AWS D1.1 “Structural Welding Code-Steel”.

3.2 Demolition

a) Disconnect, demolish and remove work specified under Division 15 and as indicated.

b) Where pipe, ductwork, insulation or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

c) Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

d) Removal: Remove all demolished materials and equipment from the project site.

e) Temporary Disconnection: Remove, store, clean, reinstall, reconnect and make operational equipment indicated for temporary or permanent relocation.

3.3 Cutting and Patching

a) Cut, channel, chase and drill floors, walls, partitions, ceilings and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved. Obtain prior approval of Consultant before performing work.

b) Repair cut surfaces to match adjacent surfaces.

3.4 Grouting

a) Install non-metallic, no shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates and anchors. Mix grout according to manufacturer's printed instructions.

b) Clean surfaces that will come into contact with grout.

c) Provide forms for placement of grout, as required.

d) Avoid air entrapment when placing grout.

e) Place grout, completely filling equipment bases.

f) Place grout on concrete bases to provide a smooth bearing surface for equipment.

g) Place grout around anchors.

h) Cure placed grout according to manufacturer's printed instructions.

3.5 Air Balancing

a) Unit shall be factory balanced for the specified air-flow rate however it shall also be capable to be field set at the desired air volume.

b) External scale shall be provided to accurately set the flow.

c) Radiated noise shall not exceed NC 35 in any case.

3.6 Installation

The installation shall be carried out complete in all respects as per manufacturers recommendations, all duct connections, electric connection and control connections etc., shall also be done by the contractor the unit shall be provided with proper hanging system.

3.7 Commissioning & Testing

The unit shall be factory tested for full and part load operation. The unit shall be commissioned and tested as per the manufacturer's recommendation. The contractor

shall be required to carry out test, on forms to be supplied later by the Consultants, and obtain approval.

3.8 Control Dampers & Actuators

Dampers shall consist of: a 20 gauge galvanized steel channel frame with 5" depth; triple V type blades fabricated from 16 gauge galvanized steel; blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper ½" dia plated steel axles turning in synthetic (acetal) sleeve bearings; extruded vinyl blade seals for 180F maximum temperature; jamb seals shall be flexible aluminum; and external (out of the airstreams) blade-to-blade linkage. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressure to 6" w.g., velocities to 4000 fpm and accordance with AMCA Standard 500. Dampers larger than 48" width and / or 74" height will be factory fabricated of multiple equal sections; jack shafted together.

Damper shall be provided with flanges for duct connection or mounting on wall.

Actuator shall be heavy duty floating type actuator of torque as required for the specified size of damper shall be able to directly mount to damper shaft.

3.9 Duct Work Insulation

3.9.1 Insulation

All supply air ducting and return air ducting shall be insulated with insulation indicated in Insulation Schedule. Panels shall be cut to size to fit duct being insulated and shall be fixed to the duct with approved adhesive. Adhesive shall cover at least 75% of duct area. Sheet metal hooks will not be allowed. The insulation is to be installed flush with the duct, but so as not to lessen the thickness of the insulation. Insulation shall be continuous, and no gaps, crevices, or other discontinuities shall be acceptable. The insulation shall be held in place additionally by using polyethylene packaging bands, 10mm wide.

3.9.2 Jacket

To provide mechanical protection to the insulation shall be provided in mechanical rooms, on ducts which are installed at or below 2m height. Jacket shall be as indicated

under Insulation Schedule (Section-2), pasted to insulation using approved adhesive. All circumferential and longitudinal joints shall be over-lapped at least 40mm.

3.9.3 Cladding

All insulated ducting exposed to the atmosphere shall be provided with a cladding of 24 gage (0.70mm) GI sheet over the insulation. All joints shall be sealed with "Silicon Sealant", so that the cladding becomes completely waterproof. Cladding shall also be installed at all other locations shown on the drawings.

3.9.4 Insulation Tapes

At all insulation joints use 75mm wide self-adhesive tape consisting of reinforced aluminum foil and white Kraft paper.

3.9.5 Adhesive

Adhesive shall be rubber reinforced co-polymeric compound, equivalent in all respects to Zahabiya (Pakistan) ZGPA-7/223.

3.10 Duct Works & Accessories

3.10.1 Sheet Metal

Sheet metal duct work shall be constructed of galvanised sheet steel conforming to ASTM A527, lock-forming quality, uncoiled, regular spangle and having a minimum coating of 275 g/m².

3.10.2 Duct Construction and Installation Standards:

a) All duct construction and installation shall be carried out in accordance with current SMACNA HVAC Duct Construction Standards and SMACNA Accepted Industry Practice for Industrial Duct Construction, unless otherwise indicated herein.

Each duct system shall be constructed for the specific duct pressure requirements of the project as per the external static pressure.

•1" WG pressure class shall be the minimum basis of compliance with the standards, regardless of the velocity in the duct, except when the system is variable volume. Measurement of duct velocity to be entirely the responsibility of the Contractor.

•All variable volume duct up-stream of VAV boxes shall have a 2" minimum basis of compliance. Measurement of duct velocity to be entirely the responsibility of the Contractor.

•2" WG pressure class shall be the minimum basis of compliance for all ducts having velocity greater than 2000fpm and less than or equal to 2500fpm. Measurement of duct velocity to be entirely the responsibility of the Contractor.

•3" WG pressure class shall be the minimum basis of compliance for all ducts having velocity greater than 2500fpm and less than or equal to 4000fpm. Measurement of duct velocity to be entirely the responsibility of the Contractor.

c) Minimum sheet thickness to be used shall be as follows, unless static pressure requirements dictate higher thickness as per SMACNA standards see TABLE-3 & 4 on pages 15670-6 & 15670-7 respectively.

3.10.3 Equipment Installation Responsibility

a) The Contractor shall ensure that the equipment is installed totally in accordance with the manufacturer's instructions (equipment installation manual must be obtained & read), and as directed by the Consultant. Correct alignment & leveling must be ensured.

b) Field assemble equipment (if required) in accordance with instructions in the manufacturer's installation bulletin.

c) Install the equipment on the foundation. Neoprene isolation pads or spring vibration isolators as specified for the equipment shall be placed under the equipment.

d) Insure that structure, piping or other equipment adjacent to this equipment do not restrict operation & maintenance requirements of the equipment.

e) Install all piping, cable, and other connections with all fittings, to the equipment. All material and labor required for a complete installation shall be supplied by the Contractor.

f) Connect equipment control panel to all operating external safety and auxiliary control devices.

g) Provide and install gauge cocks and thermometer wells for temperature and pressure readings at the inlet and outlet of all fluid flows.

h) Provide and install a flow switch on water circuits wherever necessary, and interlock it with the starting control circuit of the unit.

i) Install any control components provided by the manufacturer for installation external to the machine.

3.11 Flexible Duct

Supply and install pre-insulated flexible duct as and where shown on the drawings.

a) The duct shall be fabricated with extremely strong woven fiber glass fabric, with a flame-resistant coating & permanently bounded to a coated spring steel wire helix, with a bidirectional metallic reinforced vapor barrier, with a stand-up beam. The duct shall be factory insulated with one inch fiber glass insulation with a vapor seal. Duct and insulation shall comply with NFPA-90A and be listed as Class-1 air duct under UL Standard 181. Also, the duct shall be suitable for the temperature range from 20°F to 250°F and velocity up to 5000 fpm. Positive pressure 10 inches and negative pressure 1 inch. Flexible duct shall be similar to model M-KC thermo flex Duct manufactured by Flexible Technologies, USA.

b) Limit length of the flexible duct to not more than 4 feet, unless otherwise shown on drawings.

c) Securely fasten the flexible duct run outs to sheet metal collars. Slip the flexible duct over a matching sheet metal collars and clamp the flexible duct with a galvanized steel jubilee clamps.

d) Provide slack in duct @ 20% (twenty percent).

3.12 Louvers

3.12.1 General

a) Supply & install where indicated/shown on drawing or specified herein anodized aluminum exhaust/intake air louvers.

b) The blades and frames shall be of heavy gage extended aluminum sections provided with powder coating as approved by the Architect. The blades of louvers shall be set at 45°.

c) The louvers shall be provided with aluminum insect screen, so installed as to be removable for cleaning & replacement of screen.

d) Prior to order the Contractor shall submit shop drawing showing dimensions, free area available and sample to the Consultant for approval.

3.13 Mechanical Identification

3.13.1 General

The contractor shall install mechanical identification tags, shield, plates, etc., where specified below, shown on drawings, or directed by the Consultants. All components of the identification system shall be submitted to the Consultants for approval & approval obtained prior to installation.

3.13.2 Equipment Name Plates

All equipment shall be provided with metal nameplate with operational data engraved or stamped; permanently fastened to equipment at an accessible & visible location. Nameplate shall have name of manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data.

a) Material shall be Fiberboard / Brass / Stainless steel / Laminated Plastic.

b) Stencil paint shall be black enamel, except as otherwise indicated.

c) Manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure sensitive vinyl pipe markers, conforming to ASME A13.1 shall also be accepted.

3.13.3 Equipment Data Plates

All equipment shall be provided with Equipment Data Plate to be permanently fastened at a suitable accessible and visible location of the equipment. Data plates shall be of min. 3mm thick laminated plastic of suitable size (min. 150mm x 100mm) fastened securely to the equipment. The plates shall generally display the following data:

a) Equipment identification symbol/number.

b) Fluid flow rates.

c) Pressure, pressure drops.

d) Cooling capacities or other capacities.

e) Motor data.

Any other matter required by the Consultants.

3.13.4 Labeling & Identifying

a) Piping Systems: install pipe markers as follows on each system, wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces

(shafts, tunnels, plenums) and exterior non-concealed locations. Include arrows showing normal direction of flow:

i) Near each valve and control device.

ii) Near each branch, excluding short take-offs for fixtures and terminal units.

iii) Mark each pipe at branch, where flow pattern is not obvious.

iv) Near locations where pipes pass through walls, floors, ceilings or enter non-accessible enclosures.

v) At access doors, manholes and similar access points that permit view of concealed piping. vi) Near major equipment items and other points of origination and termination.

vi) Spaced at a maximum of 15 meters intervals along each run. Reduce intervals to 8 meters in congested areas of piping and equipment.

vii) On piping above removable acoustical ceilings, except omit intermediately spaced markers.

b) Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.

i) Lettering Size: Minimum 6.5mm lettering for name of unit where viewing distance is less than 60mm, 12mm high for distances up to 180mm and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

ii) Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions and warn of hazards and improper operations, in addition to name of identified unit.

c) Duct Systems: Identify air supply, return, exhaust, intake and relief ducts with stencilled signs and arrows, showing duct system service and direction of flow.

i) Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 15 meters.

ii) Adjusting: Relocate identifying devices, which become visually blocked by work of this Division or other Divisions.

3.14. Equipment Lifting

The contractor shall be solely responsible for safe lifting of the equipment's from place of storage to location of final installation and finally on the foundations.

Prior to lifting the equipments the following procedure shall be adopted:

a) Submit comprehensive insurance policy for the full value of the equipment to the Engineer/Employer from approved insurance company.

b) Submit complete information of specialist firm of lifters/riggers to the Engineer & obtain approval.

c) Submit complete procedure & equipment to be used for lifting the equipment in place. Identify on plans location of tripods, hoist, etc. that will transfer weight to the equipment, to the structure & obtain approval.

d) All the above to be completed with one month before the date of lifting of equipment.

3.15. Tests on Completion

a) The Contractor shall give to the Engineer/Consultant/Engineer in writing 15 days' notice of the date after which he will be ready to make the "Tests on Completion". Unless otherwise agreed the tests shall take place within 10 days after the said date on such day or days as the Consultant/Engineer shall in writing notify the Contractor.

b) If the Consultant/Engineer fails to appoint a time after having been asked to do or to attend at any time or place duly appointed for making the said tests, the Contractor shall be entitled to proceed in his absence and the said tests shall be deemed to have been made in the presence of the Consultant/Engineer.

c) If in the opinion of the Consultant/Engineer the tests are being unduly delayed he may, by notice in writing, call upon the Contractor to make such tests within 10 days from the receipt of the said notice, and the Contractor shall make the said tests on such day within the said 10 days as the Contractor may fix and of which he shall give notice to the Consultant/Engineer. If the Contractor fails to make such tests within the time aforesaid, the Consultant/Engineer may himself proceed to make the tests.

All tests so made by the Consultant/Engineer shall be at the risk and expense of the Contractor.

d) The Employer, except where otherwise specified, shall provide free of charge subject to the provisions of Sub-clause (e) of this clause; electricity, fuel and water, as may be reasonably demanded to carry out such tests efficiently.

e) If any portion of the works fail to pass the tests, tests of the said portion shall, if required by the Consultant/Engineer or by the Contractor, be repeated within a reasonable time upon the same terms and conditions, as aforesaid, save that all expenses to which the Employer may be put by the repetition of the tests shall be deducted from the Contract Price.

3.16. Inspection of Completed Works

a) The Contractor is required to give the Employer/Engineer/Consultant due notification when he expects the work to be completed, a report in triplicate of the measurements carried out with regard to pressure testing of pipes and leak testing of duct work and other specified tests shall be attached to this application. The final inspection should then be carried out, without unnecessary delay, and if possible within four weeks.

b) At the request of either party, inspection of such Sections of the work as will not be accessible after completion, or will be difficult to alter, which are to be taken into use by the Employer before the time of the final inspection, may be carried out in advance. (Advance Inspection).

c) An inspection is to be carried out immediately before the expiry of the guarantee period. (Guarantee Inspection).

d) Inspection of corrected faults or omissions noted in connection with advance, final, or guarantee inspection is also to be done (Supplementary Inspection).

e) Inspections are to be carried out by the Consultant/Engineer or any other suitable and competent person appointed by the Employer.

f) The costs of Advance Inspection, Final Inspection & Guarantee Inspection are to be met by the Employer, where the inspection has been carried out by a person appointed by him.

The costs of supplementary inspections and re-inspections are to be borne by the Contractor. It is the responsibility of the Contractor to provide & pay for, any help or assistance necessary in connection with the inspection work.

g) The inspector's decision as to what faults or omissions may have occurred is binding on both sides.

h) The Contractor is required to carry out, without delay, any improvements, alterations or additions which may be considered necessary as the result of an inspection report.

i) When the final inspection has taken place, the work is to be handed over to the Employer in so far has been found to be in the state required by the Contract and can suitably be put into use for this purpose for which it was intended.

j) The Employer has the right to put into use any Section of the work contracted for and not approved at the time of inspection, provided this can be done without jeopardising the progress of the work, and he may use it without special compensation even before the faults or omissions have been made good.

k) Where special dates are specified under the Contract for the completion of different Sections of the work, the provisions of this Clause are to apply to each part separately.

l) The inspection report required under this Clause is to be delivered in writing, and signed by the inspector, giving the date on which, it is to be made available for the parties' inspection. The report should cover the following points:

i) State whether the work has been approved or not.

ii) State the reasons for failing to approve it, if it has not been approved.

iii) State faults or omissions for which the Contractor is to be held responsible, together with the time within which they are to be made good.

iv) Include notes on matters which do-not require immediate action, but ought to be finally settled in connection with the guaranteed inspection.

v) The sum to which the Employer is entitled.

vi) Date on which the insurance taken out by the Contractor lapses.

vii) If the work has been approved at the final inspection, the date from which the guarantee/maintenance period is to run and the day after which it expires.

viii) Distribution of costs connected with the inspection.

3.17. Acceptance & Interim Operation

a) After the performance tests, if the equipment supplied by the Contractor is found to meet the guarantee and any other specified requirement, and if all other work called for hereunder has been completed, the Employer's acceptance will be forth-coming and final payment will become due as provided for under the terms of payment. This acceptance shall, however, not relieve the Contractor of his responsibility for the first inspection.

b) Should the equipment furnished by the Contractor fail to operate as required, or in case of failure to meet any of its guarantees, the Employer shall have the right to operate the equipment, using the Contractor's supervisory operating personnel, until such defects have been remedied and guarantees met with. In the event that defects necessitate the rejection of the equipment or any part thereof, the Employer shall have the right to operate the equipment until such time as new equipment is provided to replace the rejected equipment. Such operation shall not be deemed as an acceptance of any equipment.

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DIVISION – 09 90 00

PAINTING, COLOR COATING AND FINISHING

1.1 General

All parts of the work installed under this Specification shall be painted with approved first quality enamel paints, except those items specified as being painted by Builder or otherwise exempted from painting in this section of the Specification.

The requirement for painting of all pipe work and ductwork is in addition to the color coding or banding specified in this Specification.

Paint shall be selected to withstand the temperature on the surface which it is applied, and shall be suitable in all respects for the environmental conditions in which it shall be located.

All metal work exposed to atmosphere e.g. roof mounted plant shall be epoxy coated to withstand the effects of chemical attack as experienced in areas close to cooling towers.

All paint used shall be of one approved manufacture, and finishes shall be full gloss unless otherwise specified.

Before ordering any primer, undercoat and finishing paint, the Contractor shall propose the color scheme to the satisfaction of the Engineer.

Before ordering any painting materials, the Contractor shall advise the Engineer of the type and manufacturer of all materials.

The Contractor shall select all finishing and painting materials from types suitable for the surfaces to which they are applied and for the environmental conditions in each area.

1.2 Plant, Machinery & Equipment

All items of plant, machinery and equipment supplied painted ex-factory shall be given one finishing coat of full gloss enamel, except where the manufacturer's standard finish is approved.

1.3 Exposed Metalwork

All exposed metalwork shall be wire-brushed and cleaned from rust, scale, dirt and grease, and shall then be given one priming coat, one undercoat and one finishing coat of full gloss enamel.

The priming coat for exposed galvanised iron shall be an approved galvanized iron primer.

The priming coat for exposed non-ferrous metalwork shall be approved as suitable for the metal to which it will be applied.

1.4 Concealed Metalwork

All galvanized iron surface concealed in roof spaces, false ceilings, building ducts etc. shall not be painted.

All black iron and steel surface shall be wire brushed and given one coat of zinc chromate or red primer.

Color banding for identification shall be provided as described elsewhere in this Specification.

1.5 Ductwork & Pipework & Metal Sheathing

Uninsulated ductwork, internally insulated ductwork, uninsulated pipework and metal sheathing shall be painted as for exposed or concealed metalwork as applicable.

Turned parts of valves, controls etc., shall be cleaned and polished to approval.

1.6 Plastered Finish Insulation Surfaces

Plastered finish insulation surfaces shall be given one coat of size, one undercoat consisting of two parts of ordinary undercoat to one part of sealer, and one finishing coat of full gloss enamel.

1.7 Calico Finish Insulation

Exposed insulated surfaces finished in calico, scrim or canvas covering shall be painted with two (2) coats of polyvinyl acetate emulsion. Each coat shall be a different color.

1.8 Pipe work Identification

All pipes etc. shall be identified in accordance with BS 1710:1984.

Circumferential bands of standard ground colors shall be not less than 100mm wide on pipes up to 50mm nominal diameter, and not less than 150mm wide on pipes greater than 50mm nominal diameter.

Supplementary colors shall be displayed as bands not less than 25mm wide in the centre of the ground color bands.

Where lettering is required it shall be painted in contrasting colors in accordance with the standard, in block letters not less than 15mm high for pipes up to 50mm nominal diameter, and in block letter not less than 40mm high for larger pipes.

Identification bands shall be located where they are clearly visible in each room or compartment through which the pipe runs, and shall be placed at centres not exceeding 6m.

Direction of flow shall be indicated by an arrow painted on the pipe adjacent to each color band. Arrows shall be 75mm long on pipes up to 50mm nominal diameter, and 150mm long on larger pipes.

1.9 Color Schemes

The whole of the installation shall be painted in accordance with the requirements indicated in Table 1.

Equipment shall be painted and color coded to BS 381C:1980 as indicated in Table 1.

1.10 Labeling

All plant and equipment provided under this Specification is to be labelled in English. All warning signs shall be English as to duty or services, all such labelling to correspond to schedules, diagrams, etc. to be provided as part of the Record Drawings. Labels are of white Traffolyte with black engraved lettering not less than 20mm high or as otherwise required and approved. Labelling is also required for any Mimic Diagrams.

Manufacturers' nameplates shall generally be provided for all plant and equipment and shall show serial and model numbers and date of manufacture.

The following is an indication of specific items requiring labelling. (The list is by no means limited - all items shall be labelled to the intent of this section).

- All valves, motor starters, fans, distribution boards, gauges, contactors, cable terminals in switchboards, circuit breakers.
- Labels to be attached to valves (or pipe adjacent thereto) with a light gauge metal band or alternatively to be screwed to the insulated valve box where provided. These labels shall state the valve number.
- Distribution boards, starters etc. are to be labelled to indicate the circuit number, phase and item controlled.

Label shall be screwed or riveted to sheet metal. Adhesive fixing is not acceptable.

Details of exact lettering shall be agreed with the Architect prior to manufacture.

A complete valve schedule shall be incorporated in the as-built drawings and this schedule shall clearly indicate the valve numbers, duty, function, size, flow rate and any other relevant information necessary to allow the plant operators to safely operate each valve and to subsequently maintain or replace the valve as required.

The valve schedule shall clearly relate to the various system schematics to enable the entire operating sequence and circuitry to be followed.

1.11 Application of Painting

All paints shall be prepared and applied in accordance with the manufacturer's recommendations.

All galvanized metal surfaces shall be properly etch-primed to ensure correct adhesion of the paint to the surface. Materials for etch-priming shall be as recommended by the paint manufacturers. Subsequent painting of galvanized surfaces shall comply with this Specification.

Prior to painting, all metallic surfaces except galvanized surfaces shall be thoroughly scraped and wire brushed as necessary to remove scale, rust and swarf. Surfaces shall then be solvent cleaned to remove all oil, grease and dirt.

When the surfaces to be painted are clean and dry, one coat of an approved primer shall be evenly applied over the entire area. After surfaces have been primed, the Contractor shall notify the Architect so that an inspection of the

primed surfaces can be made prior to the application of the undercoat and the finishing coats.

When the priming coat has been approved, one coat of an approved paint flat undercoat shall be applied. Before applying the finishing coats, the Contractor shall ensure that the undercoated surface is rubbed flat and smooth. Finally, an approved high gloss finishing paint shall be applied when all dust has been removed.

Each successive coating shall be completely dry prior to the application of the next coat. The minimum thickness of each layer of paint shall be 50 microns.

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DIVISION - 22 05 29

HANGERS AND SUPPORTS

1. General:

All pipe supports shall be approved supports locally manufactured as per specialist pipe supports manufacturers, such as Hilti or Fisher. Pipe hangers, brackets, saddles, inserts, clamps and pipe rolls including rods, bolts, turn buckles, bases and protection shields.

Chain, wire, strap or other such devices will not be permitted as hangers or supports.

Pipe hangers shall be capable of supporting the pipe in all conditions of operations. Hangers shall be supported with beam-clamps, concrete inserts, Phillips concrete fasteners, or rawl-bolts. Concrete inserts when used shall be installed in the exact location prior to the pouring of the concrete.

2. Suspended Piping Supports:

a) Piping shall be supported by adjustable hangers or supports, which shall provide a means of vertical adjustment after erection. Unless otherwise indicated on drawings maximum spacing between pipe supports for straight runs of steel pipe shall be in accordance with recommended spacing shown in the table given below:

	Nominal Pipe Size, Ø mm											
	13	20	25	40	50	65	75	100	125	150	200	250
Maximum Span, m	1.5	1.8	2.1	2.7	3	3.3	3.6	4.2	4.8	5.1	5.2	6.7
Rod Size, Ø mm	10	10	10	10	10	13	13	16	16	19	22	22

Pipe hangers and supports shall be spaced not over 1.5m apart at heavy fittings and valves. A hanger shall be installed at not over 300mm from each change in direction of piping.

Vertical Piping shall be guided or supported in the centre of each riser but not over 4.5m on centres and shall be supported at the base of the riser on a base elbow or tee with a pipe stand only where required.

b) CI Piping shall be supported at not more than 2m for horizontal piping and 3m for vertical piping.

c) PVC Piping shall be supported so as not to cause any deflection and adequate support spacing shall be ensured but shall not exceed 2m.

d) Polyethylene piping shall be supported as per manufacturers' recommendations.

3. Pipe Sleeves:

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction or afterwards if necessary. Each sleeve shall extend through its respective wall, floor or roof and shall be cut flush with each surface. Sleeves shall be of such size as to provide a minimum of 6mm all around clearance between bare pipe and sleeve or between jacket over insulation and sleeve. Sleeves shall be of steel pipe or cast iron pipe.

Sleeves in exterior below ground, walls, pits and tanks shall be similar to 'Doyma' sleeves, consisting of a galvanised steel sleeve to be embedded in concrete, with the pipe passing through synthetic rubber rings that are compressed using galvanised steel pressure plates on both sides of the rubber ring as shown on drawings.

4. Other Supports:

Equipment, duct-work and any other plant component requiring supporting and anchoring shall be provided with properly engineered supports and anchors, as shown on the drawings, or as per manufacturer's recommendation or as directed by the Consultant/Engineer in all cases drawings & submittals for supports & anchor system shall be submitted to the consultant and approval obtained.

5. Payments:

Unless otherwise indicated in the BOQ, no separate payment shall be made for supports, hangers, sleeves, etc. and cost for these shall be part of the price quoted for the, supported piping, equipment, etc. Payment shall however be made for 'Doyma Sleeves' as indicated in the BOQ.

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DIVISION - 23 05 93

TESTING, COMMISSIONING AND HANDOVER

1.1 General

The Contractor shall carry out all commissioning and testing necessary for the safe, reliable and satisfactory operation of the system and equipment installed.

The Works shall be commissioned and tested in accordance with manufacturer's instructions, the appropriate CIBSE or ASHRAE commissioning codes, local Government requirements, applicable insurance company's and this Specification.

At least two month's prior to testing or commissioning any system, the Contractor shall furnish the following information for each system or process to the Engineer for review.

- Submission of testing procedure and details as well as the relevant report forms to the Engineer for approval.
- Type of instruments to be used
- Manufacturer of instruments
- Calibration methods for instruments
- Operating instructions for instruments
- Accuracy and tolerances of instruments
- Complete schedule and programme of all testing and commissioning activities

The Contractor shall employ thoroughly competent and experienced personnel to carry out all tests.

All instruments and labour necessary for testing and commissioning shall be provided by the Contractor.

In particular, the instruments as indicated in Schedule AA shall be provided and remainthe property of the owner after testing and commissioning.

- One flow rate measurement set
- One hot wire anemometer with accessories for measuring static pressure
- One portable octave band sound meter
- One portable ^{o}Cwb sling psychrometer.

All instruments shall have been recalibrated within six months of the start of commissioning or testing. Calibration of all instruments shall be certified by the instrument manufacturers or an approved calibration agency.

Should the results of any test show that any plant, system or equipment fails to perform to the efficiencies or duties as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performances be obtained.

Should it be necessary for the Contractor to modify or replace any item of plant as described above, he shall be responsible for the cost for making good of any damage or deterioration to the building or other services consequent on such modifications.

The Contractor shall allow in his cost for returning to site during the first year of operation from the date of Certificate of Completion at certified by the Engineer to test equipment and systems under maximum design conditions.

1.2 Factory Tests

The following items of equipment shall be tested at the manufacturer's works or elsewhere as appropriate prior to installation. In all cases, 'Type-test' certificates shall be submitted in triplicate to the Engineer. Cases where `Type-test' certificates will be accepted are as follows:

1.2.1 Fans

`Type-test' Certificates showing fan characteristic curves, (BS 848 Part 1, test method as appropriate) and Type Test Certificates for sound power levels (BS 848 Part 2).

1.2.2 Pumps

`Type-test' Certificates for head discharge, speed and power input (BS 599).

1.2.3 Electric Motors

`Type-test' Certificates in accordance with BS 5000. For motors of 40 kW output and above, routine individual test certificates in accordance with BS 5000.

1.2.4 Starters and Control Gear

`Type-test' Certificates (BS 587). For control panels as a whole, routine (individual) high voltage test in accordance with BS 587.

1.3 Site Testing and Commissioning

1.3.1 Execution of Tests

The plant will be inspected and tested during and after installation on site as set out below and approved for satisfactory design, workmanship and materials, for compliance with the provisions of the appropriate specifications and for performances, materials, dimensions and ratings as tendered.

All tests shall be witnessed by the Engineer or his appointed deputy with at least seven days' notice given prior to any test.

All tests shall be executed and, if not satisfactory, repeated to the satisfaction of the Engineer at no extra cost.

All DX/VRV system shall be commissioned and tested to the recommendation of the manufacturers.

1.3.2 Preliminary Commissioning Check

The Contractor shall ensure that all equipment included under this contract is thoroughly cleaned, lubricated and checked for serviceability immediately before setting to work. Particular attention is drawn to the removal of building debris from the air systems, motors, fan bearings and pipework.

All pipework shall be thoroughly flushed and chemically cleaned to ensure that all foreign matter is removed and internal surfaces are decreased. During all preliminary flushing, plant shall be isolated by means of bypasses to avoid dead legs, and the systems shall be completely isolated from any existing systems to ensure contamination cannot occur.

Further flushing and chemical treatment shall be carried out on isolated systems by connection of temporary diesel driven pumps to circulate water and dosing chemicals. The Contractor shall allow for cross-connection of flow and return pipework at the extremities.

All automatic controls and safety devices shall be inspected and checked for serviceability before the working fluid or electricity is applied to the system.

1.3.3 Air Handling Equipment & Ductwork

All the commissioning procedures shall comply with those set out in the current edition of the CIBSE Guide Commissioning Code Series A or SMACNA standards.

The Contractor shall allow for balancing all air diffusers and grilles by means of the regulating dampers provided. Air quantities shall be set to within +5% - 0% of the design value.

The following data shall be recorded on the commissioning sheets:

- Dry and wet bulb temperatures:
  - At ambient conditions
  - Within each occupied space, at various locations within same space as required
  - At each main supply and return air duct
  - Before and after coil
- Fresh air supply flow rate to each air handling unit
- Air flow and resistance across each main plant item, e.g. filter, cooling coil.
- Air flow at each supply and exhaust duct, and at each supply, return and exhaust air grille and diffuser.
- All fan and motor speeds.
- Starting and operating current for each motor.

All ductwork shall be tested for leakage rate in accordance with DW/143:1983. The floor where this test is to be carried out shall be as directed by the Engineer.

After leakage test for distribution metal ductwork, for VAV systems, all VAV terminals on ONE typical floor shall be connected to the distribution ductwork properly jointed and secured and outlets of the system shall then be pressure tested again to a pressure of 750 Pa. The total leakage rate in this test shall not exceed 5% of the total system design air flow rate.

The floor where this test is to be carried out shall be as directed by the Engineer.

Should result of the test turn out to be unsatisfactory, the Contractor shall carry out necessary remedial works and repeat the test thereafter until the specified requirement is fulfilled. In this case, the test shall also be carried out on one other floor chosen by the Engineer. Should the test on this new floor turn out not

satisfactory this practice of re-test shall repeat until there is a floor where the test carried out is a satisfactory one without requiring any remedial work.

1.3.4 Pipe and Water Systems

All the commissioning procedures shall comply with those set out in the current edition of the CIBSE Guide commissioning Code Series W.

All water pipework, coils and other fittings shall be hydraulically tested to 1.5 times the working pressure but in no case less than 14 bar. The pressure shall be maintained for a period not less than 24 hours within ±2%.

Where any section of pipework or equipment of the plant is unable to withstand the maximum pipework test pressure, it shall be isolated during the pipework tests, then, that section of pipework or equipment shall be re-tested at the appropriate test pressure.

Before finally charging, the chilled and condenser water systems shall be thoroughly flushed and all strainers, filters, etc. cleaned.

All chilled and condenser water systems shall be adjusted and balanced for the correct duty by the regulation valves provided.

The following data shall be recorded on the commissioning sheets:

- Circulation pump motor speed
- Suction and discharge heads for all the pumps, and flow rates as checked against pump curves.
- Water flow rates in main branches and through major equipment
- Supply and return water temperatures of each water coil
- Starting and operating current of each pump motor
- Water pressure drop across each item of hydraulic equipment, e.g. cooling coils, control valves, strainers, etc.

1.3.5 Control System

The Contractor shall include all thermostatic and automatic controls to be commissioned and tested by the control manufacturers Engineer. Generally, the commissioning procedure shall comply with that set out in the current edition of the CIBSE Guide Commissioning Code Series C.

The Contractor shall calibrate all thermostats, humidistat and pressurestats, set the modulating range and set points on all automatic valves and dampers as required to ensure that operating conditions are correct. The time and control sequence shall also be tested and verified.

Interlocking circuit and safety devices shall be tested to ensure safety operation of the plant.

1.3.6 Electrical Test

The following tests shall be carried out in full compliance with the IEE Regulations by the Contractor in the presence of the Engineer.

- Insulation resistance test of all power and control cables
- Insulation resistance test of all motor windings
- Test of conductor continuity
- Test of effectiveness of earthing
- All thermal overload relays and starters
- Sequence of operation
- Flick test of motors

1.3.7 Miscellaneous Measurement and Testing

Room temperatures and humilities and noise levels (at each octave band midfrequency from 63Hz to 8,000Hz) shall be measured to ensure design conditions are achieved. Measuring instruments hall be located 1500 above floor level at points away from the influence of draughts or hot or cold surfaces. Such measurements shall not be carried out when weather or other environmental conditions are likely to cause undue influence to the results.

Sound and vibration testing shall be carried out to ensure that equipments are operating with satisfactory sound and vibration levels and that there is no transmission of objectionable vibration or through the building structure. Sound levels shall be measured with and without the plant in operation.

All data relative to the performance tests shall be provided with 7 days of completion of the tests. Final retention moneys will not be released of completion of the tests. Final retention moneys will not be released until the performance test results have been received and approved.

1.4 Handing Over

The following procedure shall be adopted prior to handing over the installation:

(a) All preliminary testing, checking, adjusting and balancing of the installation shall be carried out before forwarding notification that the installation is considered to have reached the Completion.

(b) After inspection, and when the approving authority is satisfied and agrees that the installation is ready for handing over to the Purchaser, the plant shall be finally commissioned and Installation Manuals together with post contract drawings shall be provided as specified.

Certificate of Completion will be certified only after the plant has been inspected and approved and the above requirements fulfilled.

1.5 Post Contract Drawings

Supply prior to completion (which will not be granted until such have been supplied) six copies of all installation drawings which have been correctly brought up to date to reflect all field changes and are a true and accurate representation of the actual installations. Five copies of these drawings shall be folded and inserted in plastic envelopes in the installation manual and one copy shall be laminated into plastic. In addition supply two sets of microfilm aperture cards of all drawings. These drawings shall include the following:

(a) Complete ducting and layout drawings showing the actual sizes and locations of all ducts, dampers, supply outlets, return inlets, fresh air intakes, etc. and the final measured air flow rates at all relevant locations.

(b) Complete plant room and/or equipment layout drawings with full identification of each and every item of equipment.

(c) Complete piping layout drawings, showing the actual sizes and locations of all refrigerant, water, instrument air, steam, fuel oil, gas and any other lines applicable to the system.

(d) Complete schematic flow and control diagrams of all air, water, refrigerant, instrument air and any other systems incorporated in the installation.

(e) The drawings shall show all motorized automatic and hand-operated controls such as dampers, valves, relief valves, cut-outs, thermostats, expansion valves, solenoid valves, bleeds, vents, drains, strainers, gauges, thermo wells, by-passes, sight glasses, and all similar items pertinent to the functioning of the installation. Where applicable the drawings shall also include the settings and differential bands of all controls, cut-outs and other variable or adjustable items. All items must be clearly identified as to type and functioning of the installation.

(f) Complete control wiring diagrams showing all electrical controls, relays, cut-outs, timing devices, inter-locks, fuses, over-loads, contactors, solenoids, starters, etc. with all items clearly identified as to type and function, and "as installed" switchboard layout drawings.

If the quantity of drawings involved is too large to conveniently bind in the installation manual, then a separate matching cover shall be supplied for each of the three drawing sets.

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DIVISION – 23 07 13

DUCT WORK

1.1 General

a) This section of the Specification covers the general requirements for ductwork, ductwork accessories, and associated air control devices, unless the general requirements are abrogated by specific requirements elsewhere in the Specification or Drawings.

b) The Contractor shall supply and install all ductwork and accessories for the correct and satisfactory operation of the air systems covered by this Specification.

c) Where standards are referred to, the equivalent local standard shall be used if such exists. In all cases, the latest edition shall be followed.

d) All ductwork and fittings delivered to site shall be new and shall be clearly and indelibly stamped to identify different grades, materials and manufacturers.

e) All ductwork shall be manufactured as far as practicable to site dimensions taken by the Contractor. Where site dimensions cannot be taken in advance, dimensions shall be taken from architectural/structural detail dimensioned drawings to accommodate any discrepancies that may occur between interior decorator shall also be taken into consideration with regard to the requirements and interior finishes.

f) Prior to commencing work on site, the Contractor shall prepare complete working drawings for all ductwork systems included in the Contract to the satisfaction of the Architect. Working drawings shall include plans, sections, elevations, schematics, schedules and details of all systems and shall show locations and details of all dampers, splitters, hangers, supports, supply, return, intake and exhaust air fittings, joints, flexible connections, test points, insulation, linings, cladding, etc.

g) Prior to ordering any materials, the Contractor shall submit to the Architect for review manufacturer's data for all dampers, actuators, supply, return, intake and exhaust air fittings, proprietary brand jointing systems or materials, and for any other equipment as may be requested by the Architect.

h) In the case of supply, return, intake and exhaust air fittings, the submission shall include one finished sample in an approved colour and finish of each type of air fitting to be provided under the contract. No fittings may be ordered until the

Architect has reviewed the sample in writing including the finish and colour. Samples shall include mounting frames, fixings, etc., so that the entire fitting assembly may be reviewed.

i) All ductwork, fittings, accessories, joints and jointing materials shall be suitable for the service and shall not deteriorate due to atmospheric action.

j) All fire dampers and casings shall be manufactured and installed in accordance with the Local Authorities' requirements and CP13 Fire Damper specification.

k) All ductwork and materials including linings, adhesives, flexible ducts, flexible connections, gaskets, sealants, fibreglass boards, etc., shall fully comply with all requirements of the Local Authorities and shall satisfy all local codes in respect of resistance to penetration of fire and spread of flame and smoke.

l) The materials, construction and installation of all sheet metal ductwork and fittings shall be in accordance with the Specification for sheet metal ductwork, DW/142 : latest edition (HVCA). Where any part of the installation is not covered by the HVCA Specifications, then the standard of the Sheet Metal and Air Conditioning Contractor's National Association of U.S.A. (SMACNA) latest edition shall apply for either high velocity or low velocity systems. Where any part of the installation shown on the drawings is not covered by either the HVCA or SMACNA Standard, then reference shall be made to the Architect for endorsement of materials and methods prior to installation.

m) The ductwork installation shall be leakage tested in accordance with Ductwork leakage testing, DW/143 : latest edition (HVCA). A complete record of the test shall be submitted to the Architect on approved forms for review. The Contractor shall provide all necessary equipment for the tests. Should any test indicate leakage rates in excess of that specified by DW/142, the section of ductwork shall be dismantled, joints cleaned down and reassembled and test repeated.

n) The Drawings indicate the clear internal air passage dimensions of the ductwork and the manner in which the ductwork systems are to be installed. Due allowance shall be made for the thickness of internal or external linings when dimensioning ductwork and selecting fittings and accessories. The actual work involved in respect

of transitions, offsets, etc., shall be ascertained by the Contractor, who shall co-ordinate the ductwork installation with the work of other trades and services.

Aspect ratio, dimension and routing of duct work shall be adjusted to suit co-ordination of services and headroom requirement. The Contractor shall bear all costs associated with the adjustment.

1.2 Sheet Metal Duct Materials

a. Generally, all ductwork shall be of hot dipped galvanised steel sheet to BS 2989: latest edition, Grade Z2, coating type 'C' as specified in DW/142.

b. Galvanised steel ductwork shall be fabricated from new, best quality, full sized galvanised flat steel sheets.

c. The pressure class and air leakage limit shall be as defined in DW/142.

1.3 Sheet Metal Duct Construction

a. All sheet metal ductwork shall be constructed free of waves or buckles to the size shown on the plans. Rectangular ducts exceeding 300 mm longest side shall be cross broken between adjacent stiffeners, or alternatively shall be constructed of one size heavier material than scheduled. Internally insulated ducts shall not be cross broken.

b. Longitudinal joints shall be made with Pittsburg Lock or grooved seams, closed for tightness and appearance. Cliplock or Snaplock button punched joints may be used with tack soldering or self tapping screws at maximum 750 mm centres.

c. All flange and stiffener angles shall be solid rivetted at centres not exceeding 100 mm. Mating flanges shall be match drilled and bolted by 5 mm diameter cadmium plated nuts and bolts at 150 mm centres, using 4 mm thick rubber or equal approved insertion gaskets. Standing seams will not be permitted.

d. All joint exposed to weather, other than angle flanged joints, shall be soldered water tight.

e. All transverse duct joints shall be taped with approved duct tape.

Longest Side	GalvanisedSteel (mm)	Intermediate Stiffening (mm)	Transverse Joint
1-300	0.5	None	Drive Slip at 2400

			crs
301-450	0.6	None	Drive Slip at 2500 crs
451-750	0.6	25x25x3 angles at 1200mm crs on all sides over 450 mm	Drive Slip at 2500 crs
751-1050	0.8	25x25x3 angles at 1200mm crs on all sides over 450 mm	25mm standing seam
1050-1350	0.8	38x38x3 angles at 1200mm crs on all sides over 750 mm	38x38x3 angle flange
1351-1500	1.0	38x38x3 angles at 750 mm crs.	38x38x3 angle flange
1501-2100	1.0	38x38x3 angles at 750 mm crs.	38x38x3 angle flange
2101-2400	1.2	50x50x6 angles at 600mm crs.	50x50x6 angle flange
Over 2400	1.2	50x50x8 angles at 600mm crs.	50x50x8 angle flange

1.4 Sheet Metal Duct Bends & Elbows

a. Where possible, changes in direction shall be made with the internal throat radius of the air passage equal to the duct width. Where space does not permit this throat radius, bends of smaller radius may be used with approved stream splitters in accordance with the following schedule:

Throat Radius	Duct Width	No of Stream
100 - 200	200 - 700	2
701-1300		3
Over 200	300 - 600	1
601 - 1500		2

Over 1500		3

b. The radius of each splitter shall be approved by the Engineer.

c. Stream splitters shall be constructed of 1.2 mm galvanised steel or 1.6 mm aluminium secured both edges by folding, and shall be solid rivetted or pop rivetted and soldered to the duct at centres not exceeding 100 mm. The entering and leaving edges of stream splitters will be folded to form a hem not less than 15mm long, which will be supported by approved stays at intervals not exceeding 600 mm for galvanised steel or 400 mm for aluminium

d. Where radius bends are impractical and where shown on the drawings, square throat elbows shall be employed, which shall be fitted with approved aerofoil section air turns at maximum 30 mm centres, fixed in runners and secured tot the duct as for stream splitters.

1.5 Sheet Metal Duct Transitions & Fittings

a. Duct surfaces which diverge from the centres line of the air flow shall not diverge at a ration greater than 1:7, and converging surfaces shall do so at a ratio not greater than 1:4. Where space prohibits such ratios, stream splitters shall be provided so that the required ratios are maintained relative to the centre line between adjacent surfaces.

b. Where it is impossible to offset ductwork around obstructions, the obstruction within the duct shall enclosed in a fairing which shall be semicircular on the entering air slide and which shall converge equally on the leaving air side to form an angle not greater than 60 degrees. The duct dimensions shall be increased around the obstruction to maintain the same net free area.

c. Branch take-offs from main ducts shall be made with an inside radius 0.75 x branch duct width, and shall be provided with an adjustable splitter damper the length of which shall be 1.5 x the internal take-off width. Where air diffusers take-off directly from a duct, they shall be provided with stream splitters 80 mm long at 50 mm crs. in the take-off adjacent to the duct and with a full size adjustable damper. Stream splitters may be omitted if the length of straight take-off duct attached to the diffuser exceeds 4 times the take-off diameter or 4 times the longest duct side.

1.6 Round Flexible Ducts

a. All flexible ductwork shall be of the patent pre-insulated type and shall be by suitable for the duties and pressures as required for the particular system.

b. All bends made in flexible ducting shall be formed to manufacturer's recommendations and shall have a centre-line radius of not less than 1.5 time the diameter of the ducts. Bends shall remain at full diameter throughout the length of the bend.

c. All joints between lengths of flexible ductwork shall be made with short spigots of galvanised sheet metal circular duct to form a slip joint. Similarly all connections to fittings and terminal boxes etc. shall be of the spigotted slip joint type.

d. Duct connections shall be taped and provided with bands as follows.

e. All joints shall be sealed with shrink-on type duct bands. These shall be continuous screw type metal or PVC bands similar to "Jubilee" hose clips or approved equivalent may be used. Self tapping metal screws and rivets shall not be used.

f. All flexible ducts shall be adequately supported with hanger straps located, at a minimum of 2000 centres, to prevent undue sagging and strictly in accordance with the manufacturer's recommendations.

g. Circular flexible acoustic ductwork shall be of the metal helix type incorporating perforated acoustic reinforced aluminium internal liner 25mm thick flexible fibreglass insulation as specified and reinforced external vapour barrier.

h. The ductwork shall have the following minimum acoustic performance:

1.8 Octave Band Mid Frequency

Frequency Hz	63	125	250	500	1K	2K	4K	8K
Insertion Loss dB	22	24	33	31	31	35	34	24

i. The completed ductworks shall have Class 1 surface spread of flame and Class 0 ratings when tested to BS 476.

1.7 Kitchen Exhaust Ductwork

a. Dishwasher exhaust ducts shall be constructed of stainless steel 304 to BS 1449 Part 1 latest edition or other local code. Metal thickness and construction details of the stainless steel ducts shall be same as for galvanised sheet steel. All duct seams and

joints shall be air tight with heat resistant and waterproof sealant and low points shall have a drained sump. Ducts wider than 600mm shall be jointed by stainless steel flanges.

b. Unless otherwise specified, kitchen exhaust ducts shall be constructed of minimum 1mm thick SS316 stainless steel including sealing air tight all seams and points with heat resistant and waterproof sealant. Provide all low points with a drained sump.

c. Air-tight access doors shall be provided every 6000mm, and shall have minimum size 600 x 600mm. Access doors shall have equivalent thermal resistance as the main exhaust ductwork.

d. Where shown on the Drawings, kitchen exhaust hoods shall be of the double skinned balance type provided over all main cooking equipment. The clear height from the floor to the underside of the hood shall be as stated in local codes. Where no measurement is given, locate hoods 800mm above the surface to be exhausted. Bottom edge of hood shall be at least 1.85m above floor level but not exceeding 2m. The hood shall in plan overlap all equipment by 100mm.

e. Hoods shall be manufactured from 1mm thick SS316 stainless steel and all stiffening and supports shall be hidden by the double skin. The hood shall include all necessary grease filters and lighting. Provide allowance for sprinklers where shown on the drawings. Lighting shall be of vapour proof type and constructed of die cast aluminium alloy with clear prismatic glass. Lighting shall be sealed against oil laden fumes at temperature of 150°C.

f. Individual removable drip trays with sufficient length, width and depth shall be attached to the entire length of the filter with handles to permit quick removal.

g. Grease filters shall be provided, sized such that the face velocity over the filters shall be between 0.75 m/s and 1.25 m/s. Grease filter shall be of rugged, heavy duty, washable metal construction with stainless steel frame. Filter media shall be 50mm thick non-combustible material consisting of alternate layers of flat and herring-bone crimp zinc electroplated steel screen wire. Filters shall be tight fitting and firmly held in place. They shall be installed at an angle between 45° to 60° and easily removable for cleaning.

1.8 FITTING

1.8.1 Joints And Fittings

i) All cross joints, longitudinal joints, take-offs, bends, transitions and other fittings shall be in accordance with DW/142 : latest edition for the appropriate class.

ii) All flanges and steel works for jointing and supporting members shall be hot-dipped galvanised to BS729:1971, Part 1 or BS2989 G275 whichever is applicable.

1.8.2 Ductwork Jointing Sealant

Jointing for flanged cross joints shall be formed from a lead impregnated gasket or other approved material to thickness not less than 4mm. Sealant shall be suitable for the type of fluid and temperature encountered.

1.8.3 Vanes and Deflectors

Vanes or deflectors shall be provided inside ducts where required. In particular, such vanes or deflectors shall be provided at all bends having an internal radius less than the width of the duct and also where the included angle exceeds 30° at changes of section. Vanes and deflectors shall be of special profile to ensure complete change of direction of flow at the point, with extended leading and trailing edges, and with radii and spacing selected to achieve uniform velocity at the bend.

1.8.4 Flexible Joints

i) All flexible connections for use at temperatures up to a maximum of 90oC shall be of neoprene coated glass fabric having a density of not less than 1 kg/m^2.

ii) All flexible connections fur use with temperatures in excess of 90oC and in carpark, smoke exhaust and other high temperature applications shall be
of non-combustible woven glass fabric type capable of withstanding 250°C under continuous operation for at least 2 hours.

iii) All flexible connections exposed to the weather shall be cover with prime quality galvanised sheet steel or fibreglass weather shields arranged to form a complete weatherproof jacket.

iv) All flexible connections shall be fixed over mild steel angle flanges at both ends and secured to same with not less than 2.5mm thick x 25mm wide mild steel bands. For circular ducts flexible connections shall be of the split semi-circular type drawn up

tight with bolts at the split points. Flat bars for rectangular ducts shall be fixed with bolts or screws at not more than 150mm centres. The flanges to take the connections shall be not less than that specified for the ducts and the "free" space between flanges shall not be less than 50mm. The flexible connections shall be installed with not less than 25mm additional slack length between the flanges to prevent transmission of vibration.

v) Flexible connections shall not be used to correct misalignment of fan and duct.

1.8.5 Fire Dampers

a) Fire dampers shall comply fully with the up-to-date requirements of the Local Services Department and any other Local Authorities having jurisdiction regarding rating, construction, installation and testing.

b) The fire dampers shall be constructed generally to the same standards of air-tightness as the rest of the system.

c) Fire dampers are to be provided where ducts enter shafts, pass through masonry or concrete walls, floors, fire partitions, and wherever required by authorities having jurisdiction over the work. All rectangular fire dampers shall be constructed to provide a fire rating the same as the wall or floor penetrated.

d) In locations where the fusible link is of the electro-thermal type, the Contractor shall leave the bare wire link connections adjacent to the damper (unless otherwise indicated) for connection to electrical circuits by another Contractor. This Contractor shall be responsible to inform when connection can be effected.

e) Fire dampers shall be of multi-leaf type or shutter type (100% out of the air stream) as indicated on the Drawings and constructed from corrosion resistant material or otherwise protected to inhibit corrosion. All fire dampers shall be operated by fusible links designed to function at 68oC unless otherwise specified or shown on the Drawings.

f) Fire damper assemblies shall incorporate provision to permit free expansion in case of fire, and the integrity of the fire damper shall be maintained by fire resistant packing around the casing and duct through the fire partition. Access openings shall be provided adjacent to fire dampers to permit access to and replacement of links.

1.8.6 Access Panels

a. Access panels shall be provided at every point in the ductwork systems where access for checking, servicing and cleaning of equipment is required. Such equipment shall include all fire dampers, plenums, motorised dampers, fan chambers, air chambers, etc. Where additional access panels are required for checking, servicing and cleaning of equipment not mentioned above, these shall be provided by this Contractor.

b. Submit required location and sizes of any access panel in finished building surfaces and exposed areas for approval in time to enable them to be incorporated into the construction. Access panels in building surfaces will be supplied by other trades Contractors. The exact location shall be shown on shop drawings.

c. Access panels in ductwork, casings, or sheet metal partitions shall be of G.I. double construction with insulation of the same general character as adjacent sections of ductwork of not less than 0.8 mm sheet metal and shall have gaskets around their entire perimeter to ensure a seal conforming to DW/142 leakage class specification as required by the system. For rectangular or square duct, minimum size shall be 450 mm x 450 mm or 50 mm narrower than the duct whichever is smaller. For circular duct, access panels shall be "ductmate" or approved equivalent, minimum size 250 x 150mm for duct up to 450mm diameter, 400 x 300mm for ducts up to 1200mm dia. and 600 x 450mm for ducts up to 2000mm dia. Access panels shall be fully removable but secured with sufficient steel cable to ensure panels are not lost but can be removed to provide adequate room for proper access.

1.8.7 Volume Dampers

a. The Contractor shall provide and install hand operated dampers where required for the proper regulation of the ventilating and air conditioning systems. In general, dampers shall be provided as follows:

i) In all main supply and exhaust air ducts, branches, outside air connections to fan coil units and all outside air supply outlets.

ii) Behind all supply and exhaust air diffusers/grilles/linear diffusers or supply connection to grilles.

b. All volume dampers shall comply with DW/142 and shall be provided in separate purpose-made flanged casings of rigid construction conforming to the same standards of air-tightness.

c. Materials for dampers in all cases are to be mild steel galvanised or aluminium.

d. The damper spindles shall be provided with suitable seals when passing through the casing and penetrations shall be limited by the use of internal linkages.

e. Dampers up to width of 300mm in the plane of rotation shall be of butterfly type having blades of double construction fitted round a square mild steel spindle and the edges of blades folded and left smooth. Sides of blades shall be folded, left smooth, and in all cases shall be felt lined to give a good fit against sides of duct. The spindle shall be turned down at each end and be carried in substantial bronze bosses fixed to the sides of duct, with substantial cast quadrant piece in an accessible position and with means of clamping after adjustment. Spindles shall be of sufficient length to ensure easy access to the quadrant after installation of insulation.

f. Dampers larger than 300mm shall be of multi-leaf opposite blade type, mounted in built-up frames inserted in the ductwork and bolted thereto. Individual blades shall be as specified for butterfly dampers, each shall be carried on solid spindle with ends housed in bronze or nylon bushes. The group of blades forming the damper shall be linked to a hand-operated mechanism, which shall be controlled by a quadrant in cases where the damper is accessible from ordinary working level and in all other cases, shall be provided with screw-operate remote-control gear with the winder at an accessible point. In all cases, the adjusting gear shall be accessible after installation of insulation. Dampers in circular ducts up to 250mm in diameter shall be of butterfly type as for dampers up to width of 300mm specified above, except that edges of blades are not required to be folded.

g. After final testing and adjustment, all dampers are to be clamped in their correct positions which are to be marked on the quadrant in a permanent manner and stops fitted. All damper quadrants are to be covered with wooden or steel boxes with hinge lid for access.

h. Where fitted directly behind supply and exhaust air diffusers or grilles, dampers shall be adjustable through the face, without the need to remove the diffuser or grille face.

i. Dampers required to control areas larger than 1.6m² shall be divided into multiple sections each of 1.6m² maximum area with individual drive motors for each section.

j. Take off's or spigots for connection of circular flexible ductwork to main ducts which are 200mm diameter or smaller shall be aluminium spun cone type complete with volume control damper as specified above. For larger sizes take off's shall be of sheet metal to the same thickness as the main duct. In all cases, the take off's shall provide at least 25mm overlap surface for proper connection of the flexible duct.

1.8.8 Motorised Dampers

a. Motorised damper actuators shall be of the electric type and sized to provide smooth modulating control under design temperature and pressure conditions. Actuators shall be site interchangeable for direct or reverse action and be suitable for on/off or modulating operation. Dampers shall be suitable for both vertical and horizontal installation. Damper actuator shall be installed outside the air stream.

b. Each motorised air damper assembly shall be fitted with an adjustable crank arm and ball joint, through which it will be connected to the damper actuator by an aluminium rod of not less than 6mm diameter.

c. Positive positioning devices shall be furnished where required. Positioners shall be furnished for all sequencing applications.

d. All damper actuators shall be externally mounted to the damper frame via a single linkage.

e. All electric operated dampers shall be of the low leakage type averaging approximately 100 litres/sec. per m2 of opening when a pressure difference of 1000 Pa is applied across them.

f. Dampers shall consist of a formed channel section frame containing linked aerofoil section blades. The units shall be of the opposed blade type operated by electric regulating motors where damper assemblies of area greater than 2m2 are required, they shall be made up of individual damper units fitted to a suitably braced steel sub-frame.

g. Damper, frames and supports shall be able to withstand a differential pressure of 2000 Pa in fully closed position.

h. Motorised fire damper shall be of a design and construction that will provide the required fire resisting rating of 2 hours or more tested and certified by PSB or other local authority. Installation shall comply with CP13 requirements and other local authority requirement.

i. Damper blade and frame seals shall be of flexible material suitable for the type of fluid handled and have the required high temperature resistant at 250°C or more for continuous operation to handle high temperature application such as carpark and smoke exhaust.

j. Spring return shall be provided to drive the damper into failsafe open or close position as required during power failure.

k. Circuit switches for remote monitoring of damper position shall be provided as specified and installed outside the air steam.

1.8.9 Self-Closing (Non-Return) Dampers

Self-closing dampers shall present a minimum resistance to air flow under running conditions and take up a stable position in operation. Maximum resistance shall be presented under reverse air flow conditions such that they will be forced to close and remain so. Resilient strips or other purpose made devices shall be provided to prevent the damper rattling and as an aid to air sealing under reverse flow conditions.

1.8.10 Hangers

a. The Contractor shall be responsible for building in all support etc. and shall allow for using Philips Redhead bolts for concrete, and cutting away and building in of brackets in brickwork, etc.

b. No vibration whatsoever shall be transmitted from the ductwork of plant to the structure. The Contractor shall provide where necessary resilient mountings to achieve this.

c. The construction of hangers shall be in accordance with DW/142. All such hangers shall be provided with screw lengths or turnbuckles for adjustment of ducting runs to

level; welding of hanger to bearers will not be permitted. All nuts shall be provided with washers and lock-nuts. Projecting ends of bolts shall be cut-off and ground smooth.

d. On no account shall supports be riveted or bolted to the air ducts.

e. All vertical ductwork shall be supported by angle iron bearers under flange joints.

f. All support and hangers shall be of hot-dipped galvanised mild steel construction to BS 729 : latest edition Part 1 with minimum coating thickness of 85 and 210 for indoor and outdoor installation respectively.

g. All bolts and nuts shall be electroplated with zinc or cadmium to BS 3382:Parts 1 and 2 with minimum plating thickness of 25.

h. The Contractor shall note that ducts must be tightened to underside ofslabs/beams and after the projecting ends of bolts are cut off, no other part of the support shall project below the bottom angle iron bearer, thus maintaining maximum height throughout.

1.9 GRILLES AND DIFFUSERS

1.9.1 General

a. All air diffusers, air registers, louvres, exhaust air grilles, door relief grilles, light troffers, linear grilles and all other such fittings shall be of an approved type and as scheduled in the following clause of this section of the specification and as shown on the drawings.

b. Provide approved certified performance data for all air diffusion equipment to be installed.

c. All outlets shall be selected for efficient air distribution and low noise levels and responsibility shall be accepted for selecting and checking neck velocities, horizontal and vertical flow patterns and noise levels. Outlets with poor distribution and excessive noise levels shall not be used.

d. All outlets selected for variable volume systems shall be suitable for the system and shall be capable of providing adequate distribution without causing draughts at high volume or "dumping" at low volume and shall only be used if manufacturer's have specifically tested them for variable volume systems.

e. As selected below all outlet air flow rates shall be controlled by means of dampers in branches, opposed blade dampers in necks, behind grilles or distribution slots, dampers in cushion heads or satellite units or stream splitter dampers as appropriate. All dampers shall be of an approved type and shall be readily accessible without moving diffuser escutcheons or registers.

f. All slot diffusers, linear grilles and light air saddle diffusers shall have provision for air pattern adjustments such that air can be deflected in a vertical or horizontal direction.

g. All internal parts of outlets, such as straightening vanes and volume controllers shall be finished matt black. External finishes shall be coloured to match adjacent surfaces. Unless otherwise specified aluminium outlets shall be colouranodised and steel outlets shall be finished in baked enamel.

h. Internal duct surfaces visible through any air outlet shall be painted matt black.

i. Outlets shall be installed with trim gaskets where applicable and in accordance with the manufacturer's recommendation.

j. Diffuser shall be tested in the factory or approved testing laboratory to provide the following certified performance data:

i)Face velocity

ii)Pressure drop

iii) Throw for terminal velocity of 0.75, 0.25 m/s and room air velocity.

iv) Sound power level tested in reverberant room to ASHRAE Standard 36.

1.9.2 Linear Slot Diffusers

a. Linear slot supply air diffusers shall be supplied and installed complete with plenums, transitional spigots for air connections, and caps or jointing bars for each module and "secret" fasteners where necessary for jointing of all modules and mitred corners.

b. Where shown on the drawings the slot type diffusers shall be extended without plenum boxes as required to maintain a continuous slot. Where the linear slot diffuser has been so extended and is not used for return air or fitted with a plenum box, a blanking plate shall be fitted on the top of the diffuser securely fixed in position.

c. When viewed from the conditioned spaces the appearance of the slot diffusers shall be that of a continuous diffuser. Where the ends of each module butt together, "secret" guides and/or fasteners shall be used so that the joint in each and every case is perceptible as a very thin line. Any misalignment will be rejected.

d. The deflectors of the diffuser shall be such that it would allow the air to flow across the surface of the diffuser evenly to eliminate the condensation problem.

1.9.3 Ceiling Diffusers

Ceiling diffusers shall be of all aluminium construction and shall be mounted to suit the ceiling grid type. Each diffuser shall include an insulated cushion (plenum) head box. Unless otherwise stated, diffusers shall be all 4 way blow and fitted with blank off plates to adjust the neck size and the direction of throw. The blank off plates shall be made of canite or similar material painted black.

1.9.4 Sidewall Registers And Grilles

Unless otherwise specified, grilles shall be of the double deflection type with the horizontal blades mounted at the front of the grille. All grilles shall be capable of 0-45o adjustable deflections in both the vertical and horizontal planes at 12mm centres. Grilles shall be held in position with "secret" fasteners.

1.9.5 Egg Crate Grilles

a. Unless otherwise shown the core shall comprise 13mm x 13mm aluminium egg crate held in position with springs or "secret" fasteners.

b. Where the grille size does not conform to the ceiling grid size the grille shall be located centrally within the ceiling tile if the tile is of the type suitable for cutting. Alternatively, the grille shall be mounted in an insulated mounting plate of standard grid size and finish painted to match the ceiling.

1.9.6 External Louvres

a. Louvres shall be fabricated from galvanised steel or "window grade" aluminium.

b. Galvanised or aluminium mesh to suit the material of the louvres shall be fitted across the inside surface of the louvres. Mesh shall be 13mm x 13mm x 1.2mm.

c. Blades shall incorporate a return fold and weather bar on the high side, a vertical stiffener on the lower edge and shall be fitted at 45o.

1.9.7 Door Grilles

a. Door grilles where indicated on the drawings shall be supplied by this Contractor for installation by builder.

b. Grilles shall be of the telescopic, flanged frame type with inverted chevron, sight proof blades. The free area of the opening in the grilles shall not be less than 60%.

c. Grilles shall comprise fixed, horizontal blades, concealed vertical bracing bars where necessary and shall be of aluminium construction anodised to the approved colour unless otherwise specified in the "Schedule of Air Outlets".

1.10 THERMAL AND ACOUSTIC INSULATION

1.10.1 General

a. This section of the specification covers the supply and installation of the thermal and acoustic insulation required for ductwork.

b. Preparation of the equipment and application of all insulating materials shall be carried out only by skilled tradesmen, experienced and competent in this type of work.

c. In general, insulating materials shall be of best quality in their respective types, and shall have the following properties:

i) High thermal efficiency and low moisture absorption combined with adequate strength to prevent deterioration under normal operating conditions. ii)Resistance to fibre and attack of algae, bacteria, Vermin and the growth of mould and fungi.

iii) Free from objectionable smells when dry or wet and shall not cause or promote corrosion or deterioration when in contact with galvanised metal, steel, iron, copper, bronze, brass, aluminium or PVC.

d. All insulating materials shall be delivered to the site in a dry condition and shall be housed in a dry store until drawn up for use.

e. Prior to the application of insulation, all surfaces shall be thoroughly cleaned of scale, rust, grease, oil and dirt. The application of the insulating materials to any part of the installation shall not be commenced until all pressure tests on the relevant part have been completed and approved.

f. All insulation materials, regardless of the methods of fixing, shall be in close contact with the surfaces to which they are applied. Edges and ends of insulating sections

shall be arranged to butt up close to one another over the whole insulating surface. Joints of insulation shall be properly sealed. Pressure sensitive tapes shall not be accepted as joints having mechanical strength.

g. Allowance for thermal movement shall be provided for in the application of insulation.

1.10.2 Thermal Insulation

a. Thermal insulation shall be of rigid fibreglass of 48kg/m3 with thermal conductivity of not greater than 0.038 W/mK at 20oC mean temperature.

b. The insulation shall be wrapped with fibre reinforced double sided aluminium foil vapour barrier. The fibre reinforcing grid shall not be greater than 10mm x 10mm. All joints in the aluminium foil shall be vapour sealed.

c. Ductwork shall be insulated from hangers and supports generally as indicated in DW/142 : latest revision (HVAC).

d. Fibreglass shall be adhered to duct with fire resistant and non water based adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.

e. For ducts up to 450mm wide, the insulation shall be wrapped around the duct. For horizontal ducts with any side over 450mm, metal pins or nylon pins shall be stud welded using the capacitor discharge method without damaging the galvanising on the bottom surface at 400mm maximum centres. Then insulation shall be wrapped around. For vertical ducts with any side over 450mm, the pins shall be located on all sides of the duct at approximately 300mm centres. Protruding ends of pins shall be cut off flush after clips have been applied. The vapour barrier facing shall be thoroughly sealed with a vapour-barrier mastic or tape where the pins have pierced through.

f. All joints shall be sealed with at least 75mm wide vapour barrier tape to provide a continuous external vapour seal. Prior to the application of tape all contact surfaces of vapour barrier foil shall be wiped clean of dust and grease using cloth and suitable solvent all in accordance with the manufacturer's recommendation.

g. All ductwork insulation shall extend over external flanges and stiffening.

h. Insulation shall be applied so as to form a continuous heat barrier without gaps, cavities and openings. Care shall be exercised to ensure that the minimum thickness specified is maintained at corners, protrusions, etc.

i. At the point of support, specially prepared blocks of hardwood or styrofoam material must be positioned to ensure integrity of vapour barrier by bonding the supports to the insulation.

j. All externally insulated ductwork exposed in plant rooms, corridors and other areas subject to normal usage traffic shall be sheathed externally by means of 0.5 mm galvanised steel with all joints lapped and secured by self tapping screws at 100 mm centres.

k. All insulation shall be applied so as to give a smooth, homogeneous and lineable surface. All rigid sections shall be concentric, and accurately matched for thickness. Steps and undulations in the surfaces shall not be acceptable. Any sections or slabs having damaged ends or edges shall be rejected.

l. All insulation shall fit tight to surfaces to be covered, and all slabs and sections shall be built up close, butting edges being mitred, chamfered or shaped as necessary. Any minor interstices left in insulation shall be filled and sealed.

m. The vapour barrier shall be sealed around all hangers or other projections through the insulation.

n. Continuous insulation shall be provided through all sleeves and insulation joins shall be staggered with respect to joints on the associated ductwork system.

o. Where ducts pass through walls and slabs, suitable fire stop system shall be provided for the duct including the fire damper. The continuity of the insulation shall be maintained throughout.

1.10.3 Acoustic Lining Ductwork

a. All acoustic lining shall comply with Class 1 surface spread of flame and Class 0 rating when tested to BS 476.

b. All acoustic lining shall have a thermal conductivity rating of not more than 0.036 W/m K at a mean temperature of 24°C and shall be of the semi rigid type manufactured from minimum 50mm thick mineral wool or fibre glass, having a density of not less than 48 kg/m^3.

c. Insulation shall be faced with perforated galvanised sheet. Insulation shall be adhered to the ducts with an approved type adhesive and fastened with welded pins and speed clips located at not more than 400mm centres.

d. All joins between insulation butts shall have the surface layer lapped and adhered together or pop riveted as appropriate in the direction of the air flow.

e. All end pieces shall be complete with sheet metal nosing and all corners shall be held firm with angles formed from galvanised sheet steel.

f. Acoustic lining shall have sound absorption coefficients of not less than following:

		Frequency (hertz)			
Thickness (mm)		125	250	5000	1000
25 (foil laminate)	.01	.19	.43	.71	.73
50 (foil (laminate)	.22	.52	.73	.94	.94

g. Acoustic lining in masonry ducts shall be as for sheet metal ducts as previously specified except that pressed 1 mm thick galvanised steel "Z" sections shall be located at approximately 1000mm centres to support the full weight of the butts in a horizontal direction.

h. The galvanised steel "Z" sections shall be firmly attached to the masonry wall with expanding type masonry anchors or at not more than 450mm centres.

i. Pins and speed clips shall be used as for ductwork except that approved cement type fixings shall be used for direct and firm attachment of pins to the masonry wall in lieu of welded type.

The thickness of insulation shall be as follows:

Duty	Location	Insulation Thickness	
		Thermal	Acoustic
Conditioned air duct(Supply & Return)	In false ceiling void of air conditioned space with no roof above	25mm	
	In false ceiling void of air conditioned space with roof above	50mm	

	In air handling unit room	-	50mm
	In air handling unit room where using AHU room as return plenum	-	50mm
	In concrete shaft	25mm	
	In non air-conditioned space	50mm	
Outside and ventilation air duct	In air-conditioned space In return air space	25mm 25mm	
Plantrooms		50mm lined with perforated sheet metal with 23% free area	

1.11 Plenum Box

a. The plenum boxes shall generally be designed to meet the requirements as specified in the Noise and Vibration Control section of this Specification.

b. The boxes shall be so designed as to provide an efficient, quiet and maintenance free air distribution system.

1.12 Test Points

a. Test holes for measuring air flow shall be provided at the following locations:

i) At all fans (in the straightest section of duct near to the outlet).

ii) At main branches after regulating dampers.

iii) At cooling coils, heater batteries (both before and after the coil or battery).

iv) Any other position indicated on the Drawings.

b. The location of these holes shall be confirmed by the Architect.

c. On insulated ductwork, these holes shall be boxed out for the thickness of the insulation.

d. Test holes shall be 25mm diameter and fitted with an effective removable seal.

e. For circular ducts up to 1200mm diameter, provide two holes on perpendicular centreline. For circular ducts above 1200mm diameter, provide four holes on two perpendicular centrelines at 45 degrees to each other.

f. For rectangular ducts, provide the following:

i) Four ducts having diagonal dimensions up to 450mm provide six (6) openings, located on two perpendicular sides, three per side. Openings to be located at 1/6, 1/2 and 5/6 locations on both duct faces.

ii) For ducts having diagonal dimensions up to 900mm provide eight (8) openings located on two perpendicular sides, four per side. Openings to be located at 1/8, 3/8, 5/8 and 7/8 locations on both duct faces.

iii) For ducts having diagonal dimensions up to 2300mm provide ten (10) openings, located on two perpendicular sides, five per side. Openings to be located at 1/10, 3/10, 5/10, 7/10 and 9/10 locations on both duct faces.

iv) For ducts having diagonal dimensions exceeding 2300mm provide twelve (12) openings, located on two perpendicular sides, six per side. Openings to be located 1/12, 1/4, 5/12, 7/12, 3/4 and 11/12 locations on both duct faces.

1.13 Leak Testing

a. All low pressure supply and exhaust systems shall be tested by hand feel and audio checking of all joints and sealing all obvious leaks with a synthetic rubber sealing compound to approval.

b. All medium and high pressure systems shall be pressure tested to not less than 2000 Pa static pressure or 1.25 times the maximum operating pressure of the system whichever is greater.

c. Ductwork carrying air at less than 10 m/s and pressures less than 500 Pa is low pressure. For velocities above 10 m/s and pressures greater than 500 Pa but less than 1500 Pa, ductwork is medium pressure. For velocities over 10 m/s and pressures greater than 1,500 Pa but up to 2,500 Pa, ductwork is high pressure.

d. Regardless of the actual air velocity and pressure, the following systems shall be tested in accordance with medium pressure ductwork :

i) All VAV systems

ii) Smoke control/purging system

iii) Kitchen exhaust system

iv) Underground carpark ventilation

e. The test apparatus, test procedure, detection and repairs of leaks shall comply with the Sheet Metal and Air-Conditioning Contractors National Association Inc. of America (SMACNA) Manual for the Balancing and Adjustment of Air Distribution Systems AIA File No. 30-D-4 Chapter 8 (Latest Edition) or other approved standard, except where the following requirements supervene.

f. Testing shall be done in short convenient lengths and shall include all branch ducts, riser ducts, flexible connections and fittings from the fan discharge up to the terminal equipment and shall be completed prior to the insulation being applied.

g. Each section tested individually shall have a leakage rate not exceeding 5% per minute of the total volume of the section. Thus, a section having a total volume of $12m^3$ shall have a leakage rate not exceeding $0.6m^3$/min or 10 ℓ/s.

h. Notwithstanding the above, the cumulative total of the leakages from all sections shall not exceed 0.5% of the maximum total air flow rate for the system.

i. Where the cumulative total of the leakage from individually tested sections exceeds 0.5% of the maximum total air flow rate for the system, the individual sections shall be retested and repaired as necessary to reduce the cumulative total leakage to less than 0.5% of the maximum total air flow rate for the system.

j. On completion of the installation of all medium and high pressure ductwork, all joints between the pre-tested sections shall be tested by the brush and soap bubble method at the maximum available system pressure and all leakage made good.

k. Notifications of tests shall be given at least 48 hours prior to testing of each section so that a representative may observe the test.

l. The method of testing, sections of ducts and the test procedure shall be clearly indicated on shop drawings so that site personnel involved in the testing are fully aware of testing criteria.

m. Alternative methods and procedures of testing may be used provided that full approval has been obtained prior to proceeding.

3.14 AIR BOOTS/PLENUM BOXES

1.14.1 General

a. The air flow and acoustics performance of the air boot shall be tested in accordance to ADC Standard or other approved international standard.

b. The boot shall be provided with suitable support points independent of the suspended ceiling.

c. The Contractor shall co-ordinate with the Ceiling Contractor for installation of the air boot and diffuser.

1.14.2 Light Troffer Air Boot

a. The Contractor shall supply and install single and double air boots above light troffers and blank off the slots of the light troffers which are not used for supplying air as indicated on Drawings. The Contractor shall coordinate with the light troffer supplier to ensure matching of sizes.

b. The air boot shall be constructed of 0.8mm galvanised sheet metal and internally lined with minimum 25mm thick 24kg/m^3 matt faced fibreglass. An inlet spigot of size as indicated on Drawings shall be provided for connecting flexible duct. At the outlet, the slot width shall be as nominated in the drawings and at each outlet there shall be an adjustable aerodynamically curved extruded aluminium blade for adjustments at the site for projection of air in a horizontal or vertical pattern.

c. The air boot must be capable of handling the air flow quantity per metre per slot as indicated on Drawings. The sound power level at such rated capacity must comply with the specified noise criteria.

d. The blank-off plate shall be of 0.8mm galvanised sheet metal painted matt black. The plate shall be securely fixed by means of spring clips to prevent any movement. The plate shall be easily detachable so that air boots can be installed for air supply. All plates shall be of standard sizes and interchangeable. Fixing details shall be proposed to the satisfaction of the Architect prior to manufacture.

1.14.3 Air Boot For Supply Air Diffusers

a. The air boot shall be robustly constructed in 0.8mm galvanised sheet metal and internally lined with minimum 24 kg/m3 fibreglass liner 25mm thick. All internal components shall be painted matt black.

b. Spigot diameter to the air boot shall be of 200mm diameter unless specified or shown otherwise.

1.15 Fire Resistant Ductwork/Enclosures

a. Fire resistant ductwork or enclosures shall be fabricated from material such as "Durasteel" or "Promat" or approved equal.

b. The materials shall have adequate thickness and the same fire rating properties as the structure in which they are installed.

c. Fire resistant enclosures shall be provided to all protected lobbies and fire escape routes where services pass through, and/or other areas as indicated on the drawings.

d. Fire resisting ductwork shall be constructed as per standard galvanised steel ductwork to DW142 and encased in 19mm thick fire resisting board using self tapping screws. Provide galvanised steel support channels at 600mm centres. The space between the fire resisting board and metal duct shall be packed with mineral wood.

e. The complete assembly shall be non-combustible to BS 476:Part 4:1970.

f. Fire resisting enclosures shall be similarly constructed as for fire resisting ductwork but without the mineral wool. As many layers of fire resisting board shall be used as required to provide the required fire rating. Provide adequate supports to suit the weight of the enclosure.

g. Fire resisting board shall have zero indices for ignitability, spread of flame and smoke developed, in accordance with BS 476 and as approved by the FSB. The Contractor shall provide Certificate of Supervision with endorsement by supplier's PE upon completion of the installation.

1.16 VARIABLE AND FAN ASSISTED AIR VOLUME BOXES

1.16.1 General

a. The Contractor shall select all boxes, electric reheaters suitable for the scheduled duties, and space available.

b. VAV equipment including the electric reheaters as applicable and octopus shall be packed, factory assembled type of imported origin mounted as shown on the Drawings.

c. The boxes shall be supplied to meet the specified noise criteria.

d. All VAV boxes shall be of the highest commercial standard and shall be designed, constructed, rated and tested (including acoustic performance) in accordance with an approved authority such as Air Diffusion Council (ADC) or approved international standard.

e. Materials shall comply with the relevant British Standards or other approved international standards.

f. All factories applied acoustical and thermal insulation, including facing and adhesive is to be fire resistant and is to conform to the requirements of the Local Authorities.

g. Power supply for VAV/CAV terminals shall be taken from the respective AHU motor control panel with all necessary wirings. Maximum 5 VAV/CAV terminals shall be connected to one MCB circuit.

1.16.2 Variable Air Volume Box

a. All boxes shall have pressure independent control type.

b. Each box shall have a matching thermostat. The finishing shall be required to match with the interior design. Confirmation of exact location and finishing must be obtained from the Architect before installation.

c. All boxes shall be self-contained and fabricated from galvanised steel of minimum 22 gauges.

d. The casing shall be sealed to limit to the leakage of air to not more than the specified percentage of the air volume handled at the corresponding working pressure as shown in the equipment schedule. The data must be submitted at the time of tendering.

e. The casings shall be lined internally to provide thermal and acoustic insulation, the insulation should have an index number below 12 as defined in the 'Fire Propagation Tests', BS 476:Part 6 and be protected against erosion.

f. All acoustic tests shall be carried out in an approved Testing Laboratory. Sound power level tests results for both air discharge and casing radiation noise shall be

tabulated for all wave bands from 63 Hz to 4000 Hz for 100 Pa and 250 Pa, and submitted for approval prior to ordering.

g. Under no circumstances shall the sound power levels exceed the maximum permissible levels indicated in the "Equipment Schedule".

h. Each box shall have an access door(s) which must be air tight and positioned to enable ease of maintenance (from below) on the working parts within the box.

i. Where boxes comprising a number of components are offered, each component shall be constructed in sheet metal and to a similar specification as indicated above and shall be provided with connecting flanges and complete in all respects.

j. VAV boxes shall be normally open and fitted with a thermostatically controlled electric or pneumatic actuator as specified to vary the supply volume between the limits scheduled and pressure independent.

k. Control shall be ±5% at any point in the range, for inlet static pressure between 50 Pa and 500 Pa.

l. A facility shall be provided to modify the operating volume by simple adjustment (within the catalogue range). A calibration scale in m^3/s shall be fitted.

m. The volume control devices shall be robustly constructed from aluminium or other corrosion resistant materials and have a proven record of accurate and maintenance free operation. Unit shall be designed for field conversion from normally open to normally closed, or vice versa, without relocating the actuator, changing parts or adding relays. The dampers\ shall have built-in stop to prevent overstriking and shall seal against an approved gasket to limit close-off leakages lower than that specified. The leakage data shall be submitted at the time of tendering.

1.16.3 Fan Assisted Variable Air Volume Box

a. Variable volume fan assisted terminal units shall comprise an acoustic insulated casing, primary supply air inlet damper and damper control, secondary air fan with back draught damper complete with speed controller, mixing chamber and inlet and outlet connections.

b. All aspects of fan assisted VAV boxes shall match those for VAV boxes as appropriate and as specified elsewhere in this specification.

c. Secondary air fan and motor assemblies shall be centrifugal, aluminium scroll and stainless steel shaft statically and dynamically balanced. Fan assembly shall be fitted with vibration isolators to prevent noise transmission. Fans shall be suitable for variable speed operation. Fans shall be selected to operate at an external static pressure as scheduled.

d. Primary air dampers shall be arranged to be normally closed wit the control system fitted to the terminal units.

1.16.4 Constant Air Volume Boxes

a. Constant volume boxes shall be pressure independent and shall be constructed similar to VAV boxes.

b. The Contractor shall supply and install the constant volume boxes including the velocity sensor and actuator are compatible with the control system to be used.

1.16.5 Electrical Reheater

a. Reheater elements (where specified) shall be mounted in supply air ductwork adjacent to unit discharge and shall comply with all relevant local codes. Reheater capacities, voltages and steps of control are scheduled.

b. Each box reheater shall be provided with a manual reset high limit safety thermostat mounted downstream of the elements. Thermostats shall have concealed screwdriver set point adjustment in the range 0 to 100 C with a high limit dial stop factory adjusted to 52 C but capable of being adjusted in the field.

c. Switch contact action shall be single pole double throw. Thermostats shall have a rod and tube sensing element.

d. A sheet steel enclosure with a removable cover shall be provided over the reheater element terminals. Under no circumstances shall any other equipment be mounted under this cover. Heater elements shall be connected with high temperature cable, with terminations made strictly in accordance with the element manufacturer's requirements, such that deterioration and burning of the cable at the termination point is avoided throughout the lift of the building.

e. An earth strap shall be connected to the removable reheater element plate from the main earth connection to the unit. Reheater elements shall be fully withdrawable without damage to high temperature protection sensing elements.

f. Any control equipment required on the box shall be mounted in a separate enclosure located a minimum of 500mm clear of the terminal enclosure, measured edge to edge. Cabling to the reheater elements shall be provided with the unit, from approved tunnel type indirect pressure terminals mounted in the controls enclosure, such that all on-site connections are made in the controls enclosure.

g. A clearly labelled isolating switch shall be mounted on the side of the controls enclosure.

h. Reheaters shall be installed in a galvanised steel plenum insulated with insulation meeting NFPA 90A requirements and VL 181 erosion requirements.

1.17 RE-INSULATED DUCT WORK

1.17.1 Materials

a. The pre-insulated duct work panel manufacturer shall European origin.

b. The duct work shall be made of pre-insulated aluminium sandwich panels with aluminium foil both sides of the sandwich panel filled with expanded polyurethane rigid foam insulation.

c. Both sides of the aluminium foils shall be lacquered with a 3 g/sq.m weatherproof and ultraviolet rays protection polyster lacquer.

d. All the panels shall be embossed with the name of the manufacturer and production date.

e. Minimum thermal insulation characteristics shall be as follows:

- Insulating material: Close cell rigid expanded polyurethane foam, CFC, HCFC and HFC free.
- Density 45-48 kg/cu.m,
- Thermal Conductivity
- Initial 0.0206 W/mK
- After aging 0.0226 W/mK
- Fire Reaction – Class B European Standard •Pressure: 2000 Pa – operating
- Pressure: 5000 Pa – 1 Hr.
- Air Tightness - Compliance with EN 1507, EN 14239 Class B and C
- Water vapour Transmission: > 2000 sq.m.hPa/mg
- Max. Velocity: 35 m/s

- Working Temperature: -35deg C. to +110 deg.C

Description	Duct Work (Indoor Installation)	Duct Work (Outdoor / Exposed Installation)	Duct Work (Mech./ Plant Rooms/ Large Sections)	Remarks
Panel Thickness	21 mm	30 mm	30 mm	Otherwise as per Manufacturer's Recommendations
Outer Foil Thickness	80 Microns (Embossed)	200 Microns (Embossed)	200 Microns (Embossed)	Otherwise as per Manufacturer's Recommendations
Inner Foil Thickness	80 Microns	80 Microns	80 Microns	Otherwise as per facturer's mendations

1.17.2 Installations

a. To be generally in accordance with manufacturer's guidelines, under the supervision. Certified professional/manufacturer's local agent.

b. Duct shall site delivered ready to install, and fabricated in the local agents workshop.

c. The pre-insulated duct work supplier shall be the sole authorized dealer/agent by the manufacturer.

d. The local agent must have his own fabrication workshop completely equipped with all necessary manufacturer's recommended tools and instruments.

e. The ducts shall be fabricated completely in accordance with the manufacturer's guidelines/recommendations.

f. Duct shall be joining using manufacturer's recommended flange/slide-inchannels. And connected to the duct panels using self-extinguishing adhesive composed of special resin provided by the manufacturer.

g. Application of gasket in Teflon between the joining system to provide proper air tightness, both on negative or positive, complying to EN 13403 Class b and C.

h. Duct section and the internal pressure the duct work must be provided with stiffening devices composed of aluminium stiffening rods (approx. min. 14 mm dia) connected with a cross fixing device, applied to the duct by means of PVC plates approx. 120 mm dia. for indoor application and steel plates (approx. min. 170mm dia. for outdoor/heavy application.

i. All the duct s shall be as per approved shop drawings prepared by the Contractor.

j. Flanging: Anti-condensation polymer flange profile, invisible/flush type, external corners of the ducts shall be provided with aluminiumself adhesive tape of same finish as of the duct.

k. Tee Connection: large branches exceeding 900 W x 450 H (any direction), using dedicated Tee-connector profile.

l. Damper shall be of same material as of pre-insulated duct, with mild steel/aluminium blades.

m. Damper Connection: Special flanged connector shall be used.

n. Flexible Duct Connection: Use spin collars/special bands arrangements.

1.17.3 Warranty

a. Manufacturer/agent shall warrant the system against manufacturing defects and/ deterioration for 10 years from the date of commissioning.

b. Contractor's installation shall be deemed as acceptable by the Engineer/Employer, after manufacturer/agent certified that it is in conform to standards and has been inspected in course of execution.

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DIVISION - 23 07 19

PIPING INSULATION

1. Piping Insulation:

a) Insulation Installation:

No insulation shall be applied to any system of piping until all foreign matter has been removed from the surface to be insulated, and until the piping has been tested, cleaned out and made tight and painted. All insulation shall be applied in a manner consistent with good practice and methods. All longitudinal joints of pipe shall be top and bottom. Insulation shall be continuous through walls, floors, ceiling and partitions etc.

b) Insulation:

All cold & hot water piping shall be insulated as indicated under INSULATION SCHEDULE in EQUIPMENT & MATERIAL SCHEDULE (Section 2). Insulation shall be in preformed sections with tongue and groove attachment. All insulation shall be fixed to the pipe with approved adhesive. Insulation shall be continuous and gaps if any, shall be filled up. Circumferential and longitudinal joints of vapour barrier and jacket shall be over-lapped at least 50mm.

c) Vapour Barrier:

Shall be as specified under INSULATION SCHEDULE in EQUIPMENT & MATERIAL SCHEDULE (Section-2). Vapour barrier shall be fixed to the insulation with approved adhesive covering at-least 75% area. All circumferential and longitudinal joints shall be over-lapped at least 40mm. Vapour barrier shall be completely continuous. All scratches, tears, etc., shall be made good by pasting fresh layers of the vapour barrier on the discontinuity.

d) Jacket:

Shall be as specified under INSULATION SCHEDULE in EQUIPMENT & MATERIAL SCHEDULE (Section-2). All circumferential and longitudinal joints shall be overlapped at least 40mm. The jacket shall be stretched tight over the insulation using adhesive which shall cover 100% area. Cut edges shall not be visible. All longitudinal joints shall be on top for horizontal piping and hidden from view for vertical piping. Circumferential joints shall be equally distant and equal to the width of the jacket roll. Patches shall not be permitted.

e) Vapour Barrier Coating:

shall be as specified under INSULATION SCHEDULE, in EQUIPMENT & MATERIAL SCHEDULE (Section-2).

f) **Cladding:**

All chilled and hot water piping shall be provided with cladding as specified below.

2. **Valves, Fittings & Other Specialities:**

shall be insulated with preformed adjoining insulation, cut to suitable shapes and sections, to closely fit around valves and fittings. Insulation thickness shall not be less than the adjoining straight pipe insulation thickness. The adjoining insulation near these fittings shall be mitred and trimmed into suitable sections to fit closely around the valves, flanges and fittings. All trimmed sections shall be secured by wrapping of approved type of self-adhesive tape to form a complete vapour seal. There shall be a clear break between adjoining pipe insulation & valve/specialities insulation, so that when valve/specialities insulation is opened for maintenance the adjoining pre insulation is not affected.

3. **Condensate Drains:** shall be insulated as specified under INSULATION SCHEDULE in EQUIPMENT & MATERIAL SCHEDULE (Section-2).

4. **Cladding:**

All insulated pipes shall be provided with a cladding of 26 gauge 0.55mm G.I. sheet. At all flanges and valves the cladding shall be openable type. Valves shall be provided with valve boxes with quick opening clamps. Large valve boxes may be held together using "Jubilee Clamps".

5. **Buried Steel Piping:**

The bare steel piping, or the steel cladding of an insulated pipeline shall be externally painted with one coat of Asphalt primer 2000 (National Petrocarbon Pvt. Ltd.) followed by two coats of Hykote Enamel (National Petrocarbon) reinforced with one layer of galssfibre wrap. The primer and enamel shall be applied strictly in accordance with manufacturer's recommendations.

6. **Adhesive:**

shall be "MOWLITH" as manufactured by HOEST, Pakistan.

7. **Insulation Tapes:**

At all insulation joints use 75mm wide self-adhesive tape consisting of reinforced aluminium foil and white Kraft paper.

8. Reference Specification

The following specifications shall be construed to be part of these specifications.

- 15010 - Basic Mechanical Requirement
- 15015 - Basic Mechanical Materials and Methods

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DIVISION - 23 34 16

CENTRIFUGAL FAN

1. General:

The Contractor shall supply fans of the type specified below, and conforming to the data given in the EQUIPMENT & MATERIAL SCHEDULE (Section 2). The Contractor shall be responsible for the proper selection of the fans so that the specified operating conditions are obtained. Motors shall conform to specification under MOTOR (Section 15024) and shall be sized to provide the required BHP for meeting the specified conditions without overloading.

2. Centrifugal Fans:

Shall be single width, single inlet or double width double inlet, class I, II or III as required or indicated in the EQUIPMENT & MATERIAL SCHEDULE (Section 2) for the design system pressure.

Fan Housing: Housings shall be of heavy gauge steel, continuously welded construction with rigid reinforcement. In class I & II construction size 12 inches through 27 inches shall have 12 gauge sides and 14 gauge scrolls, while sizes 30 inch through 66 inches shall have 10 gauge sides and 12 gauge scrolls. All fan housings shall be equipped with flanged discharge, and removable spun inlet cones designed for smooth airflow.

Single-inlet, single-width fans shall be provided with extended inlet collars for slip-on type duct connections. Inlet collars shall be of heavy gauge round design.

Fan Wheels: shall be rigidly constructed, accurately balanced both statically & dynamically on precision electronic balancers, and shall be free from objectionable noise and vibration.

Each wheel shall be designed for critical speed of at least 1.25 times the maximum class speed. Upto 27 inches fan blades may be forward curved, backward curved or airfoil design. Fan blades over 27 inches shall have backward curved or airfoil design, unless otherwise specified under EQUIPMENT & MATERIAL SCHEDULE (Section-2). Forward or backward curved wheel shall be of steel plate, while aerofoil wheels shall be of cast-aluminium, or formed steel with cavity filled.

Fan Shaft: Fans shall have shafts of solid hot rolled steel, accurately turned, ground, polished & ring gauged for accuracy. Close tolerances must be maintained where the shaft makes contact with the bearings. Shaft diameter, must have first critical speed at least 1.35 times the maximum class speed of the fan.

Bearings: Fans shall have heavy duty, grease lubricated, precision anti-friction ball or roller, self-aligning, pillow block type bearings, selected for minimum average bearing life of 125,000 hours when operating at maximum catalogued class conditions. Bearings shall be provided with suitable arrangements for re-lubrication.

Mounting & Drive: The fan and motor drive shall be mounted on heavy steel framing. Motor shall be mounted on slide rails. Drive arrangement shall be as specified, or as recommended by AMCA for the condition of operation. Drive shall be selected for minimum 1.2 BHP. Fans upto& including 50HP shall be with variable pulley & suitable for adjustment within ±10% of specified RPM. Provide complete belt guard on fan and motor pulley, constructed of heavy steel framing and expanded metal mesh screening.

Painting & Coating: Each fan component shall be thoroughly degreased, phosphatised and provided with two coats of special anti-rust primer and two coats of stove enamelled paint.

3. Installation:

Fans shall be rigidly secured so that they operate without vibration and transmission of vibration to structure, shall be isolated. Connection to ducting shall be through flexible connectors. Ducting connection to fan shall ensure lowest turbulence and smooth transition of sides. All supporting arrangement of the fans shall be drawn up by this contractor and submitted to the consultant for approval.

Floor mounted fan shall be installed as a 100mm high concrete foundation with edges provided with 25×25×3mm angle iron.

4. Commissioning and Testing:

The fans shall be commissioned and tested by this contractor. Test forms, supplied by the consultants shall be filled in and the consultant's approval obtained.

5. Reference Specification

The following specifications shall be construed to be part of these specifications.

- 15010 - Basic Mechanical Requirement
- 15015 - Basic Mechanical Materials and Methods
- 15020 - Painting & Coating
- 15023 - Supports & Anchors
- 15024 – Motors
- 15025 - Mechanical Identification
- 15027 - Vibration Isolation Control
- 15030 - Equipment Installation

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DIVISION - 23 34 19

PROPELLER FAN

1. General

The Contractor shall supply fan of the type specified below, and conforming to the data given in the EQUIPMENT & MATERIAL SCHEDULE (Section-2). The Contractor shall be responsible for the proper selection of the fan so that the specified operating conditions are obtained. Motor shall confirm to specification under MOTOR (Section-15024) and shall be sized to provide the required BHP for meeting the specified conditions without overloading.

2. Propeller Fans (Non-metallic Construction):

shall be manufactured out of special plastic. Fan shall be propeller type and shall be directly mounted on the motor, and shall operate without disturbing noise & vibration. The discharge side of the fan shall be provided with self-closing shutters. Fan shall be suitable for continuous operation.

Fan installed on glass shall be through glass type, for which purpose the contractor shall cut a hole in the glass of the right diameter.

Fan installed in wall shall be provided with “deodar” wooden frame 20mm thick and spanning full width of the wall. The discharge end of the wall opening shall be provided with an aluminium louver with bird screen.

3. Propeller Fan (Metallic):

Propeller fan blades shall be of aluminium, mounted on a hub directly attached to an electric motor. Fan shall operate without abnormal noise and vibration, and shall be statically and dynamically balanced.

Fan shall be mounted on the wall with approved anchors, and shall be provided with “deodar” wooden frame 20mm thick and spanning full width of the wall. The discharge end of the wall opening shall be provided with an aluminium louver with bird screen.

4. Installation:

Fan shall be rigidly secured so that they operate without vibration and transmission of vibration to structure, connection to ducting shall be through flexible connectors. Ducting connection to fan shall ensure lowest turbulence and smooth transition of sides. All supporting arrangement of the fans shall be drawn up by the contractor and submitted to the consultant for approval.

5. Commissioning and Testing:

The fan shall be commissioned and tested by the contractor. Test forms, supplied by the consultant shall be filled in and the consultant's approval obtained.

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DIVISION - 23 37 13

DIFFUSERS, REGISTERS & GRILLS

1. General:

These shall be factory-fabricated of powder coated or anodized aluminium and of colour as approved and shall distribute the specified quantity of air evenly over the space intended, without causing noticeable drafts, or dead spots anywhere in the conditioned area. The Contractor shall be responsible for diffusion, spread, drop and throw. If, according to the certified data of the manufacturer of the proposed units, the sizes indicated on the drawings will not perform satisfactorily, the units shall be re-selected to perform quietly and effectively in accordance with the manufacturer's recommendations as approved by the Consultant. A schedule of all air inlets and outlets shall be submitted to the Consultant, indicating location, types, specified air quantity, neck or face velocity, sound power level values, pressure drop, throw and drop for registers and maximum and minimum diffusion range, prior to ordering.

2. Diffusers:

shall be round, half round, square, rectangular, slot, strip shaped or perforated type with fixed or adjustable air discharge pattern, as indicated on the drawings. Ceiling mounted units shall be furnished with anti-smudge device, unless the diffuser unit minimises ceiling smudging through design features. Diffusers shall be provided with air deflectors specified herein. Ceiling mounted units shall be installed with trims tight against ceiling whether flush, recessed or surface mounted. Rubber gasket shall be provided between ceiling and surface mounted diffusers, when necessary for air leakage-control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and will not interfere with the volume controller. Return or exhaust units, when indicated, shall be similar to supply diffusers. Diffusers shall be provided with opposed blade volume controller with accessible key operator.

3. Registers:

shall be of the type and size shown on the drawings approved. Registers shall be provided with rubber gaskets between flanges and walls or ceilings. Wall supply registers shall be installed at least 6 inch (150mm) below the ceiling unless otherwise indicated. Registers shall be provided with opposed blade volume controllers with accessible key operator.

4. Self Closing Gravity Louvers:

These shall be of aluminium construction, and shall consist of self closing gravity louvers at one end and fixed louvers at the other end.

5. Grills:

shall be of sizes and type shown on the drawings. All grills shall be provided with control dampers unless otherwise indicated on drawings.

6. Swirl Diffusers:

fixed blade type shall be similar to TROX Model RFD and shall be supplied & installed where shown on the drawings. Diffusers shall be provided with plenum & top entry spigot & shall be provided with stove enamelling of approved colour. Dampers shall be provided.

7. Jet Nozzles:

Adjustable construction type shall be similar toTrox model DUK-V and shall be supplied and installed where shown on the drawings. The spherical discharge nozzle shall be mounted in a housing and shall be provided with a front mounting flange and circular spigot for direct connection to a circular duct. The nozzle shall be capable of upward and downward manual adjustment. Discharge nozzle and installation flanges shall be of aluminium. Duct connection element shall be rolled galvanised sheet steel.

8. Disc Valve:

Circular disc valves shall be suitable for supply and extract air, comprising valve ring with peripheral seal, central disc with threaded spindle and lock nut and installation subframe.

Face sections and installation subframe shall be aluminium with no additional treatment; threaded spindle and lock nut shall be galvanised steel.

Disc valve shall be similar in construction to Trox LVS model. Locking nut shall be able to lock from bottom / outside the disc valve through a locking key.

9. DAMPA Sq. 600 Diffuser:

Shall be as manufactured by Thermec, & designed to integrate with the DAMPA ceiling system. Finish shall be powder coated/stove enamelled of approved colour. Diffuser shall be provided with damper & field constructed inlet plenum, which shall be lined with 1-inch (25mm) thick acoustic liner.

10. Plenum for Linear Diffusers:

Plenums for linear diffusers shall be factory fabricated by the manufacturer of the linear diffuser, using 20 gage (1.01mm) galvanised sheet steel, of size shown on the drawings. Plenums shall be provided with hanging holes at every 1200mm centres, intake round spigots at 1200mm centres unless otherwise indicated on drawings; arrangement for alignment of plenum sections; arrangement for fixing of diffuser to plenum with out visible screws and assuring leak-proof fitting into the plenum.

11. Installation:

shall ensure that all lines are perpendicular and parallel to the building walls and other surfaces, flush with the ceiling and properly centred so that complete symmetry is obtained.

All diffusers shall be installed directly to the supply air ducting, so that the weight of the diffusers is not transferred to the false ceiling. Diffuser shall be so installed that the collar is flush with the ceiling. Gaskets shall be used to prevent leakage.

Registers and grills on side walls shall be fixed on deodar wooden frames provided with anti-termite Solignum treatment. Frame thickness shall be 6mm less than the register/grill collar and shall cover the full depth of the wall. Perfect alignment & symmetry shall be maintained.

After the system is in operation, if drafts, dead spots, or excessive noise are noticeable in the conditioned areas due to improper selection or construction of the air outlet, the airoutlet shall be changed to the proper type to remove the defect, without additional cost to the Employer.

12. Reference Specification

The following specifications shall be construed to be part of these specifications.

- 15010 - Basic Mechanical Requirement
- 15015 - Basic Mechanical Materials and Methods
- 15020 - Painting & Coating
- 15023 - Supports & Anchors
- 15030 - Equipment Installation

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DIVISION - 23 41 00

1. General:

Each air system shall have its own air filters, and shall be of capacities and sizes as given in specifications herein, or in the EQUIPMENT & MATERIAL SCHEDULE.

The air-handling unit filter shall be mounted in an air-tight flat or angular filter box of galvanised steel or aluminium sheet so that they can be removed from either end for replacement and cleaning. In an air handling unit the filter section shall be a standard module from the AHU manufacturer.

In selecting the sizes of the air filters, the space available in the Plant Room and air handling units etc., should be kept in view.

The Contractor shall provide the following information for each of the air filters proposed to be supplied by them.

a) Capacities in CFM and media air velocity.

b) Initial and Recommended Final air pressure drop in inch of WG (Pa) for each type of filters.

c) Manufacturer's performance guarantee certificate and technical bulletins.

The Contractor shall install a multi-blade damper in the plenums of air handling unit having high efficiency filters to balance the air system when the filtering media is new with low initial resistance.

2. Viscous Impingement Filters (Filter Class G2 to EN 779):

Filters shall conform to filter Class G2 to CEN Standard EN 779, & provide a Dust Arrestance Efficiency of 65% to 80%.

Filters shall be 2-inch (50mm) thick, permanent viscous impingement, washable, all metal, panel type. Media shall be corrugated strips of aluminium screen enclosed in an 18-gauge aluminium frame with flush mitred corners. The corrugation shall be tapered to form a series of pyramid shaped pockets to prevent dust-laden air from drifting through the filters. Expanded metal shall be placed on both sides of the filtering media to add strength and for mechanical protection.

Resistance to airflow of a clean filter shall not exceed 0.1inch WG. Pressure drop across the filter and final pressure drop shall not exceed 0.5 inch of WG. The filters shall be selected for face velocities not exceeding 500 fpm (2.5 m/s).

Provide filter adhesive in suitable containers in sufficient quantity for three month's requirement, based on operating the system for 10 hours a day. Provide a filter-washing tank suitable for washing of the particular size of filter.

3. Replaceable Panel Filter (Filter Class G2 to EN 779):

Filters shall conform to filter Class G2 to CEN Standard EN 779, & provide Dust Arrestance Efficiency of 65% to 80%.

This filter shall consist of 2-inch (50mm) thick glass fibre mat coated with dust binding adhesive (Viscosine) as the filtering media. The filtering media shall be fixed into a U-shaped metal frame and a metal grid shall be provided for additional support.

The filter shall be supplied with a 50mm deep galvanised steel cell (holding) frame with quick release clamps or hinge type spring clips for positive airtight clamping of the filter.

The filter shall have a rated face velocity of 500 FPM (2.5 m/s) with maximum initial resistance of 0.24 inch of WG (60 Pa) and final pressure drop of 0.72 inch of WG (180 Pa).

4. Throwaway Disposable Synthetic Media Panel Filters (Filter Class G4 to EN 779):

Filters shall conform to filter Class G4 to CEN Standard EN 779, & provide Dust Arrestance Efficiency of greater than 90%.

This filter shall be a pleated disposable filter utilizing synthetic media securely sealed in a die-cur beverage board frame. The filter shall be 2-inch (50mm) thick.

The filter shall be supplied with a 50mm deep galvanised steel cell (holding) frame with quick release clamps or hinge type spring clips for positive airtight clamping of the filter.

The filter shall have a rated face velocity of 500 FPM (2.5 m/s) with maximum initial resistance of 0.30 inch of WG (75 Pa) and final pressure drop of 0.72 inch of WG (200 Pa).

5. Medium Efficiency Bag Filters (Filter Class F6 to EN 779):

Filters shall conform to filter Class F6 to CEN Standard EN 779, & provide Average Atmospheric Dust Spot Efficiency of 60% to 80%.

These filters shall be extended surface air filters, pocket type having a minimum of 8 pockets; with either a retainer device designed to give full top, bottom and side support to each pleat, or with the pleats so designed as not to require a supporting retainer. Retainer device, if used, shall be of galvanised wire with PVC coating.

Filter media shall be ultra-fine fibreglass specifically manufactured for filtration.

Filters shall be provided with holding frames lined with sealing gasket with quick-release clamps, for side access application, designed to ensure a positive seal against leakage of unfiltered air. The filters shall have a rated filter face velocity of 500 FPM (2.5 m/s), providing a maximum Initial Resistance of 0.24 inch of WG (60 Pa) and a recommended final resistance of 1 inch WG (250 Pa). Filter depth shall be 22 inches (560mm).

6. **Medium Efficiency Bag Filters (Filter Class F7 to EN 779):**

Filters shall conform to filter Class F7 to CEN Standard EN 779, & provide Average Atmospheric Dust Spot Efficiency of 80% to 90%.

These shall be similar to Class F6 Bag Filters as specified above. The filter shall have a rated filter face velocity of 500 FPM (2.5m/s), providing a minimum initial resistance of 0.3 inch of WC (75 Pa), and a recommended final resistance of 1 inch WG (250 Pa).

7. **High Efficiency Bag Filters: (Filter Class F8 to EN 779):**

Filters shall conform to filter Class F8 to CEN Standard EN 779, & provide Average Atmospheric Dust Spot Efficiency of 90% to 95%.

These shall be similar to Class F6 Bag Filters specified above, except that the filters shall have a minimum of eight pockets and shall have a rated filter face velocity of 500 FPM (2.5

m/s), providing a maximum Initial Resistance of 0.35 inch of WG. (88 Pa), and a recommended final resistance of 1 inch WG (250 Pa). Filter depth shall be 22 inches (560mm).

8. High Efficiency Pleat Filters (Filter Class F9 to EN 779):

Filters shall conform to filter Class F9 to CEN Standard EN 779, & provide Average Atmospheric Dust Spot Efficiency of greater than or equal to 95%. These shall be of high efficiency extended surface rigid type, consisting of galvanised steel holding frame and replaceable filter.

The holding frame shall be of 16-gauge galvanised steel, minimum 70mm in depth, and designed to provide positive seal against leakage of unfiltered air. The frames shall be provided with integral spring type latches to firmly hold the filter against neoprene rubber gaskets.

The filters shall be made from water-resistant ultra-fine glass fibres. The media shall be pleated and shall have crimped aluminium separators to maintain uniform spacing between pleats. The filter casing shall be of galvanised steel.

The rated filter velocity shall be 500 FPM (2.5 m/s) providing a maximum Initial Resistance of 0.60 inch of WG (150 Pa) and a Recommended Final Resistance of 1.2 inch WG (300Pa). Filter depth shall be 292mm.

9. Activated Carbon Filters:

These filters shall consist of activated carbon filter cells for removal of odour and harmful vapours by adsorption process.

Filter housing shall be constructed of 16 gaugegalvanised steel sheet with internal stiffener bars. Top and bottom slide track inserts shall be one-piece moulded corrosion resistant plastic.

Filter cell frame shall consist of moisture resistant chipboard with neoprene seals. The activated carbon cells shall be of wedge formation securely fixed to the frames. The activated carbon used shall have cylindrical shaped granules. Filter shall be minimum 1 inch (25mm) thick. Carbon trays shall be rechargeable and manufactured of high impact plastic with internal separators to prevent settling of the carbon beds. Two beads of caulking, one on either side of the mounting holes and around the framework to allow the filters to seal against each other shall be provided.

The filters shall have a rated filter velocity of 500 fpm (2.5m/s), providing a maximum initial resistance of 0.5 inch of WG (125 Pa). Minimum service life shall be one year.

10. Reference Specification:

The following specifications shall be construed to be part of these specifications.

- 15010 - Basic Mechanical Requirement
- 15015 - Basic Mechanical Materials and Methods

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DIVISION - 23 62 00

AIR COOLED CONDENSING UNIT

1. General:

The contractor shall supply & install air cooled condensing unit matching with AHU DX coil elsewhere mention in this section of the required capacity and rating as shown on the HVAC SCHEDULE.

Cabinet: Cabinet shall be weather-proofed for outdoor use and shall be assembled on a heavy angle iron frame. Cabinet shall have sheet steel panels coated with two coats of baked enamel.

Condenser: shall be air cooled type. Condensing coil shall be of copper tubing mechanically bonded to aluminium fins. Coils shall be factory pressure tested. Back seating service valves in liquid & suction lines shall be provided.

Condenser Fan: Fans shall be vertical discharge, direct drive aluminium propeller fans, statically and dynamically balanced. Motors shall be of 3-phase, heavy duty with permanently lubricated bearings and rain protection shall be provided to the motor by either providing waterproof motors or weather tight slingers over the motors. Motors shall have built-in thermal overload protection. Fans shall have safety guards.

Compressors: shall be hermetic or semi-hermetic, pressure lubricated with overheat protection for the motor. Compressors shall be mounted on vibration isolators.

2. Refrigerant Circuit:

General: Refrigerant control shall be through expansion valves. All refrigerant circuits shall be through copper tubing with brazed joints. Units shall have an operating charge of Refrigerant-22, factory-provided after a pressure test to 450 psig. Circuits shall be provided with suction and liquid line service valves.

Single Circuit: Units below 15 nominal tons capacity shall have a single refrigerant circuit with one condenser coil, one evaporator coil, one or two compressors, one expansion valve and one receiver.

Dual Circuit: Units above 15 nominal tons capacity shall have two independent refrigerant circuits which could operate independently even if one circuit is

inoperative because of defective components. Each circuit to have one evaporator coil, one condenser coil, one compressor, one expansion valve and one receiver.

3. Electrical Controls:

Unit shall be factory provided with complete electrical control circuitry. Unit shall be provided with starter plus overload protection for all motors, internal high pressure cut-out & over-load protection for the compressors.

Unit shall be provided with return air temperature controller and three position (FanOff-Cool) switch completely wired and unit-mounted. Controls shall be reset by means of three-position switch or thermostat but prevented from repeated cycling by reset relay control circuit. On dual compressor units a compressor sequence switch shall be provided to alternate lead-lag compressor operation.

4. Refrigerant Controls:

Unit shall be factory provided with a thermal expansion valve. On units with two refrigerant circuits, each circuit shall have its own expansion valve.

5. Spares:

Spares shall be provided as indicated under HVAC SCHEDULE

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DIVISION - 23 81 27

SMALL SPLIT AIR CONDITIONER

1. General:

This Contractor shall supply & install air-cooled split type air conditioners with condensing units of the type and capacity rating as shown in SCHEDULE.

2. Evaporator Unit:

Unit shall be supported by a rugged frame and enclosed by sheet steel panels. Panels should be coated with two coats of baked enamel paint and insulated on the inside by ½inch (12mm) thick insulation. The insulated drain pan shall have connections on both sides. The Evaporator coils shall be of ⅜inch (10mm) diameter seamless copper tubes, mechanically bonded to aluminium fins. Coils shall be factory tested and dehydrated and provided with quick connect couplings. Evaporator blower fans shall be centrifugal, forward curved type, statically and dynamically balanced, directcoupled to the motor. The fan motor shall be multispeed type with built-in thermal overload protection. Filters shall be cleanable and easily accessible.

3. Condensing Unit:

Unit shall be weather-proofed for outdoor use and shall be assembled on a rugged frame. The Cabinet shall have sheet steel panels coated with two coats of baked enamel paint. Internal protection devices on the compressor shall include a thermal overload relay and a pressure relief valve. The compressor shall have internal spring mounts and external vibration isolation mounts to minimise noise and vibration. Condenser coils shall be ⅜inch (10mm) diameter seamless copper mechanically bonded to aluminium fins. Coils shall be factory tested and provided with quick connect couplings.

4. Controls:

Refrigerant control shall be provided by capillary tube. Unit control shall be through a control box which has the unit on-off switch, fan speed selector switch and room thermostat, all installed in it.

5. Installation of Split Units:

a) Supply and install the air-conditioning units where shown on drawings.

b) Provision of space clearance required for units (indoor & outdoor) shall be strictly followed as per manufacturer's recommendations.

c) Indoor & outdoor units shall be installed properly levelled & aligned.

d) Indoor & outdoor units will be fixed with appropriate size Anchor.

e) In case of front discharge condensing unit, the air discharge direction will be the same as the wind direction but symmetry will be maintained according to building orientation.

f) Outdoor unit and floor mounted indoor unit will be installed on 4 inch high concrete pad, & provided with cement plaster finish or steel structure as shown on drawings.

g) On unit 5 HP and larger, install rubber-in-shear vibration isolators below out-door unit. On floor- mounted indoor unit use 1 inch thick neoprene pad. On ceiling suspended indoor units use rubber-in-shear isolators.

6. Refrigerant Piping:

a) Refrigerant piping shall be copper tubing conforming to standards and source given in SCHEDULE

b) Use copper phosphorus filler metal for brazing rods.

c) Perform pipe brazing by flowing nitrogen gas through it.

d) Prevent ingress of foreign material and water vapor into refrigerant pipes. Keep pipe ends plugged.

e) All pipe passages thru walls/roof shall be thru a suitably sized G.I. pipe to act as a sleeve. (Refer DETAIL DRAWING).

f) Install closed cell foam insulation 3/8 inch thick on liquid and suction lines. Wrap all joints with self-adhesive aluminium tape.

g) Insulated pipes exposed to the atmosphere shall be installed in a rectangular 22 gage (US) G.I. sheet race-way, similar to a cable tray, with removable top cover, as per approved sample.

h) Install pipe supports at every meter distance and at every change of direction. (See DETAIL DRAWING).

i) On units of 5HP & higher, install refrigerant drier on liquid line with shut off valve on both sides of the drier and a bypass line with shut-off valve.

j) When brazing work is finished, check for leaks at the joints. For this purposepressurise piping by charging with nitrogen to a pressure of 250 psig along with a small amount of refrigerant. Use Freon leak detector to check for leaks. As refrigerant gas is heavier than air, apply Freon sensor to the bottom of the joint.

k) After refrigerant-piping work is finished, evacuate the installed pipes along with indoor unit evaporator coil upto 1mm Hg vacuum or by Freon sweep method by vacuum pump.

7. Condensate Drain Piping:

a) Install drainpipes as and where shown on drawings.

b) Drainpipes shall be G.I. pipe sized in accordance with schedule as given in TABLE at the end of this section, unless otherwise shown on drawings.

c) Provide support at every 1 meter and at every change in direction. (Refer DETAIL SKETCH OF SUPPORT).

d) Drainpipe shall be installed with proper slope.

e) Trap shall not be installed on small split units upto 2 TR capacity.

f) Do-not connect drain piping to drainage system. Use in-direct connection.

g) Insulate drainpipe with closed cell foam insulation 3/8 inch thick and seal insulation joints with self-adhesive aluminium tape.

h) All pipe passage thru walls shall be thru a suitably sized G.I. pipe to act as a sleeve.

8. Electric Wiring:

a) Provide and install electric wiring and earthing from electric supply point provided by others either near outdoor unit or indoor unit as required. Provide all control wiring between indoor and outdoor unit. Size of wires shall be as per schedule noted at TABLE 15182-1, or otherwise shown on drawings.

b) All electric wiring exposed to the atmosphere shall be installed in G.I. Pipe (KPM, Light Quality), and all indoor wiring shall be installed in metallic conduit, sized in accordance with Schedule given in TABLE 15182-1.

c) After completion of wiring, check all wiring with Meggar Tester to ensure no damages to wire insulation during pulling of wire into conduit.

9. Commissioning & Testing:

The contractor shall be responsible for commission the air conditioning unit in accordance with manufacturer's recommendations.

The split units will have a guarantee/warranty period of 12 months from the date of commissioning the units, and should any defects arise during this period which can be attributed to poor workmanship, improper material, or defective manufacture of the air conditioning units, for which the Consultant shall be the sole judge, the Contractor shall be required to replace or repair all defective parts, except compressors (burnt or otherwise) which shall be replaced with new compressors. All repairs and replacement shall be as directed by the Consultant.

Schedule of Sizes for Piping & Wiring Small Split Air Conditioners

(Decorative Model)

Item	Units	12,000 (Btu/Hr)	18,000 (Btu/Hr)	24,000 (Btu/Hr)	30,000 (Btu/Hr)	36,000 (Btu/Hr)	48,000 (Btu/Hr)
Liquid Line	Inch	3/8	3/8	3/8	3/8	3/8	½
Suction Line Ø	Inch	5/8	5/8	5/8	5/8	3/4	3/4
Drain Line	Inch	1	1	1	1	1 ¼	1 ¼
Power		1.40	2.10	2.80	3.50	4.2 TP	5.6 TP

Power Wire Size *	mm Sq.	2 × 4	2 × 4	2 × 6	2 × 6	3 × 2.5	3 × 4
Control Wire Size	mm Sq.	5(1.5)	5(1.5)	5(1.5)	5(1.5)	5(1.5)	5(1.5)
Earthing Wire Size	mm Sq.	2.5	2.5	2.5	2.5	2.5	2.5
Power Conduit Ø	mm	20	20	20	20	20	20
Control Conduit Ø	mm	20	20	20	20	20	20

** For Lengths Exceeding 100 Feet, Cable Size May Have To Be Increased*

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DIVISION - 22 33 34

HOT WATER HEATER/GEYSER (GAS OPERATED)

Storage types Gas Fired Water Heater of capacity as given in the EQUIPMENT & MATERIAL SCHEDULE (Section 2), and shall be installed where shown on the drawings.

The storage tank shall be constructed of galvanised sheet steel. Thickness of sheet steel shall be a minimum of 14 US gage for system pressure upto 30 psig and 10 US gage for higher pressures.

The heater shall be provided with the following accessories.

a) Two magnesium anodes to inhibit corrosion of the tank. These shall be easily removable & replaceable from the top.

b) 50mm thick fibreglass insulation.

c) Jacket of mild steel provided with two coat of stove enamelled paint over primer.

d) Dial type insertion thermometer, Ø 75.

e) Imported thermostat.

f) Safety relief valve.

Heater shall be installed & the following work carried out.

Install heater on 12" concrete foundation, of size to suit heater dimension.

Clamp/supply heater

Connect cold & hot water line with gate valves.

Connect gas line with gas cock.

Install flue duct using 20 gauge GI sheet & terminate as shown on plans.

All heaters, after installation, shall be subjected to an operation test to determine the efficient working of the recovery side, thermostat, etc., to the satisfaction of the Consultant. Heaters shall be inspected by the Consultant prior to supply & installation.

Payments shall be made for unit item price quoted in the Bill of Quantities which shall include the supply and installation of water and gas piping connections, relief valve, thermostats, exhaust ducting, etc., as specified and/or directed by the Consultant, complete in all respects.

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DIVISION - 22 47 00

ELECTRIC WATER COOLER

1. General:

Provide and install where shown on the drawings vertical free standing refrigerated water coolers with self-filling 5 gallon (19 litres) bottle on top. The unit shall be supplied with integral sediment & activated carbon filtration system.

2. Cabinet:

Housing shall be made of high density polyethylene saturated with U.V. protection and antistatic material in one piece blow moulding part. The material surface shall be textured to help conceal scratches. Drip tray shall be of rugged moulded high impact polystyrene, easily removable for cleaning. Faucets shall be durable polypropylene selfclosing type.

3. Cold Water Reservoir:

Cold water reservoir shall be constructed of ASTM 304 stainless steel with removable reservoir insulation consisting of two piece polystyrene insulation jacket.

4. Thermostat:

Temperature shall be controlled by an adjustable high quality thermostat easily accessible, and adjustable from 9°C to 12°C (48°F to 54°F).

5. Refrigeration Unit:

The refrigeration unit shall consist of a hermetically sealed compressor with automatic overload protection. No lubrication shall needed. The water reservoir shall be provided with external copper refrigerant coil using ozone friendly refrigerant. Refrigerant shall be controlled by an accurately calibrated capillary tube. Condenser shall be convection cooled.

Unit shall operate on 230V/1 phase/50 hertz, electric power.

6. Spares:

Provide 6 sets of sediment & carbon filters.

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DIVISION - 23 05 19

METERS & GAUGES

1.0 Thermometers:

The ranges of thermometers shall comply with the system parameters ensuring normal indication in the mid-region. Ranges much under or above the required readings shall not be acceptable, unless specifically approved by the Consultant.

a) **Pipe Thermometers:** These shall be adjustable angle type, with brass separable socket. Case shall be smooth die cast aluminium with metallic blue-black finish. Window shall be clear acrylic plastic or double strength glass, held in place with removable stainless steel caps. Tube shall have lens front with red appearing mercury tubing. Scale shall be on white background with jet black embossed figures and markings, of specified or suitable scale, in combination of °F-°C.

♦Scale size: 175mm

♦Stem length: 90mm up to 150mm diameter pipes
150mm above 150mm diameter pipes

♦Insertion length: 65mm for 90mm stem length
125mm for 150mm stem length

b) **Duct Thermometers:** These shall be adjustable angle type and shall conform to specifications given above for pipe thermometers, except that the duct thermometer shall be supplied with 75mm OD reversible aluminium flange and perforated aluminium bulb guard. Stem insertion length shall be 300mm.

c) **Thermometer Wells:** These shall be of brass suitable for pipeline mounting. Wells for insulated piping shall be provided with extension necks compatible to insulation thickness, to allow thermometer to clear the insulation.

d) **Installation:** Thermometers shall be installed wherever shown on the drawings. Installation on both ducts and piping shall conform to the manufacturer's recommendations. On thermally insulated ducts, casing, equipment or piping, stand off mounting brackets, bases, adopters or extended tubes shall be provided. These items shall provide clearance not less than the thickness of the insulation.

Thermometers shall have ranges suitable for the fluid being served.

2.0 Pressure Gauges

Pressure gauges shall be of scale range as required, for service condition, graduated in both Psi and Kg/cm². On open circuit pump suction line and wherever necessary install compound gauges.

a) **Case:** shall be of cast aluminium, black finished. Ring shall be close type, chrome plated. Window shall be clear acrylic. Dial shall be white with jet black embossed figures and graduations. Pointer shall be micrometer type, black finished and red tipped. Movement shall be stainless steel, rotary type. Bourdon tube shall be phosphor bronze. Socket shall be forged brass. Accuracy shall be 1% of the scale range. Connection shall be 6mm NPT. Dial size shall be Ø 4.5 inches.

b) **Installation:** Pressure gauges shall be installed where shown on drawings. These shall be installed with ball valves to serve as gauge cocks. For pressure gauges installed on steam line, a coil siphon shall be installed. Gauges shall be screwed in so that no leakage exists, and shall be installed in a neat and workmanlike manner and the dials aligned for convenient reading.

2.1 Magnahelic Gauges:

a) **General:** Magnahelic differential pressure gauge shall be of scale range as required for the application.

b) **Construction:** Housing shall be of die cast aluminium. Test case and aluminium parts irradiate dipped to withstand 168 hours (minimum) salt spray test. Exterior finish shall be baked dry grey hammerloid. Pointer shall be red tipped of heat treatedaluminium. Diaphragm shall be silicon rubber diaphragm with integrally moulded “O” ring shall be supported by front and rear plates. It shall be locked and sealed in a position with a sealing plate and retaining ring. Diaphragm motion shall be restricted to prevent damage due to over pressure. Accuracy shall be ± 2% of full scale connection shall be 3mm NPT, dial size shall be minimum Ø 100mm.

c) **Installation:** Magnehalic gauges shall be flush or surface mounted with standard hardware supplied and shall be installed as follows:

i) At Filters: Each bank of high efficiency filter and HEPA filter shall be provided with an appropriate station to determine pressure drop, consisting of magnahelic gauge, probes, flexible tubes and mounting arrangement.

ii) At Positive or Negative Pressurised Areas: At the outside of each positive or negative pressure areas, install a magnahelic gauge to read room pressure with respect to adjoining space pressure. For this purpose probes shall be installed in the room and in the adjoining corridor/space, and connected with flexible tubing to the magnahelic gauge.

iii) As shown on drawings or as required.

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DIVISION - 23 05 23

GENERAL DUTY VALVES

1. Butterfly Valves:

Butterfly valves shall be used in applications requiring 50mm or larger diameter valves, and shall have a rating suitable for the service intended, but a minimum of 10 bars. Butterfly valves shall be wafer type with modular cast iron body, suitable for mounting between ANSI 150 lb flanges. Two flanges plus required nuts and bolts shall be provided with the valves.

The center disc shall be of stainless steel, with extended shaft for accommodating insulation depth.

The liner shall be replaceable, of Nitrile or EPDM rubber. Each valve shall be provided with one replaceable liner as spare.

Actuator shall be worm gear type of aluminium or cast iron, weather proof to IP65, complete with hand wheel, position indicator, and with adjustable stops at both fully open and fully closed positions. The actuator shall be self-locking, lubricated for life and free of maintenance.

2. Gate Valves:

a) Ø 50mm (2 inch) & Smaller: 125 psi (860 kPa) SWP, 250°F (120°C), threaded ends, bronze body, union bonnet, non-rising stem, wedge disc. Hand wheel nut, packing nut, gland, stuffing box, bonnet, bonnet ring, disc and body shall be of bronze. Hand wheel shall be of malleable iron. Packing shall be suitable for specified usage but shall not use asbestos. Stem shall be manganese bronze.

b) Ø 65mm (2 1/2 inch) & Larger: 125 psi (860 kPa) SWP, 250°F (120°C), cast iron body bronze mounted with flanged ends. These shall be of solid wedge disc type, with outside screw and yoke (rising stem). Body and bonnet shall be of cast iron. Wedge shall be of cast iron with bronze disc. Seat rings shall be bronze. Packing shall be suitable for specified usage but shall not use asbestos. Packing gland shall be cast iron.
Yoke shall be of cast iron and yoke nuts shall be of bronze. Hand wheel shall be of cast iron.

3. Globe Valves:

a) Ø 50mm (2 inch) & Smaller: 125 psi (860 kPa) SWP, 250°F (120°C), bronze, threaded ends. Body, bonnet, disc holder, stem lock nut, packing nut and disc lock nut shall be of bronze. Hand wheel shall be of malleable iron with stem of manganese bronze. Renewable composition disc shall be provided suitable for water & steam. Packing shall be suitable for specified usage, but shall not use asbestos.

b) Ø 65mm (2 1/2 inch) & Larger: 125 psi (860 kPa) SWP, 250°F (120°C), cast iron body, bronze mounted with bronze faced disc and yoke bonnet, and shall be flanged. Hand wheel, gland, bonnet and body shall be of cast iron. Stem shall be of manganese bronze. Packing shall be suitable for specified usage but shall not use asbestos. Stem lock nut, disc and seat ring shall be of bronze. Disc shall be renewable composition type.

4. Ball Valves:

a) Ø 50mm (2 inch) & Smaller: 125 (860 kPa) SWP, Screwed; two-piece cast bronze body, chrome plated brass ball, teflon ball and flange seals, rods silicon brass stem, teflon and Viton "O" ring stem seals, zinc plated carbon steel handle with vinyl grip and brass handle nut.

5. Swing Check Valves:

a) Ø 50mm (2 inch) & Smaller: 125 psi (860 kPa) SWP; 250°F (120°C), threaded ends. Cap, hinge pin, body, hinge, disc nut and disc shall be of bronze.

b) Ø 65mm (2 1/2 inch) & Larger: 125 psi (860 kPa) SWP; 250°F (120°C), cast iron body, including valve cap and disc. Hinge pin, seat ring and disc ring shall be of bronze. Ends shall be flanged.

6. Y-Strainers:

a) Ø 50mm (2 inch) & Smaller:

125 psi (860 kPa) SWP; 250°F (120°C), "Y" type, with bronze body and threaded ends. Screen shall be of 20 mesh monel.

b) Ø 65mm (2 1/2 inch) & Larger: 125 psi (860 kPa) SWP; 250°F (120°C), cast iron body with flanged ends. Screen cover shall be provided with blow off taping. Screen shall be of perforated stainless steel, (33 holes per sq.cm.), with 1.1mm diameter and 0.41mm thickness.

7. Float Valve:

Shall be best quality heavy duty type provided with Ø 150mm copper ball and heavy duty bronze float arm.

Valve shall provide tight shut off at full closed position.

8. Foot Valve for Pump Suction Line:

Shall be installed where required or indicated on the drawing. Foot valve shall be of brass, and shall be provided with integral strainer. Foot valve shall be provided with a spring loaded vertical check disc with gasket for tight shut-off.

9. Gaskets:

General: non-asbestos, compressed gasket material with high-strength aramid fibres bonded with high grade nitrite NBR synthetic rubber, suitable for 750°F (400°C) and 1450 psi (10000 kPa).

10. Thread Lubricant:

General: non-hardening, non-poisonous as approved.

11. Dielectric Couplings:

General: provide sweat-to-screw dielectric couplings at junction of copper pipe to steel pipe and insulation bushings for flanged connections to steel or cast iron valves and fittings.

12. Installation of Valves and Strainers:

All gate valves, globe valves, check valves, control valves, butterfly valves, drain cocks, etc. necessary for satisfactory operation of the system shall be provided whether indicated or not. All valves having stem over 2m height shall be provided with galvanised chain operators. Valves in horizontal lines shall be installed with stem horizontal or above. Isolation gate valves shall be installed on each side of each piece of equipment as pumps, coils and other similar items; at the midpoint of all looped mains; and at any other points indicated or as required for draining, isolation or

sectionalising purposes. Each valve shall be identified with not less than 35mm round or square black over white laminated plastic tags secured to valve with a suitable brass chain. Tags shall be engraved to identify valve by number and valve function. Strainers shall be installed wherever necessary to protect equipment and control valve, where proper functioning would be affected by dirt on the seat or scoring of the seat. Strainers shall be arranged not to clog piping and allow easy disconnection for change. All strainers 50mm and above shall be provided with Ø 20mm ball valves for blow-off. Strainers shall allow removal of accumulated dirt and screen replacement without disconnecting main piping.

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DIVISION - 23 11 23

HORIZONTAL, END SUCTION Centrifugal Pump

1. Scope:

These specifications cover vertical split case end suction centrifugal pumps for hydronic applications. Pump curves certifying pump operation, BHP & NPSH curves shall be submitted to the Consultant for approval.

2. Service Condition:

Pumps shall be designed and constructed to operate satisfactorily in a typical hydronic application, and shall be the product of a manufacturer regularly engaged in the production and marketing of these pumps.

3. Operating Conditions:

The flow rate, pump head & other required data are indicated in the Equipment Selection Data and the pumps supplied shall conform to these requirements. The Contractor is required to ensure non-overloading selection of motor for parallel pumping operation.

NPSH required by the pump shall be stated & the NPSH as available checked by the Contractor for the specific application. The pump RPM shall be as specified in the Equipment Selection Data. Pump casing shall be designed to withstand the discharge pressure specified on the Schedule Sheet plus the static head on the system, plus 50% of the total head, but not less than 125 psi (8.5 bars).

1 **Pump Construction:**

2 **Details of pump construction shall be as follows: a) Casing** shall be vertical split with centreline discharge, foot-supported and made of cast iron. Casings shall be provided with tapped & plugged holes for priming, vent & drain.

b) **Casing Connections:** shall be ANSI B16.1, 125PSI (8.5 bars), ASA Standard flat face flanges.

c) **Casing Wearing Rings:** Easily replaceable casing wearing rings of suitable material for service shall be provided in front and rear of impeller.

d) **Casing Joint Gasket:** An O-ring shall be provided at the casing joint to prevent leakage.

e) **Impeller:** shall be the single section enclosed type of bronze. Impeller shall be statically and hydraulically balanced. Drilled holes shall be provided through the impeller hub to balance axial thrust loads and keep positive pressure on the stuffing box. Impeller shall be keyed & locked to the shaft with a hexagonal head impeller nut and shall be easily removable without the use of special tools.

Shaft: Pump shaft shall be high strength stainless steel sized to provide a minimum amount of deflection. Shaft shall be protected in the stuffing box area by a replaceable shaft sleeve.

f) **Seal:** Pumps shall be provided with gland packing seal or mechanical seal as indicated in the Equipment Selection Data.

g) **Bearing Frame:** shall be rigid, one piece cast iron construction. Frame shall be provided with catch basin reservoir with tapped drain hole to collect and pipe away stuffing box leakage.

h) **Bearings:** shall be ball type on both ends of the frame. Both bearings shall be locked in place and be sized to provide long life under thrust loads encountered. Both bearings shall be enclosed by replaceable box.

i) **Bearing Lubrication:** Ball bearings shall be grease lubricated with provisions for the addition & relief of grease.

j) **Deflector:** A replaceable shaft deflector of non corrosive material shall be provided to prevent the entrance of contaminants into the pump bearings at the inboard end of the bearing frame.

6. **Baseplate & Coupling**: **a) Baseplate:** shall be of heavy duty, fabricated steel or cast iron, sufficiently rigid to support the pump and the driving motor with tap hole to pipe away leakage and condensation.

b) **Coupling:** shall be spacer type.

c) **Coupling Guard:** shall be metallic and fastened to baseplate and conform to the requirements of ANSI B.15.1.

7. **Rotation:**

Pump shall have clockwise rotation viewed from its driven end.

8. **Motor:**

Motor shall be manufactured by Siemens Pakistan. It shall be selected in accordance with the pumps non-overloading performance characteristics. Motors shall be mounted with pump on base plate in manufacturer's plant and shipped as one unit.

9. **Foundation:**

Foundation for the pump shall be 1:2:4 concrete.. Edges of the foundation shall be provided with 25×25×3mm angle iron frame work and painted with two coats of oil paint. When shown on drawings, or with pumps mounted on upper floors, the pump's concrete foundation shall be supported on four suitably sized spring isolators.

10. **Installation:**

During installation, the pump shall be properly levelled, grouted in and realigned before operation in accordance with the manufacturer's recommendations. Suction & discharge connections shall be installed through flexible connectors, and electrical wiring shall be done. Drain lines from pump base plate at drip pocket shall be installed equal to the size of the opening.

11. **Commissioning and Testing:**

The pump shall be commissioned and tested by the Contractor, in accordance with the manufacturer's recommendations. The pump operational curve shall be identified by taking no-flow reading and shall be charted on the pump curve. Operational point at full flow shall be identified and submitted to the Consultant. Tests shall be conducted and test reports submitted to the Consultants and approval obtained.

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DIVISION - 23 20 10

1. Piping Insulation:

a) Insulation Installation:

No insulation shall be applied to any system of piping until all foreign matter has been removed from the surface to be insulated, and until the piping has been tested, cleaned out and made tight and painted. All insulation shall be applied in a manner consistent with good practice and methods. All longitudinal joints of pipe shall be top and bottom. Insulation shall be continuous through walls, floors, ceiling and partitions etc.

b) Insulation:

All cold & hot water piping shall be insulated as indicated under INSULATION SCHEDULE. Insulation shall be in preformed sections with tongue and groove attachment. All insulation shall be fixed to the pipe with approved adhesive. Insulation shall be continuous and gaps if any, shall be filled up. Circumferential and longitudinal joints of vapour barrier and jacket shall be over-lapped at least 50mm.

c) Vapour Barrier:

Shall be as specified under INSULATION SCHEDULE Vapour barrier shall be fixed to the insulation with approved adhesive covering at-least 75% area. All circumferential and longitudinal joints shall be over-lapped at least 40mm. Vapour barrier shall be completely continuous. All scratches, tears, etc., shall be made good by pasting fresh layers of the vapour barrier on the discontinuity.

d) Jacket:

Shall be as specified under INSULATION SCHEDULE. All circumferential and longitudinal joints shall be overlapped at least 40mm. The jacket shall be stretched tight over the insulation using adhesive which shall cover 100% area. Cut edges shall not be visible. All longitudinal joints shall be on top for horizontal piping and hidden from view for vertical piping. Circumferential joints shall be equally distant and equal to the width of the jacket roll. Patches shall not be permitted.

e) Vapour Barrier Coating:

shall be as specified under INSULATION SCHEDULE

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Cladding:

All chilled and hot water piping shall be provided with cladding as specified below.

2. Valves, Fittings & Other Specialties:

shall be insulated with preformed adjoining insulation, cut to suitable shapes and sections, to closely fit around valves and fittings. Insulation thickness shall not be less than the adjoining straight pipe insulation thickness. The adjoining insulation near these fittings shall be mitred and trimmed into suitable sections to fit closely around the valves, flanges and fittings. All trimmed sections shall be secured by wrapping of approved type of self-adhesive tape to form a complete vapor seal. There shall be a clear break between adjoining pipe insulation & valve/specialties insulation, so that when valve/specialities insulation is opened for maintenance the adjoining pre insulation is not affected.

3. Condensate Drains:

shall be insulated as specified under INSULATION SCHEDULE.).

4. Cladding:

All insulated pipes shall be provided with a cladding of 26 gauge 0.55mm G.I. sheet. At all flanges and valves the cladding shall be openable type. Valves shall be provided with valve boxes with quick opening clamps. Large valve boxes may be held together using "Jubilee Clamps".

5. Buried Steel Piping:

The bare steel piping, or the steel cladding of an insulated pipeline shall be externally painted with one coat of Asphalt primer 2000 (National Petro carbon Pvt. Ltd.) followed by two coats of Hykote Enamel (National Petro carbon) reinforced with one layer of galss fibre wrap. The primer and enamel shall be applied strictly in accordance with manufacturer's recommendations.

6. Adhesive:

shall be "MOWLITH" as manufactured by HOEST, Pakistan.

7. **Insulation Tapes:**

8. At all insulation joints use 75mm wide self-adhesive tape consisting of reinforced aluminum foil and white Kraft paper.

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DIVISION - 22 05 10

EXCAVATION & BACKFILLING

1. Excavation:

a) Excavate in such a manner that buried items can be laid to the alignment and depth indicated; excavate only so far in advance of pipe laying as approved.

b) Width of trenches shall be such that buried items can be laid to the alignment and depth indicated; excavate only so far in advance of pipe laying as approved. Width at the top of the trench shall not be more than 600mm plus outside diameter of pipe.

2. Back-filling:

a) For back-filling use builders sand, or excavated material, if of a sandy nature, but duly screened to remove all rocks & stones which are greater than ¾ inch (20mm) dia approximately.

b) In filling around pipe, deposit backfill material in successive horizontal layers not exceeding 150mm thickness before compaction. Compact each layer thoroughly by means of approved mechanical tampers. Take special care to obtain compaction under pipe haunches. Deposit backfill adjacent to pipes on both sides to approximately same elevation at the same time. Continue this method of filling and compacting until backfill is at least 450mm above top of pipe.

c) Backfilling for the remainder of pipe trenches to sub-grades of paved or landscaped areas: Perform by mechanical tamping and rolling equipment, except that use of such equipment is prohibited when said use may result in damage to pipe lines or structures.

d) Moisten backfill as necessary for proper compaction. Water setting of fill will not be permitted.

e) Complete backfilling of pipe trenches as soon as possible after the pipe is laid and tested.

f) Restore to original condition existing pavements, roadways, walkways, curbs and landscaped areas disturbed during the progress of the excavation and backfill work.

g) Compaction: Minimum of 90% of modified AASHTO maximum density as defined by ASTM D-1557.

h) Fill not compacted to the required density: re-compact until the specified density is achieved or remove the layer and replace with new material.

3. Payment:

No separate payment shall be made for excavation or back-filling, and the cost of all excavation & back-filling required to lay pipes or carryout any other works requiring excavation & back-filling, shall be considered to be part of the cost of that work.

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DIVISION - 22 05 11

DISINFECTION OF WATER DISTRIBUTION SYSTEM

1. PIPELINE DISINFECTION:

a) General:

The Contractor shall furnish all equipment, labour and material for the proper disinfection of the pipeline. Disinfection shall be accomplished by chlorination after the lines have been tested for leakage but before they have been connected to the main system. Disinfection of the pipelines shall be done in the presence of the Engineer's representative with equipment approved by him.

b) Chlorination:

A chlorine and water mixture shall be supplied by means of a solution feed chlorination device. The chlorine solution shall be applied at one end of the pipeline through a trap, in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be at-least (25 ppm) or enough to meet the requirements given hereinafter.

c) Retention Period:

Chlorinated water shall be retained in the pipeline for a period of at least 24 hours. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at such other representative points shall be at least 10 parts per million. The procedure shall be repeated until the required residual chlorine concentration is obtained.

d) Chlorination of Valve:

During the process of chlorination of the pipelines, all valves or other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

e) Final Flushing:

Following complete disinfection of the pipeline, all treated water shall be thoroughly flushed from the pipeline at its extremities. Treated water and water

used for flushing the pipelines shall be disposed of in a manner instructed by the Engineer. Fresh treated water shall be filled in the line and water tested for presence of coliform. The test result should indicate negative coliform presence. If the test indicates any positive coliform, the entire process of disinfection shall be repeated or improved upon until coliform free samples are obtained.

f) Sampling and Testing:

Disinfection of the pipeline and appurtenances shall be the responsibility of the Contractor. The first set of samples will be collected for analysis by the Engineer. Should the sample reveal presence of coliform the Contractor shall again disinfect the pipeline and appurtenance and shall pay the Employer for sampling and testing for subsequent retest until coliform free samples are obtained.

g) Clean-Up:

Upon completion of the installation of the water supply lines, distribution system and appurtenances, all debris and surplus materials resulting from the work will be removed and disposed off in a manner satisfactory to the Engineer.

h) Measurement and Payment:

Payment of this work will be made at the lump sum cost quoted in the BOQ, after satisfactory completion of this work as certified by the Consultant.

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DIVISION - 22 05 53

IDENTIFICATION FOR PIPING & EQUIPMENT

1. General:

The contractor shall install mechanical identification tags, shield, plates, etc., where specified below, shown on drawings, or directed by the Consultants. All components of the identification system shall be submitted to the Consultants for approval & approval obtained prior to installation.

2. Equipment Name Plates:

All equipment shall be provided with metal nameplate with operational data engraved or stamped; permanently fastened to equipment at an accessible & visible location. Nameplate shall have name of manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data.

a) Material shall be Fiberboard / Brass / Stainless steel / Laminated Plastic.

b) Stencil paint shall be black enamel, except as otherwise indicated.

c) Manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1 shall also be accepted.

3. Equipment Data Plates:

All equipment shall be provided with Equipment Data Plate to be permanently fastened at a suitable accessible and visible location of the equipment. Data plates shall be of min. 3mm thick laminated plastic of suitable size (min. 150mm x 100mm) fastened securely to the equipment. The plates shall generally display the following data: **i)** Equipment identification symbol/number.

ii) Fluid flow rates.

iii) Pressure, pressure drops.

iv) Capacity.

v) Motor data.

vi) Any other matter required by the Consultants.

4. Stencilling on Piping:

The Contractor shall attach a stencil near each valve on the pipe, indicating the name of the fluid. Also, an arrow should be painted next to the legend indicating the direction of flow in pipe. The legend shall be placed in a location so that it can be easily read from the floor. The legend shall conform in size of letters and colour to ASA A-13.1 of 1975, "Scheme for the Identification of Piping System", but shall not be less than32mm letters for duct work, and not less than 19mm letters for access door sign & similar operational instructions.

5. Identification Tags on Valves

Identification Tags shall be installed on all valves, controls and other parts of the system where necessary. Tags shall be either of engraved laminated plastic or brass as directed by consultant, 3mm thick (black in front and white behind) 1.6 inches (40mm) round or square with letters or numbers 0.5 inches (12mm) high and fastened securely with brass "S" hooks or chains.

The Contractor shall further provide charts, diagrams, of size and type as approved designating numbers, service or function and location of each tagged item.

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DIVISION - 22 05 73

DRAINAGE & WATER SUPPLY SPECIALITIES

1. **Trapped Floor Gully:**

   Shall be of uPVC similar to Terrain model 279/281 with inlet model 282/283. The drain shall be provided with a trap having a minimum water seal of 50mm. The drain grating and all visible parts shall be of CP brass with level adjusting arrangement.

2. **Vent Cowls:**

   All vent-lines terminating above the building shall be provided with best quality uPVC vent cowls similar to Terrain model 150.

3. **Clean-out for Finished Floor Areas:**

   Shall be similar to ZURN Model No. Z 1323. These shall be of cast iron, designed to provide an air tight seal. The clean-out shall be provided with a threaded brass plug that shall fit into the hub and provide an airtight seal. A key to unscrew the plug shall be provided. A brass ferrule shall be provided, that shall screw into the hub with the capacity of level adjustment. The ferrule shall be provided with a round scoriated brass top and a long brass screw threaded into the plug below, shall hold down the top cover. All visible parts shall be chrome plated.

4. **Roof Drain: (Cast iron)**

   Shall be similar to Zurn Model Z 100, cast-iron body with combination membrane flashing clamp/gravel guard and low silhouette dome.

5. **Roof Drain (PVC)**

   These shall be similar to the cast-iron roof drain specified above, except manufactured in uPVC. It shall have a membrane flashing arrangement and gravel guard with a low silhouette dome.

6. **Drain Gratings: (Mild Steel)**

   Drain gratings shall be installed on open channel drains where shown on the drawings. These shall be fabricated out of mild steel formed members & hot dipped galvanised after fabrication, in accordance with details shown on the drawings. Edge support angle iron member shall be grouted into the concrete edge of the channel, and the drain

gratings laid loose on top. Grating length shall not exceed 4ft, & each grating shall fit level & smoothly on the support member.

7. **Manhole:**

Manhole chambers shall conform to BS 556: Part 2 (Concrete Manholes for Drainage purposes), Top and bottom of manholes shall be constructed of 150mm thick 1:2:4 RCC with nominal reinforcement or as shown on drawings. The depth of the manhole shall be upto the invert level shown on the drawings. The civil construction shall conform to the specs of the Civil Works. The internal surface of the manhole shall be provided with 15mm thick Pudlo plaster.

Manhole shall be provided with cast iron frames and covers as shown on the drawings & specified below. The invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the adjacent sewer section. Inverts shall be formed directly in the concrete of the manhole base. Steep slopes outside the invert channels shall be avoided. Changes in size and grade shall be made gradually and evenly. Changes in direction of the sewer and entering branches shall have true curves of a radius as large as the size of the manhole will permit. Manhole shall be provided with built-in steps of Galvanized iron. The rungs shall be not less than 250mm in width and spaced at intervals of approximately 300mm and alternative rungs shall be staggered or off-set 150mm. Bars or rods for steps shall not be less than 20mm in diameter.

The manhole frame shall be carefully embedded in the top slab of the manhole as neatly as possible.

Types of manholes shall be as follows:

Type 'A' Manholes – for use in Residential applications, with 600mm x 600mm clear opening inside manhole, constructed of 200mm thick block or 225mm brick masonry, & provided with cast-iron frame & cover conforming to grade C (BS 497) as given below.

Type 'B' Manholes – for use on commercial, industrial or institutional projects, for nontraffic areas up to a maximum depth of 2 meters. These shall be provided with walls

constructed of 200mm thick block or 225mm brick masonry with cast-iron frame & cover conforming to Grade B, Class 2 (BS 497) given below.

Type 'C' Manholes – for use on commercial, industrial or institutional projects, for traffic areas up to a maximum depth of 2 meters. These shall be provided with walls constructed of 150mm thick RCC, with cast-iron frame & cover conforming to Grade A & Grade B, Class 1 (BS 497) given below.

Type 'D' Manholes – for use on commercial, industrial or institutional projects, for traffic & non-traffic areas, depth from 2m to 6m. These shall be provided with walls constructed of 200mm thick RCC of with cast-iron frame & cover conforming to Grade B, Class 2 (BS 497) given below.

8. Intercepting Manhole:

Intercepting manhole shall conform to specification given above except that it shall be provided with an uPVC RCC intercepting trap of the same diameter as the main pipeline.

9. Storm Water Drainage Manhole:

These shall be constructed to conform to specifications given for Manhole at Clause 1, except that the manhole cover shall be replaced with double grating to allow the water to flow into the manhole. The grating shall be manufactured of cast iron and provided with 25mm square holes on 25mm centres in both directions.

10. Manhole Frame & Covers:

Manhole Frame & Covers shall be of watertight quality manufactured from good quality cast iron conforming to BS 497, & shall be of types as noted below:

Grade A	-	Manhole covers & frames capable of bearing wheel loads upto 11.5 tonnes for use in carriage ways
Grade B Class 1		Manhole covers & frames capable of bearing wheel loads upto 5.0 tonnes for use in carriage ways carrying relatively slow moving normal commercial vehicles.

GradeB - Sealed manhole covers and frames capable of bearing wheel loads
Class 2 upto5.0 tons for use in areas to which vehicles would have only occasional access.

Grade C - Sealed inspection covers and frames for use in situation in-accessible to motor vehicles.

11. Gully Trap:

Gully trap chamber shall be constructed of 100mm thick masonry walls with 15mm thick pudlo plaster. Bottom of gully trap shall be 100mm thick 1:2:4 RCC pad with nominal reinforcement. Trap shall be of cast iron/uPVC 100mm dia with 50mm water seal. Frames and cover shall be of cast iron of watertight quality. Size 300mm x 300mm, weight 10 kg.

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DIVISION - 22 05 11

PUMP CONTROLLER

1. Pump Controller:

The automatic pump control system shall be of the solid-state type, with low- voltage electrodes in the UG tanks, and an electronic controller.

The level sensors shall be adjustable for high and low water levels and shall be installed in weather-proof boxes (IP 54) above each tank, with electrodes installed in PVC pipe into the tanks or as shown on drawings.

The pump controller shall start pump at a adjustable low level, stop pump at an adjustable high level and provide alarm at an adjustable low-low level, and switch off the pump.

2. Level Indicator:

The liquid level indicators system shall be of the solid-state type, showing the levels in the UG tanks through LEDs, and have the provisions for low- and high-level alarm with a 90 dBA hooter and alarm cancel button Suitable low-voltage electrodes shall be mounted on each tank, and the indicator in the pump-room.

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DIVISION - 22 11 16

BUILDING WATER PIPING

1. Scope of Work:

The work includes in general the following:

a) Internal cold & hot water piping.

b) Internal Potable Water Piping.

c) Internal Fire Protection Piping.

d) All specials shown specified or needed.

e) Services & Connection to site piping.

f) Other items specified or shown on drawings.

2. Piping Material:

a) Galvanised Iron Pipes: G.I pipes shall conform to BS 1387 of 1957 (medium series); fittings shall be screwed of galvanised malleable iron.

b) Mild Steel Pipe conforming to BS 1387 (medium series), screwed upto 50mm (2 inch) & welded above ø 50mm (2 inch).

c) Mild Steel Pipe conforming to ASTM A53, Schedule 40, screwed upto 50mm (2 inch) & welded above Ø 50mm (2 inch).

d) Polyethylene Pipes: high-density, cross-linked, polyethylene piping, conforming to DIN 16892, DIN 16893 and DVGW Code of Practice W531.

Fittings & pipe shall be suitable to work on normal operating pressure of 10 bars and 79°C. Fittings shall be “Dezincification resistance brass” compression sleeves with copper content of approximately 62%, and shall be manufactured from profiled and dieforged parts.

All supports channels, hangers and fasteners shall be as per manufacturers recommendations. Special tools as recommended by the manufacturer shall be used for installation.

e) PVC Piping shall conform to ASTM D1785 or BS 3505 of 1968, Class 'E' upto Ø 25mm (1" inch) Class 'D' upto Ø 40mm (1 ½ inch), Class 'C' upto Ø 65mm (2 ½ inch) and Class 'B', for Ø 75mm (3 inch) & above. Jointing shall be solvent welded.
Fittings shall be injection moulded of high density & shall be imported.

f) Polypropylene Piping: Type III: PP-R (Polypropylene random copolymer) piping conforming to DIN 8077-8078, with a service life of 50 years @ 60°C & 10 bars operating pressure.

Joints shall be made by electrofusion welding upto dia 110mm, & butt welding above dia 110mm. Fittings shall conform to DIN 16962. Fittings with threaded metallic inserts shall be of dezincification resistance brass.

3. Installation of Piping, Valves and Fittings:

a) General: Pipes shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Shop drawings by Contractor shall show locations of all supports, typical details for special anchorages for suspended piping, valves, tank, pumps, converters, and other mechanical equipment. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided and detailed. Pipe shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints and hangers. Changes in direction shall be made with fittings, except that bending of pipe 4 inches (100mm) and smaller will be permitted provided a pipe bender is used and wide-sweep bends are formed. The center line radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening or other malformations will not be accepted. All piping shall be installed with sufficient pitch to ensure adequate

drainage and venting. Piping connections to equipment shall be provided with unions or flanges. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

b) Screwed joints shall be used on metallic pipes of diameter 50mm and below. Screwed joints shall be made with tapered threads properly cut. Joints shall be made tight with polytetrafluoroethylene (Teflon) Tape or other approved thread joint compound applied to the male thread only. Not more than three threads shall show after the joint is made up. For galvanized pipe threaded flanges shall be used for 100mm dia pipe and above.

c) Flanges and Unions shall be faced true. Flanges shall be provided with 1.6mm asbestos-free gasket, and made square and tight. Except where copper tubing is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment such as coils, pumps, control valves & other similar items.

d) The run and arrangement of all pipes shall be approximately as shown on the drawings and as directed during installation and shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and shall be neatly spaced. Offsets will be permitted only where required to permit the pipes to follow wall, standard fittings shall be used for offsets. All risers shall be erected plumb and true, and shall be parallel with walls and other pipes and shall be neatly spaced. This Contractor shall at all times work in connection with other contractors in order to avoid interference of pipes and unnecessary cutting of floors and walls. All pipes running underground or concealed in floors or wall construction shall be installed before the construction is closed up.

e) All horizontal runs of piping, except where concealed in partitions, shall be kept as high up as possible and close to walls. Consult with other trades so that grouped lines will not interfere with each other. Where plans call for offsets, same shall be kept close to underside of beams and slabs, and run along side of beams, girders of partition.

f) The arrangement, positions and connections of pipes, fixtures, drains, valves, etc., as shown on the drawings shall be taken as a close approximation and while they shall be followed as closely as possible the right is reserved by the Engineer to change the location etc., to accommodate any conditions which may arise during the progress of work prior to installation without additional compensation to this Contractor for such change. The responsibility for accurately laying out the work and coordinating his installation with other contractors rests with this Contractor. Should it be found that any of his work is laid out so that interference will occur, he shall so report that to the Engineer.

g) All of the pipes shall be concealed in walls, slabs unless otherwise shown on drawings or directed by the Engineer.

h) Special precaution shall be taken in the installation of piping concealed underground or in the building construction, to see that the piping is properly installed. Should it be necessary to correct piping so installed, this Contractor shall be held liable for any injury caused to other work in the correction of his piping.

i) Fixture connections, shown to be installed concealed in building construction, shall in general, be carried concealed to points above floor (near fixtures) where they shall break-out and rise exposed to fixtures, all as required or approved.

j) Reducing fittings, unless otherwise approved in special cases, shall be used in making reduction in size of pipe. Bushings will not be allowed unless specifically approved.

k) Where chrome plated piping is installed, this Contractor shall cut and thread his pipe so that no unplated pipe threads are visible when the work is complete.

l) Friction type wrenches and vices shall be used on all copper tubing and brass piping. Any pipe showing tools marks will be ordered to be removed and replaced with new materials, without additional cost.

m) Unions and flanges shall be provided at suitable intervals to enable easy assembly and disassembly of the pipes. All piping installation shall allow means of easy disassembly for cleaning and maintenance.

4. Installation of Non-Metallic Piping:

a) The complete installation of the non-metallic piping system shall be in accordance with the recommendations of the manufacturer.

b) All accessories, compression fitting, tees, elbows, supports, etc. shall be original manufacturer's products.

c) The Contractors shall ensure that all plumbers are trained by the manufacturer or there local agent and that only manufacturer's recommended tools are used. The Contractor shall establish a close co-ordination with the manufacturer/ local agent to ensure all work to comply with manufacturer's recommendations and Consultants approval.

5. Cutting and Patching:

Cutting will be done under specifications of other trades. This Contractor is called upon to set sleeves for pipes accurately before the concrete slabs or beams are poured or masonry wall put-up, or may set boxes on the forms so as to leave openings in the floors in which the required sleeves can be subsequently located, in which case he is called upon to fill-in the concrete voids around the sleeves.

All patching will be done under specifications of other trades. Should this Contractor neglect to perform his preliminary work and should cutting be required in order to install his piping or requirement, then the expense of the cutting and restoring of surfaces to their original condition shall be borne by this Contractor. This contractor shall also make all chases for installing piping, etc., and must also make good the chases.

6. Protective Painting & Coating:

Protective Painting & Coating shall be carried out on pipes as specified in clause "Painting, Coating & Stencilling" Clause 15020.

7. Testing:

a) Hydraulic testing to following pressures shall be carried out on the complete piping

For Cold water, Hot Water, Potable Water and Fire Protection piping-minimum 100Psi or 1.5 times maximum operating pressure, whichever is maximum.

No loss of pressure shall be indicated for 2 hours. Tests shall be conducted in the presence of the Engineer/Engineers Representative, and the Contractor shall submit test certificates to the Engineer or Engineers Representative & obtain certification that the tested piping system have passed the prescribed tests.

b) Defects disclosed by the tests shall be repaired or if required by the Engineer, defective work shall be replaced with new work without any extra charge to the Employer. Test shall be repeated as directed, until all work is proven satisfactory.

c) This Contractor shall furnish & pay for all devices, materials, supplies, labor and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer/Engineers Representative.

d) This Contractor shall also be responsible for the work of other trades that may be damaged or disturbed by the tests, or the repair or replacement of his own work, and he shall without extra charge to the Employer, restore to its original condition, work of the trades so damaged and disturbed, engaging the original Contractors to do the work of restoration.

8. Payments

All payment for metallic & non-metallic pipes shall be made per running foot/meter of the installed length of the pipes, which shall include all fittings such as elbows, wyes, tees, collars, junction boxes, etc., including supports, excavation and back filling, concrete bedding, testing and any other work required for the Piping, and the rates per foot/meter submitted by the Contractor for this item of the Bill of Quantities shall be deemed to include all such ancillary requirements.

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DIVISION - 22 13 17

BUILDING SANITARY WASTE, VENT & STORM WATER PIPING

1. Scope of Work:

The work includes in general the following:

a) Internal Soil, Wastewater, Vent Piping.

b) Internal Rainwater Drainage Piping.

c) Sub Soil Drainage Piping.

d) All specials shown, specified or needed.

e) Services and connection to site piping.

f) Other items specified or shown on drawings.

2. Piping Material:

a) Cast Iron Pipes shall be manufactured by the centrifugal spun casting process and shall conform to standard DIN 1172 or BSS 416. heavy duty, of the bell and spigot type. Each pipe & fitting shall be class 20 psig and tested at the manufacturer's works at 20 Psig and shall show no leakage, sweating or other defects. Pipes shall be coated by immersion in a bath containing a uniformly heated composition of bitumastic base. Pipes supplied shall be accompanied by a test certificate and each pipe shall be so stamped.

b) Non-metallic Drainage Piping:

i) Polypropylene pipes to DIN 19560, with synthetic rubber seal rings to DIN 4060 (Part 1). All fittings shall be injection moulded push-fit type.

ii) uPVC Pipes to BS 4514, with synthetic rubber seal rings to BS 2494. All fittings shall be injection moulded push-fit type.

3. Subsoil Drainage Pipe:

Subsoil drainage pipe shall be uPVC, coiled, perforated corrugated pipes. Fittings and pipe shall be from single source of manufacture. Pipe shall be manufactured in conformity with DIN 1187.

Diameter of perforation shall be 0.1" to 0.15" and density of holes shall be 40% of total pipe surface area.

4. Piping Materials Application:

For piping application refer PIPING SCHEDULE under EQUIPMENT & MATERIAL SCHEDULE, Section 2.

5. Installation:

a) Each pipe shall be examined on arrival; defective pipes shall not be used. Drain shall be laid in straight lines and to even gradients between the levels shown, with pipes and fittings, of the type and diameter as shown on the drawings. Great care shall be exercised in setting out and determining the levels of the pipes and the Contractor shall provide suitable instruments, set up and maintain sight rails, and bench marks etc., necessary for the purpose. Cut pipe shall have smooth regular ends at right angles to length of pipe. All pipes to be cut with an approved cutter. All drains shall be kept free from earth, debris, superfluous cement and other obstructions during laying and until the completion of the Contract when they shall be handed over in a clean condition. Pipes shall be laid with the sockets leading upstream. No pipes shall be laid on their collar or on blocks, tiles or other temporary supports.

b) Drainage line shall be accurately laid and shall be perfectly true to line and gradient from point to point in both vertical and horizontal planes.

c) Easily accessible clean-outs, flush with the floor finish should be provided at each bend and bottom of stacks and at all points shown on drawings. The clean-outs should be made of "WYE" of full size; the minimum size shall be Ø 75mm.

d) Special fittings required in the installation not generally cast by manufacturers shall be got specially cast by Contractor matching with the shell thickness specified.

e) Branch connection shall be made with "WYE" and long "TEE-WYE" fittings. Short bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only. All fittings shall conform to code requirements.

f) Joints between cast iron to cast iron soil pipe shall be push fit joints. The joints shall be made tight and smoothly faced. Lead used in joints in cast iron piping shall be pure and soft and of best quality and shall be sufficiently heated to run joint full at one pouring without hardening. Dross shall not be allowed to accumulate in the melting pot.

g) All soil and waste lines hung from the ceiling shall be supported at not more than 1.5m centers for horizontal pipe and 2m for vertical pipes. Provide supports at all special fittings.

6. Testing and Inspection:

a) The entire drainage and vent system shall be subjected to testing after installation to ensure a leak-proof installation under operating conditions.

All the openings in the piping system shall be tightly closed by inserting test plugs of heavy rubber gasket that fit snugly all around the opening. The highest point will be left open to supply water and may be raised if necessary by temporary jointing to develop a minimum head of five (5) meters of water at each section of the system. Water is filled to the point of overflow and any drop in the level of water will indicate a leak that will be found by inspection. The water level will be checked for no drop for at least 15 to 30 minutes. No section will be tested at a pressure more than 6m of water. High stacks will be tested in sections, starting from the top section and then connecting top section to next lower section.

b) A final test of the completed drainage and vent system will be conducted by smoke to ensure that connection for water closets are absolutely gas and water tight and that fixture traps are sound.

All the traps will be filled with water and a thick smoke produced by burning oil, waste, tar paper or similar material in the combustion chamber of a smoke test machine, will be introduced into the entire system. When smoke appears at highest point it will be closed and pressure equivalent to 25mm of water column will be built and maintained.

The drainage pipe and building sewer will also be inspected for slopes which must conform to the slopes specified. The slopes will be checked with precision angle measuring instrument like universal protector, plumb and level. Any portion found not laid according to the given slope will be rectified at the Contractor's expenses.

c) This Contractor shall furnish & pay for all devices, materials, supplies, labour and power required in connection with all tests. All tests shall be made in the presence of and to the satisfaction of the Engineer.

d) This Contractor shall also be responsible for the work of other trades that may be damaged or disturbed by the tests, or the repair or replacement of his work and he shall, without extra charge to the Employer, restore to its original condition, work of the trades so damaged and disturbed, engaging the original contractors to do the work of restoration.

e) Defects disclosed by the tests shall be repaired, or if required by the Engineer, defective work shall be replaced with new work without extra charge to the Employer. Test shall be repeated as directed, until all work is proven satisfactory.

f) This Contractor shall notify the Engineer, Consultant and others having jurisdiction at least ten days in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.

g) The Contractor shall submit test certificates to the Engineer or Engineers representative & obtain his certification that the tested piping system have passed the prescribed tests.

7. Payments

All payment for metallic & non metallic pipes shall be made per running foot/meter of the installed length of the pipes, which shall include all fittings such as elbows, wyes, tees, collars, junction boxes, etc., including supports, excavation and back filling, concrete bedding, testing and any other work required for the Piping, and the rates per foot/meter submitted by the Contractor for this item of the Bill of Quantities shall be deemed to include all such ancillary requirements.

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DIVISION - 22 40 00

PLUMBING FIXTURES & FITTINGS

1. General:

All fixtures shall be free from imperfections, true as to line, angles, curves and colors, smooth, water tight and complete in every respect.

All fixtures specified to be of vitreous ware, shall be fired vitreous china ware of the best quality, non-absorbent and burned so that the whole mass is thoroughly fused and vitrified producing a material white or colored, which when manufactured will show a homogeneous mass, close grained and free from pores. The glazing and vitreous china fixtures shall be of a color approved by the Consultant, thoroughly fused, and united to the body, without discoloration, chips, or flaws and shall be free from craze. Warped or other imperfect fixtures will not be accepted.

All plumbing fixtures supplied shall be as specified & from source indicated.

All fixtures shall be furnished from one manufacturer unless otherwise specified.

All fittings, cast brass set screws, escutcheons faucets, traps, exposed piping, etc., shall be of brass, chrome plated over nickel plate with polished finished. Any supports nuts etc., visible shall likewise be chrome plate over nickel plate.

After installation of plumbing accessories, the Contractor shall ensure their protection against damage, misuse and general deterioration. Fixture outlets shall be plugged with suitable material to prevent entry of external debris. All chrome plated and other metallic fittings shall be provided with a coat of grease to prevent their deterioration. All items prior to handing over must be in perfect condition in the visual and operational sense.

All fixtures and accessories shall be first quality, imported, unless otherwise indicated.

All cracks between fixtures and walls shall be filled using approved silicone sealant.

2. Installation:

a) All screws, bolts and other anchoring devices shall be of stainless steel or chrome plated brass.

b) Install toilet fixtures, fittings and accessory units in accordance with manufacturer's instructions, using fasteners, which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored with brass screws and nylon anchors at locations and at heights indicated in drawings.

c) Set accessories plumb, level, and square at locations approved, in accordance with manufacturers instruction for type of substrata involved.

d) Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

e) Remove and replace accessories which are broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

f) Clean and polish all exposed surfaces after removing temporary labels and protective coatings.

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DIVISION - 21 11 16

EXTERNAL FIRE HYDRANT & STAND PIPES

1. Scope of Work:

The work under this section of the specifications consists of providing all material and labour for proper installation of fire water pipes and pipe fittings, including excavation & backfilling, jointing, laying, clamping, cleaning, painting etc., both above ground and underground and embedded in walls as shown on the drawings, as specified herein, or as directed by the Consultant.

The work includes, in general, the following:

a) Fire Protection Piping.

b) Fire Standpipes.

c) All valves, strainers, etc., shown, specified or needed.

d) Services and connections to Fire Fighting Equipment.

e) Other items as may be specified or shown on the drawings.

2. Dry Barrel –Pillar Hydrant – Double Headed:

Fire Stand Pipes shall be of Pillar Hydrant type, of size dia 150mm, tested to 250 psi. The pillar Hydrant shall be constructed of steel, and shall consist of four section, i.e. Dry Port, Upper Barrel, Lower Barrel, and Inlet Connection. The Dry Port shall be O'Ring sealed. The Upper Barrel shall be bolted on top to the Dry Port and at the Bottom to the Lower Barrel. The Upper Barrel shall house the outlet consisting of two nos. Ø 65mm hydrant valves with instantaneous couplings. The Lower Barrel shall carry the main hydrant valve, which shall be constructed of cast-iron and shall have a conical shaped synthetic rubber moulded disc which shall seat on to a precision machined bronze seat. The main hydrant valve shall be compression type opening against the pressure and closing with it, and shall be actuated by a cast bronze nut which shall rotate the steel hydrant rod. Hydrant valve shall be provided with flanged inlet and tee-base. All nuts and bolts shall be zinc passivated and plated. Hydrant barrel shall be

painted inside and out with a primer, and finish painted on sections below ground level with black bituminous paint, while exposed surfaces shall have red high glass enamel.

3. <u>Double Delivery Standpipe:</u>

Shall be manufactured using Ø 6inch Schedule 40, Black steel pipe, fully welded, conforming to dimensions given in A+ Engineers detail drawing, approximately 36 inch high, and with the top end capped. The barrel will be provided at the top with two dia 2½ "hydrant valves, placed 180 apart, and each outlet shall be provided with an instantaneous coupling. The bottom of the standpipe shall be flanged. When installing the standpipe, the piping leading to the standpipe shall be provided with concrete foundation/thrust block as shown in detail drawing.

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DIVISION - 21 12 13

BUILDING HOSE REEL & HOSE RACK

1. **Fire Brigade Connection:**

Supply & install where shown on the drawings a 65mm× 65mm x 100mm Fire Department Connection, rated for use upto a maximum pressure of 175 psi. The inlet connections shall be ▯ 65mm with threads compatible for use with Pakistan Fire Brigade Standards, and the outlet connections shall be ▯100mm. The connection body, clapper, swivel, and swivel plug shall be cast from an aluminium magnesium alloy. Escutcheon plate shall also be provided. Connections shall be straight, red painted, with standpipe identification.

2. **Fire Hose Reel:**

The Contractor shall supply and install recessed, swinging arm type, Fire Hose Reels, where indicated on the drawing. The Hose Reels shall conform to BS 5274:1985 and shall consist of:

a) **Hose Reel Lock Shield Valve**: manufactured from materials resistant to de-zincification, ▯25mm, threaded.

b) **Side Disks:** 18SWG, galvanised steel sheets, powder coated, post office red color.

c) **Hose:** Red rubber smooth, covered to BS3169 Type 1, Class B; ▯25mm and 30.5m long.

d) **Control Nozzle:** Nylon lever operated jet/spray

3. **Fire Hose Reel Cabinet:**

Provide and install Fire Hose Reel Cabinet constructed from 16SWG galvanised sheet steel, powder coated to BS18 B25. Cabinet shall be minimum of size 850mm x 850mm and shall be minimum 350mm deep.

a) **Water Entry:** Top, bottom, back or side, 50 dia knockouts to suit pipework requirements.

b) **Architrave:** 20SWG stainless steel, brushed satin finish.

c) **Door:** 15mm MDF finished in pre-catalysed lacquer both sides and edges in BS06 C33.

d) **Concealed Hinges:** Concealed hinges, left or right as required.

e) **Name Panel/Finger Pull:** Recessed stainless steel, brushed satin finish. Caption “FIRE HOSE REEL” in red 45mm high. Universal logo showing fire hose reel shall also be provided.

f) **Instruction on reverse of panel:** “IN CASE OF FIRE PULL HOSE FROM REEL AND WATER WILL TURN ON AUTOMATICALLY”.

4. Fire Hose Reel Cabinet Door:

Where steel cabinet is not felt necessary, only the Door will be installed over a recesses in the masonry construction for the hose reel, and / or extinguishers, as shown in the detail drawings.

Separate doors, one on top of another shall be provided & installed. The top door shall be for the hose reel, while the bottom door shall be to house fire extinguishers, as shown in the detail drawings.

Doors shall conform to specifications given at Clause 3 above for Hose Reel Cabinet.

5. Fire Hose Rack:

The Contractor shall supply and install fire-hose rack with hose of diameter 40mm with instantaneous coupling terminated with light alloy jet / spray nozzle.

Hose shall attaché to Ø 65mm fire hydrant valve (angle valve). Length of hose shall be 30 meter. Hose shall comply with British Standards BS-3169. Fire hose shall be rubber lined with nylon hose. Hose shall be as approved by the Consultant.

6. Hose Rack Cabinet

Provide and install fire hose rack cabinet constructed from 16SWG galvanised steel sheet, powder coated to fire red colour according to BS 18 B 25. Cabinet shall have a minimum size of 600mm wide x 800mm high x 150mm deep, and shall have a full glass door.

7. Orifice Plates:

Where the dynamic pressure at the inlet to Fire Hose Reel exceeds 2.75 bars (40 psi) an orifice plate shall be installed prior to the inlet of Fire Hose Reel. The orifice plate shall be fabricated of 6mm thick stainless steel (SS 304) and installed between steel flanges. Size of the bore shall be determined by the contractor. Shop drawing shall be submitted to the Consultant for approval prior to the fabrication.

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DIVISION – 21 23 16

PORTABLE FIRE EXTINGUISHING EQUIPMENT

1. Portable Fire Extinguishers:

a) General: Specific type Portable Fire Extinguishers shall be installed at locations shown on the drawings. All extinguishers shall be of suitable construction tested to at least 20 bars pressure and shall have suitable anti-corrosive protection and shall have powder coated red finish with non-damaging instruction label. Extinguishers shall be installed on purpose made hooks at a suitable height as approved by the Engineer. The extinguishers shall be provided complete with initial charge. In each case provide refill kits where available, suitable for one recharging. The extinguishers shall be of the following types.

b) Dry Chemical Powder Fire Extinguishers: Extinguisher shall conform to BS 3465 and shall contain Dry Chemical Powder in main body and carbon dioxide gas in external steel bottle, powder content as indicated in the BOQ.

c) Chemical Foam Fire Extinguishers: Conforming to BS 740

d) Carbon Dioxide Fire Extinguisher: complete with hose and horn, of capacity as indicated in the BOQ.

e) Trolley Chemical Foam Extinguisher: Provide steel tubular frame trolley with 2 rubber tyres of 16 inch diameter, mounted with Chemical Foam extinguisher having a capacity of 150 litres (34 gallons) Extinguisher main body shall be of 10 SWG M.S sheet, electrically welded and tested to 20 bars, and internally and externally powder coated. Cap and other parts shall be of gun-metal. Provide a minimum length of 20ft (6.0m) long high pressure hose, with open and shut-off control cock and discharge nozzle.

f) Trolley Mounted Dry Chemical Powder: Similar to Clause ‘e’ above, except Dry Chemical Powder Extinguishers having a capacity of 50kg.

g) Cabinet for Fire Extinguishers:

Where indicated on drawings, provide portable fire extinguishers in concrete recess, provided with red powder coated aluminium frame with hinged 5mm steel door. Size of the cabinet shall be adequate for size & quantity of fire extinguishers to be placed. Cabinet shall be minimum 400mm deep. Cabinet door shall be painted with the following caption "PORTABLE FIRE EXTINGUISHER, OPEN IN CASE OF FIRE". Universal logo showing portable fire extinguisher shall also be provided.

2. Fire Buckets:

Where shown on drawings provide Fire Bucket set each consisting of 8 Nos. provide 2 IGAL Galvanised Iron bucket, hung on ø 40mm G.I. pipe stand. The stand and buckets shall be painted with two coats of primer and two finish coat of red paint, and on each bucket the word "FIRE" shall be painted.

3. Fire Blanket:

Blanket shall be of size 900mm x 900mm minimum and shall be made of texturized woven glass Fibre. Blanket shall be provided in storage container of non-corrosive, rigid, self extinguishing white PVC.

4. Fire Fighting Accessories:

The Contractor shall supply the following fire fighting accessories and shall store them at a suitable location indicated by the Employer.

a) 2 Nos. Crow bar.

b) 2 Nos. Fire Beater.

c) 2 Nos. Fire Hook.

d) 2 Nos. Fire man's axe with rubberised handle.

e) 3 Nos. Gas Masks, haled face, Model 'TRILLIX-II' 'AVER' brand West Germany with gas filter and 2 spare filter elements for each mask.

f) 3 Pairs gloves, asbestos, heat resistant, size 400mm.

g) 3 Pairs gloves, rubber suitable for 11000 volts.

h) 3 Pairs Boot Cover, asbestos with rubber boots.

i) 3 Nos. Steel Helmets.

j) 4 Nos. - 30m long, Ø 65mm imported fire hose, rubber lined with nylon top, fitted with couplings.

k) 4 Nos. - Ø 65mm London gun metal nozzle with hand controlled branch pipe for jet/spray.

l) Glass fronted steel cabinet to house above accessories.

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DATA SHEETS

SPECIFICATION DATA SHEET FOR FANS				
S. No.	DESCRIPTION	UNIT SPECIFIED DATA		
1	FAN No.	-	E.A.F-01, 02, 03, 04, 05 & 06	E.A.F-06, 07, 08, 09, 10 & 11
2	Application area	-	Kitchen Exhaust	Wash Room
3	Type of Fan	-	Propeller Type	Cabinet Type
4	Quantity	No.	6	6
5	Altitude Above mean sea level	ft	13	13
6	Air Flow rate	CFM	100	1,500
7	External static pressure on Fan		1.2	1.2
8	Motor power	kW	As required	As required
9	Power supply (V/Ph/HZ)	-	400/3/50	400/3/50
10	Remarks		-	-

SPECIFICATION DATA SHEET FOR HVAC INSULATION, HOSTEL BUILDING						
S. No.	DESCRIPTION	MATERIAL SPECIFICATIONS	THICKNESS	THERMAL CONDUCTIVITY	DENSITY	Vapor Barrier/ Jacketing/ Cladding
			(Inch)	(BTU.in/hr ft²°F)	(lb./Ft.³)	
I / 1A	REFRIGERANT PIPING	CLOSED CELL FOAM INSULATION, FIRE RETARDANT ON DIA 1/2'' OR SMALLER PIPES	3/8''	0.26 @75°F	5-7	Insulation tape all around
I / 1B	REFRIGERANT PIPING	CLOSED CELLFOAM INSULATION, FIRE RETARDANT ON PIPES LARGER THAN DIA 1/2''	1/2''	0.26 @75°F	5-7	Insulation tape all around
I / 2	CONDENSATE DRAIN PIPING FROM AIR-CONDITIONERS	uPVC CLASS D(12 BAR), SOLVENT WELDED	3/8''	0.26 @75°F	5-7	Insulation tape all around

SPECIFICATION DATA SHEET FOR HVAC PIPING, HOSTEL BUILDING

S. No.	DESCRIPTION	TYPE OF MATERIAL	MATERIAL SPECIFICATIONS	STANDARDS	SPECIFIED MANUFACTURERS
P/1	REFRIGERANT PIPING	COPPER	SEAMLESS HARD DRAWN, TYPE L	ASTM B88	(1) MUELLER, USA (2) APPROVED EQUIVALLENT
P/2	CONDENSATE DRAIN PIPING FROM AIR-CONDITIONERS	uPVC	CLASS D(12 BAR), SOLVENT WELDED	ASTM D1785 BS 3505	(1) DADEX (2) HEPWORTH (3) VESBO (4) APPROVED EQUIVALLENT

SPECIFICATION DATA SHEET FOR SMALL SPLIT AIRCONDITIONERS, HOSTEL BUILDING

S. No.	Description	Unit	Specified data
1	**INDOOR UNIT**		
2	**Quantity**	Nos	12
3	**Evaporator Material**		Copper
4	**Refrigerant**	–	R-407c/R-134a or any other refrigerant with zero ozone depletion potential
5	**Application Area**	-	Lounges
6	**Total Capacity (Nominal)**	TR of each A/C	1.5
7	**Evaporator Fan Type**		Centrifugal Forward Curve
8	**Type of Indoor unit**	–	Wall Mounted
9			Split Unit
10	**OUTDOOR UNIT**		
11	**Compressor**		
12	**Type of compressor**		scroll
13	**Type of motor**		Hermetic/ Semi-hermetic
14	**Refrigerant**		R-407c/R-134a or any other refrigerant with zero ozone depletion potential
15	**Power Supply**	V/Ph/Hz	230/1/50
16	**Condenser Material**		Copper
17	**Condenser Fin material**		Aluminum
18	**Condenser Fins coating material**		special anti-corrosive golden coating

SPECIFICATION DATA SHEET FOR HOT WATER HEATER, HOSTEL

	Performance		
1	Quantity	Nos	As per requirement
2	Storage Capacity	Us gallons	542
3	Maximum Water Flow Rate	USGPM	-
4	Heating Capacity	Btu/hr	212,000
5	Natural gas consumption	ft3/h	240
7	Application	-	Toilets
	Construction		
8	Required height	ft	less than 5'-0''
	Required diameter	ft	as per selection
9	Remarks	-	

SPECIFICATION DATA SHEET FOR PIPE INSULATION-PLUMBING, HOSTEL						
S. No.	**DESCRIPTION**	**MATERIAL SPECIFICATIONS**	**THICKNESS**	**THERMAL CONDUCTIVITY**	**DENSITY**	**Vapor Barrier/ Jacketing/ Cladding**
			(Inch)	(BTU.in/hr ft²°F)	(lb./Ft.³)	
	HOT WATER PIPING					
a	Hot water PPR piping embedded in wall	Non-insulated				
b	Hot water PPR piping except embedded pipes in wall	Closed cell foam insulation, Fire retardant	3/8 inch	0.26 @75°F	5-7	Insulation tape all around.

SPECIFICATION DATA SHEET FOR PIPING-PLUMBING, HOSTEL				
S.	**Description**	**Type**	**Standards**	**Approved Manufacturers**
P/1	Building water supply in false ceiling cavity and covered areas	Polypropylene Random (PPR) , PN-20	DIN 8077 & 8078	(1) Dadex (Pakistan) Pipe With Dadex Fittings (2) Kelen (UK) Pipe with Kelen fittings (3) Vesbo (Turkey) Pipe with Vesbo fittings
P/2	Building water supply in areas exposed to sun	Galvanized Steel, Medium	BS 1387	IIL, APPROVED EQUIVALENT
P/3	Building Drainage (Soil & Waste)	UPVC Class B, Solvent Welded	ISO 3633/ EN 1329 and PS 3214	(1) Dadex (Pakistan) Pipe With Dadex Fittings (2) Hepworth (UK) Pipe with Hepworth fittings (3) Vesbo (Turkey) Pipe with Vesbo fittings
P/4	External Drainage (Soil & Waste)	Pressure pipe, UPVC Class B, Solvent Welded	ASTM D1785 BS 3505	(1) Dadex (Pakistan) Pipe With Dadex Fittings (2) Approved Equivallent
P/5	Fire protection Piping	Black Steel, Schedule40, Seamless	ASTM-A53 Grade-B	1) Huffaz, Pakistan 2) Lontrin, China

SPECIFICATION DATA SHEET FOR PUMPS, HOSTEL				
S. No.	**Description**	**Unit**	**Specified Data**	**Specified Data**
1	**Pump No.**	-	**P-01,02**	**P-03,04**
2	Application area	-	Hostel-B,Water supply to OHWT, One Standby	Hostel-CWater supply to OHWT, One Standby
3	**Type of Pump**	**-**	**End Suction, Horizontal, Centrifugal**	**End Suction, Horizontal, Centrifugal**

4	**Quantity**	**No.**	**2**	**2**
5	Flow Rate	USGPM	70	70
6	Total Head	ft of WC	60	60
7	Type of fluid to be handled	-	City Water	City Water
8	Pump Speed	RPM	1500/2900	1500/2900
9	NPSH Available	ft of WC		
10	Operating power	kW	As required	As required
11	Motorpower	kW	As required	As required
12	Design Pressure	Psig	100	100
13	Design Temperature	F	200	200
14	Casing Material	-	Cast Iron	Cast Iron
15	Impeller Material	-	Stainless Steel AISI 304	Stainless Steel AISI 304
16	Shaft Material	-	Stainless Steel AISI 304	Stainless Steel AISI 304

17	Base Plate Material	-	Cast Iron	Cast Iron
18	Seal type		Mechanical	
19	Coupling		Spacer	
20	Motor Type	-	TEFC, Copper winding	TEFC, Copper winding
21	Motor Insulation Class (VDE 0530)	-	F	F
22	Motor Voltage Variation	%	± 10	± 10
23	Power supply (V/Ph/HZ)	-	400/3/50	400/3/50
24	Remarks	-	One stand-by, at 50% increased head, pump performance should lie in the acceptable selection zone on pump curve	One stand-by, at 50% increased head, pump performance should lie in the acceptable selection zone on pump curve

SPECIFICATION DATA SHEET FOR FIRE PIPING

S. No.	DESCRIPTION	TYPE OF MATERIAL	MATERIAL SPECIFICATIONS	STANDARDS	SPECIFIED MANUFACTURERS
P/1	Fire protection Piping	Black Steel	Seamless, Schedule40	ASTM-A53 Grade-B	1) Huffaz, Pakistan 2) Lontrin, China

SPECIFICATION DATA SHEET FOR TOILET FIXTURES & FITTINGS, HOSTEL

Fixture No.	Item	Description	Specified model data
PF-01	WC – Western, Wall Mounted, Concealed Cistern Operated	Best quality, white/colored as approved, vitreous china wall mounted WC with matching coupled dual flush (3/6 liter) water saves model cistern, with special plastic seat & cover with stainless steel fixings, CP brass inlet pipe to cistern, stainless steel thimble, angle valve 15mm (Zilver).	Standard-CW 620 J Toto (Japan)
	Other fittings and accessories for PF-01	CP brass inlet pipe to cistern, stainless steel thimble, angle valve 15mm.	Zilver (Italy)

PF-02	WC Hand shower	CP Brass Bib-cock Outlet With PVC Hose & Shower With Trigger	Master (Pakistan), Sonex (Pakistan)
PF-03	Wash Basin Wall Mounted	Best quality, white/colored as approved, vitreous china wash basin	Avante LW-316 J, Toto (Japan)
	other fittings & accessories for PF-03	CI support arrangement, Ø 32mm PVC Bottletrap (Viega or sheffer), CP brass inlet pipe, two T-stop cocks (Zilver).	Zilver (Italy)
PF-04	Wash Basin Single lever Mixer	35mm Cartridge Brass body, Zinc Alloy Handle Nickle Plated/Chrome Plated (as approved by the Architect) Including 2 Hose	PL-B1222-Zilver (Italy)
PF-05	Bath Mixer and shower rose	35mm Cartridge Brass body, Zinc Alloy Handle Nickle Plated/ Chrome Plated (as approved by the Architect) Including 2 Hose, luxury open shower rod head shower	PL-B1238 and PL-8307-Zilver (Italy)
PF-06	Kitchen Sink	Best quality stainless steel sink as per user requirement	Toto (Japan) or Reginox
PF-07	Sink mixer	Best quality elbow operated goose neck type as per user requirement	Zilver (Italy)

PF-8	other fittings & accessories for PF-09	Ø 32mm PVC Bottle-trap (Viega or sheffer), CP brass inlet pipe, one T-stop cocks	Zilver (Italy)
PF-9	JANITOR BIB COCK	CP brass Ø 15mm with 150mm extended arm from wall	Zilver (Italy)
PF-10	BIB COCK	CP brass, Ø 15mm	Zilver (Italy)
PF-11	Wall Hung Urinal with integral trap and exposed flush valve	Best quality, white/colored as approved, wall hung vitreous china urinal, with integral trap,	Toto model UW-930 Jwith TX-501 U flush valve

SPECIFICATION DATA SHEET FOR FIRE PUMPS, HOSTEL B&C BUILDING			
S. No.	**Description**	**Unit**	**Specified Data**
1	**Pump No.**	-	**P-03**
2	Application area	-	Fire protection system water supply to Class II hose reels in Hostel B & C
3	**Type of Pump**	**-**	**End Suction, Horizontal, Centrifugal**
4	**Quantity**	**No.**	**1**

5	Flow Rate	USGPM	100
6	Total Head	PSI	125
7	Type of fluid to be handled	-	City Water
8	Pump Speed	RPM	1500/2900
9	NPSH Available	ft of WC	
10	Operating power	kW	As required
11	Motorpower	kW	As required
12	Design Pressure	Psig	250
13	Design Temperature	F	200
14	Casing Material	-	Cast Iron
15	Impeller Material	-	Bronze
16	Shaft Material	-	Stainless Steel AISI 304
17	Base Plate Material	-	Cast Iron
18	Seal type		Mechanical
19	Coupling		Spacer
20	Motor Type	-	TEFC, Copper winding
21	Motor Insulation Class (VDE 0530)	-	F
22	Motor Voltage Variation	%	± 10
23	Power supply (V/Ph/HZ)	-	400/3/50
24	Remarks	-	

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DIVISION - 26 05 11
GENERAL REQUIREMENTS:

1. GENERAL

All applicable provisions or drawings, General Requirement and General Specification and Bill of Quantities form part of the contract.

The item wise amount deems to have included all obligation set out in the contract.

It is understood and agreed that the Contractor, has by careful examination of the plans and Specifications, and the site where appropriate, satisfied himself as to the nature and location of the works, and all conditions that must be met in order to carry out the works under this section of the Contract.

2. DEFINITIONS

Where used in documents and drawings the following words shall be interpreted as listed.

2.1 "The Contract" shall cover all the works to be carried out under this trade.

2.2 "Equal", Equivalent", Acceptable" or "As Approved" applies to all material acceptable as thereinafter set forth in the text under the heading "Approval of the work".

2.3 "The Work" covers all works described or implied from Drawings, General Requirements, General Conditions, General Specifications and Bill of Quantities and the work described under the heading "Work include" described in DIVISION 26 05 11 of General Requirements.

2.4 "The Project Architect", "The Consultant", "The Engineer", "The Owner", "The Owner Representative", "Project Manager". The party or parties jointly or severally responsible for interpreting, accepting and otherwise running the performance under this contract.

2.5 "The Specifications". These Specification", All specified work under various contract documents including the documents described under "The Work".

2.6 "British Standards", British Standards (B.S) prepared by British Standards Institution London.

2.7 "Items", include all material, equipment fittings and fixtures, accessories etc. to complete the work in all respect under this contract and in accordance with the best engineering standards / practice.

2.8 All the work carried out in this contract / scope of work shall be governed by the latest I.E.E Regulations / B.S Standard / Local Electricity Rules. Among the various standards applicable, the most stringent shall be applicable.

3. NOTICE TO BIDDERS

3.1 Drawings, General Requirements, General Specification, and Bill of Quantities are to be considered as supplementing each other and as such as intended to serve jointly on the basis upon which the Contractor shall establish his bid.

3.2 It is the intent of this contract to call for finished work, tested, completed and ready for operation in all respect.

3.3 Drawings, Specifications, and Bill of Quantities do not include assurance as to their complete accuracy and validity, in all details and which may depend for proper execution, upon interpretation by Owner's Representative and other authorities, during the course of construction.

3.4 The contractor shall understand that:

3.5

3.6 In the event that a disagreement with regard to item between contract documents occurs, he shall provide items of greater quantity and better quality.

3.7 He shall provide any small items of work not specifically called for, but required to complete the intended installations.

3.8 He shall coordinate his work or adjust same so that conflicts in space do not occur with other trades involved at the project.

3.9 He shall coordinate his work or adjust the same to suit or any other existing conditions.

4. APPROVAL OF THE WORK

All workmanship and items supplied under this contract, shall be acceptable to the Owner's representative or Consultants, who have the power to reject any items which is in their judgment are not in full accordance with the plans and specifications.

5. GURANTEE AND CERTIFICATES

All work shall be guaranteed to be free from leaks or defects where required by the Owner's Representative the contractor shall give such guarantee in writing. Any defective material and workmanship shall be replaced or repaired by the Contractor as directed for in the duration of the maintenance period.

6. SAMPLES FOR APPROVALS

6.1 The contractor is required to submit on one or more wooden boards, one sample each of different sizes or capacities of conduits, conduit fittings, wires, junction boxes, switch boxes, switches, sockets, circuits breakers and distribution board, accessories and other items as required by the Consultants. No material of any kind be procured or installed without approval of such samples. All such samples will be returned to the Contractor at the end of the contract on satisfactory completion of the work.

6.2 Prior to procuring or installation work of any item, also furnish for the approval of consultants, relevant literature, catalogues, cuts, factory / assembly drawings showing circuitry arrangements, and other necessary requirements of all items to be furnished or installed under this contract.

6.3 Approval of any item tests shall not relieve the contractor from the responsibility of furnishing proper items.

7. INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

7.1 Except where modified by a specification notation to the contrary, it shall be understood that the indication and / or description of any item, in the drawings, Bill of Quantities, Specifications and / or General Requirement carried with it the instruction to furnish and install the item.

7.2 It shall be understood that the specifications drawings, and Bill of Quantities are complimentary and are to be taken together for a complete interpretation of the work. Exceptions are that notes on the drawings, which refer to an individual element of work, take precedence over the Specifications.

7.3 No exclusion form or limitations, in the language used in drawings or specifications shall be interpreted as meaning that the appurtenance or accessories to complete any required system or item are to be omitted.

7.4 The drawings or necessity utilized symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installation. The works shall be installed, in accordance with the diagrammatic intent expressed: on the drawings, and in conformity with the dimensions indicted on final architectural and structural working drawings and on equipment shop drawings / other trade drawings.

7.5 No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.

7.6 Certain details appear on the drawings which are specific with regards to the dimensioning and positioning of the work. These details are intended only for the purpose of established general feasibility. They do not obviate filed coordination for the indicated work.

7.7 The latest standards and codes of reputable institutes shall be applicable to all items and installation work. Wherever these specifications differ from contract specifications, the higher specifications shall prevail.

7.8 Submit the details and obtain prior approval for any deviation work from the Contract Drawings.

8. SHOP DRAWINGS

Contractor to prepare & submit Drawings / Sketches for coordination purpose of installation works.

- Contractor to submit three set of A1 size paper to get approval from client / consultant before executing any work.
- Shop drawings and redesign should be done even if changes on Architectural drawings are major and even if redesign of some parts of the areas is required.

9. RECORDS / AS INSTALLED DRAWINGS / AS-BUILT DRAWINGS

9.1 As Built / record drawings shall be initiated / prepared from the start of the work & be progressed towards completion.

9.2 Supply record drawings of reproducible types Sepias + 3 Prints along with electronic CD's at the completion of the work.

9.3 The drawings shall provide an accurate and complete records of the work as installed. Submit three copies of all records drawings.

9.4 Contractor to submit As-built drawing at least A2 size paper.

10. CLEANING & PROTECTING

10.1 Store all material and items in al manner that will maintain an orderly clean appearance and cover and protect them.

10.2 Protect the completed work from damage throughout the contract period.

10.3 After completion of the project, clean the exterior surface of equipment and fixtures including concrete residue.

11. OPERATING AND MAINTANCNE INSTRUCTIONS

Furnish three copies of manuals to the owner in bound form containing data covering capacities, manufacturer's instructions and maintenance of operation of all equipment and apparatus.

12. PAINTING

Deliver all equipment with standard factory finish or as clean all equipment before acceptable by the Owner.

13. EQUIPMENT AND MATERIAL

13.1 All items required for installation under these specifications shall be new without blemish or defect, where no specific indications as to the type or quality of items in indicated a first-class standard item shall be furnished in accordance with the latest applicable B.S Standards.

13.2 It is intent of these specifications that wherever a manufacturer of a product is specified, and the terms, "Other Approved", or "Approved Equivalent", or

"Equal", are used, the substituted items must conform in all respect to the specified items.

13.3 All items of one type (such as in panel boards) shall be the products of one manufacturer.

13.4 Substitution of electrical equipment for that shown on the schedules or designated by model number in the specification will not be considered if the item in not a regular item shown on the current catalogue of the manufacturer and has been successfully used for a period of not less the five (5) years.

14. TEST, ACCEPTANCE AND CERTIFICATES

14.1 All test necessary to show proper execution of work shall have been performed before final acceptance of work, Carry out these test in the presence of the Owner's and / or Consultants representative, Provide any assistance required in this regard including necessary arrangements of labour and measuring instruments.

14.2 It is the Contractor's responsibility to ensure that all components of the system including the controls are operating satisfactorily before any of the work shall be considered completed.

14.3 Test the installation for proper ground, continuity and installation. If test indicate in-adequate insulation resistance, corrections shall be made accordingly, any defects or deficiencies discovered in any of the electrical works shall be promptly corrected.

14.4 Earth resistance measurement must indicate acceptable values.

15. LIMITING NOISE PRODUCED BY ELECTRICAL INSTALLATION

15.1 Perform the necessary work shown below to assure that minimum noise is produced by any of the electrical equipment supplied and installed under this contract.

15.2 Check and tighten the fastenings of sheet metal plates, covers, doors and trims used in the enclosure of electrical equipment.

15.3 Remove and replace any individual device containing one or more magnetic flux path metallic cores (e.g. discharge lamp ballast, transformer, dimmer, etc.) which is found to have a noise output exceeding that of other identical installed at the project.

16. SYSTEMS DATA

16.1 Unless specifically mentioned elsewhere all equipment and items shall be designed to operate satisfactory without any derating for following tolerance levels.

- Voltage rating of H.T. Equipment – 11 KV.
- Voltage rating of L.T. Equipment
- Three phase: 400 Volts ± 10% at 50 Hz
- Single phase: 230 Volts ± 10% at 50 Hz

16.2 All equipment and items shall be suitable for smooth operation between temperature range 0 to 50o Celsius and at relative humidity up to 90 %.

17. IDENTIFICATION

17.1 Following items or material need identifications.

Identify Individually: -

i) Each primary and secondary switch board.

ii) Each panel board.

iii) Each primary and secondary distribution switch and circuit breaker regardless of whether separately mounted or grouped with others in a single housing.

iv) Each wire of or cable in each primary & secondary feeder.

17.2 The identifications of all above items shall be as explained under this section.

17.3 The nomenclature used to identify power centers, networks, units, switchboards panel-board shall confirm to the nomenclature used on the drawings.

17.4 The nomenclature used to identify switches or circuit breakers shall:

i) Where they disconnect mains or service, designate these services or main involved.

ii) Where they control feeders, designate the feeder number and the name of the space and the load supplied.

iii) Where they control lighting and appliance branch circuitry, designate the name of the space and the load supplied.

17.5 The nomenclature used to identify feeder wires and cables shall designate the feeder number. Identification for power centers, Switch boards and panel boards shall be by means of engraved lambdoid nameplates showing ¼" high white lettering on a black background fastened to the outside face of the front.

17.6 Identification for distribution switches or circuits breakers Panel / DB's by name of the following.

i) Where individually enclosed use engraved lambdoid nameplates showing 1/8" high white lettering on black background fastened on the outside front face of the enclosure.

ii) Where is power centers and switch, use directories mounted behind transparent plastic covers, in metal frames fastened on the inside face of the doors.

Identification for the wires and cables of feeders shall be by means of wrap around labels except that fiber or non-ferrous metal tags fastened with non ferrous metal wires shall be used for secondary feeders in manholes.

17.7 Phase identifications letters shall be stamped into the metal of the busbars of each phase of the main busses of each switch-board (distribution board) and panel board. The letters shall be visible without having to disassemble any current carrying or supporting elements.

17.8 Provide type written directories for panel boards.

17.9 All electric switch boards rooms, electric closets shall be equipped with enameled sheet metal “red on white sign” reading “Electrical Equipment Room – No Storage permitted”. Signs shall be mounted at clearly visible locations within the rooms.

17.10 Identify each junction box, pull box, and empty conduit system for wires of future system.

17.11 Prior to installation of identifying tags and name plates submit their nomenclature for acceptance by the Consultant.

17.12 Identify each power and ELV cable run into manhole and each conduit to be sealed with caulking material.

18. RULES REGULATIONS & CODES

The entire electrical installation works shall be carried out by licensed contractor authorized to undertake such work under the provisions of the Electricity Rules 1973 as adopted and modified to date by the Government of

Pakistan. Contractor must follow all local / international electrical codes as per requirement of different manufacturers.

Contractor shall maintain, at all times during construction, continuous availability of qualified Engineer for statuary inspection and approval from concerned authorities

19. WORK INCLUDED

The works shall broadly include but not be limited to the supply, installation, testing & commissioning of the following.

- Submission of magger test reports for L.V. works / cables & earth resistance tests sheet. The above are to be witnessed by Client / Consultants representative.
  (Note. Instrument must be calibrated from registered authorities).
- Testing & commissioning procedures Performa to be adopted / submitted shall be given in advance for approval.
- On completion of satisfactory testing / commissioning all reports / documents shall be submitted to the Client.

20. HEALTH AND SAFETY

Due precautions shall be taken by the Contractor, and at his own cost, to always ensure the safety of his staff and labor 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

21. FIRST AID AND FACILITIES

Contractor shall be responsible for the provision of adequate first aid facilities at the site for all personnel employed or retained by Contractor or by any of its subcontractors in the performance of the Work.

In the event any of Contractor's personnel or the personnel of a subcontractor requires the services of an ambulance, hospital or physician, Contractor or its subcontractor will promptly pay all charges therefore directly to the providers of such services.

22. ELECTRICAL INSPECTORS APPROVAL

The contractor shall be responsible for compliance with the rules and regulations enforced by the Pakistan Electricity Rules and Electrical Inspectors office. All formalities to commence work and approvals of Electrical Inspector shall be the responsibility of the contractor. All documented payments shall be made by the Owner.

DIVISION – 26 05 19

LOW VOLTAGE CABLES

1. GENERAL

1.1 Generally except for the voltage rating & insulation, the specs for H.T. Cables shall be complied.

1.2 Use type and size of cables as shown on drawing / mentioned in cable schedule.

1.3 Where single core sheathed cables are indicated on drawings, use 450 / 750 V grade cables.

1.4 For main and sub main use 600 / 1000 V PVC/PVC single core cables / stranded cables as indicated on drawings.

1.5 Use cables having high conductivity, soft annealed standard or solid conductors.

1.6 Take actual measurement and site condition into consideration prior to ordering any cables. Do not rely on drawing or BOQ for actual quantities of cables.

1.7 Prior to and after installation, ensure that the entire length of each cable is undamaged.

1.8 Where necessary, use cable accessories such as saddles, clamps, fixing channels, cables joints, clips, lugs, tape solder, identification tags, bushes, glands, etc. where shown on drawing use proper size of cable tray.

1.9 Identify each phase by color code: Red, Yellow, Blue for phases and black for neutral and green of yellow green for earth conductor.

1.10 For single Phase circuit, use red color for phase / line, black for neutral and green, yellow for earth conductor.

1.11 Tag each circuit with designation exactly as indicated on the drawings.

2. INSTALLATION

2.1 Carry out pulling of cables terminations and connection in a neat and clean manner.

2.2 All termination shall be mechanically and electrically sound.

2.3 Install cables in such as way that no appreciable mechanical strains are imposed on the terminals.

2.4 At every cable termination, do not remove the sheath and insulation farther than in necessary.

3. CABLES IN COUDUIT

3.1 where cables to be drawn in conduit use only single core, cables unless specifically indicated otherwise on drawings.

3.2 Pull cables in conduit with care. Where lubricant is necessary for puling cables, use lubricant recommended by cable manufacturer.

3.3 Do not make joints in cables. Cables connectors may be allowed only where looping in of cables is rendered very difficult. Use only suitable rated connectors.

3.4 Leave a minimum 150 mm of loose wire at each termination point.

3.5 Leave a minimum 300 mm of loose cable at each termination point.

4. CABLES RUN ON SURFACE

Where cables are to be run on cable tray, directly on walls or ceiling, get the method of installation approved prior to actual start of installation work.

DIVISION – 26 05 26

EARTHING SYSTEM

PART – 01

GENERAL

An Integrated grounding system shall be provided to establish a single point earthing system that achieves an acceptably low resistance to earth. Where practical, the new earthing system shall be inter-connected with the existing system.

PART – 02

PRODUCTS

EARTHING SYSTEM COMPONENTS

Earthing system shall comply with BS7430/IEEE Regulations and comprise of the following components. The overall resistance to ground shall not exceed 1 ohm as per requirement of Electrical Inspector.

Earth Electrode

- Shall be copper bonded steel having copper coating of 10 mils.
- 3 met long, 17.2 mm dia size rods are recommended.
- Shall be provided with earthing chamber for inspection of connection.
- Connection of conductor to earth rod shall be with exothermic connection.
- Ground resistance lowering material (GRM) shall be as recommended by earth rod manufacturer.

Earth Conductor

- Conductor shall be of electrolytic copper, bare or PVC insulated single core as shown on drawings.
- Where cable is used, it shall have insulation in green or green/yellow colour.
- Size and type are shown on the drawings.

Earth Bonding Busbar (EGB)

- Bonding busbars shall be provided where several conductors are to be connected.
- Shall comprise of tinned electrolytic copper bar mounted on insulators with GI support brackets.
- Minimum size of EGB shall be 300 mm long x 50 mm wide and 6mm thick.

Test point

- Test point comprising of a disconnect link shall be provided at suitable location for testing of earth electrode during maintenance.
- Test point shall be of tinned copper.

Earth Pits

- Shall be of pre-cast concrete with a cover placed over the grounding rod in level with the finished ground level.
- The cover should have marking showing its number and written "Earth rod".

PART – 02

EXECUTION

INSTALLATION

The contractor shall install complete earthing system required to ensure that the entire electrical installation is effectively bonded and required earth resistance is achieved. At the end of maintenance period, the contractor shall test the system to verify that the resistance value during completion has not sufficiently chance to warrant remedial measures.

All switchgear, metal conduit and trunking systems, metal frames, enclosures, lighting fittings and cables armour shall be bonded together and connected to the earth. Similarly, all earth pins and metallic plates of socket outlets, switches, accessories and enclosures shall be bonded to earth with earth continuity conductors. Each individual earth path shall be electrically continuous throughout its length from the farthest point of the associated part of the system back to the main earth.

- Mechanical protection must be provided for the system.
- Main equi-potential bonding conductors in relation to the neutral of the supply shall be as per BS7671.
- All extraneous conductive parts shall be bonded to earth.

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DIVISION 26 05 33
CONDUITS PIPES & ACCESSORIES

PART – 01
1.0 General:

1.1 All conduits, accessories such as junction boxes, sockets, tees, bend, elbow shall be of similar quality and properly sized to perfectly match with, the sizes of conduits to which they are installed.

1.2 Do not use conduit less then 25mm diameter.

1.3 Do not use defective conduits, pipes, or accessories.

1.4 Maximum allowable percent of conduit fill shall conform to the following.

- 2 Conductors 30 Percent
- 3 or more conductors 40 Percent

1.5 Get approval of samples of all sizes and type of conduits and pipes prior to commencement of any activity.

PART – 02
MATERIAL:

2.0 PVC CONDUIT AND ACCESSORIES.

2.1 Use PVC rigid conduits of class-D type. Use PVC bends with enough enlarged ends to receive conduit without reduction in the internal diameter at joints.

2.2 Use only manufactured smooth bends where conduits change directions.

2.3 Do not use direct heating method for making bends in conduit. Use hot air and fill the conduit with sand for forming bends in the conduit. The minimum bending curve curvature shall not be less than 8 times the conduit diameter.

2.4 Use solvent cement or proper glue at all joints so as to make joint watertight.

2.5 The contractor shall furnish all conduit fittings, bushings, elbows, coupling, bends inspection boxes, pull boxes, solid plugs, check nuts, supports, etc. as

required for a complete conduit installation and the same shall be of quality equal to that specified for conduit. Smooth bushes shall be used at conduit ends in order to save wire insulation from damage due to sharp conduit edges in cable pulling operation.

3.0 INSPECTION AND PULL BOXES.

3.1 Use pull boxes / inspection boxes along the conduit runs to facilitate pulling operation of wires. These pull boxes / inspection boxes are not necessarily shown on drawings.

3.2 Use pull boxes made from 16 SWG gauge sheet steel.

3.3 Providing pull boxes in accessible locations but avoid aesthetic area. Shown location of pull boxes on as built drawings.

3.4 The maximum distance of conduit rum without the use of pull boxes shall be:-

- Straight conduit 100 Feet. Conduit run with one 900 Bend 65 Feet.
- Conduit run with two 900 Bends. 50 Feet.

PART – 03
INSTALLATION

At all termination points of PVC conduits and pipes, smooth out the rough edges and make conduits free from burrs and sharps edges.

All conduit and pipes shall be installed empty and all conducting / piping works must be complete prior to carrying out of wiring operation.

Fasten all conduits rigidly into all outlets boxes, L.T. Switchboard, Distribution Boards, cable boxes, pull boxes, junction boxes, safety switches and other devices in the conduit system.

Plug or cap open ends of conduits in course of construction and keep them until the wires are pulled in.

Use 18 SWG G.I Wire or nylon fish tape in all empty conduits to facilitate wiring operation.

Run all conduits carefully to avoid piping, valves ducts and other mechanical and plumbing equipment's in the building.

Do not use more than (4) four bends in any conduit run from outlet to outlet.

Do not use sharp 900 bends and tees.

- Take care to adequately protect conduits from mechanical damage.
- use flexible conduit terminations (from 2 feet minimum to 6 feet maximum, in length) for connection to all motors and vibrating equipment.

4.0 CONCEALED CONDUITNG WORK

4.1 Where conduit is to be concealed, maintain a minimum of 32 mm cover of concrete measured from the top of conduit to finished surface.

4.2 In RCC work, lay all conduit works prior to pouring. In slab, support all conduit on top of bottom reinforcement. Firmly support all outlet boxes and install them in a way that the finish flush with the soft of slab or beam.

4.3 Do not make any chases in RCC structure for concealing conduit work.

4.4 When conduits have to be concealed in cement concrete (CC) do not make chase deeper and wider than required and use appropriate tools to make such chases. Do not make unnecessary chases or cutting.

4.5 Normally run all branch lighting and receptacle circuit conduits concealed in concrete slabs or in hung ceiling.

4.6 Minimize crossovers of conduits.

4.7 Adequately support conduits in hung ceiling by means of approved clamps or heavy iron wire tied to structural members supporting the ceiling. Paint these clamps and Ross with one coat of prime paint supporting of conduits by wire shall not be allowed.

5.0 SURFACE CONDUITING WORK

5.1 Install conduit either, Parallel and / or perpendicular to the surface of wall and structural members.

5.2 Use Saddles not less than 6 mm thickness and clamps made of 16 SWG sheet steel to fix the conduit surface.

5.3 Use other accessories, necessary to install conduits properly.

5.4 Provide proper support (saddles and clamps) to surface conduits. The maximum spacing between center to center of these supports shall be as follows.

¾" to 1 dia	----------	3 Feet
1 – ½" dia	----------	5 Feet
2" dia	----------	6 Feet
3" to 4" dia	----------	7 Feet

6.0 PAINTING / COLOUR IDENTIFICATION

All M.S surface conduits / trays, hangers, supports etc. shall be applied with one finish coat after installation.

All surface conduits (PVC / Steel) shall be applied with color identification marks at (one) meter interval and at all bends, junction boxes etc as follows:

- Electrical (Light / Power) ---------- Blue
- Computer ---------- Green
- Other Systems ---------- Yellow
- Security System ---------- Red

For other system (if any) get color code approval from consultant.

DIVISION – 26 05 36

CABLE TRAY AND LADDER

PART – 01

GENERAL

- Cable trays and ladders including all hanging supports etc. shall be fabricated in MS/G.I. Sheet of specified gauge & size as given in BOQ/detail on drawings / as per site.
- Cable trays and Ladders shall be Hot Dip Galvanized after fabrication. (in case of perforated cable trays and ladders)
- IEC 61537 Cable Tray and Cable Ladder Systems shall comply with IEC 61537 and BSEN ISO14713.
- The tray/ladder shall be provided with edge primer and finished coat of zinc chromate after fabrication.
- All supports, hangers, fish plates / any mechanical components shall have the same finish as the tray/ladder**.** Alternatively galvanized steel installation supports and accessories from Hilti/Fischer only will be acceptable.
- Calculations for supports shall be submitted by the manufacturer.
- Cable trays and ladders shall ensure earth continuity between joints by 16 sq.mm flexible straps.
- Samples & Technical details to be submitted to consultant for approval prior to placing order by contractor.
- Routing and mounting heights of cable tray to be coordinated with other disciplines.

PART – 02

PRODUCTS

CABLE TRAY

- Metal cable trays shall be perforated and where cover is specified it shall be with solid cover.
- Perforations shall be as per standards

- Cable trays installed outdoors shall have a sunshield designed to allow sufficient ventilation
- Cable trays up to 300 mm wide shall be of 16 SWG and of 14 SWG above 300mm wide.

PART – 02

EXECUTION

INSTALLATION

- Cable trays and ladders shall be provided with wall/ceiling supports as required. In all cases there shall be working space available to access the cables installed.
- The type of supports and its spacing shall be on the basis of self weight and of the cables. The cable tray manufacturer shall provide supporting document for the supports.
- All supports shall be pre-fabricated at the factory and finished as the cable tray/ladder.
- Cutting of cable tray/ladder/ trunking and its supports shall be avoided. Where this is inevitable and approved by the Consultant, the cut portion shall be provided with two coats of zinc chromate paint.

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DIVISION – 26 23 00

LOW VOLTAGE SWITCHGEAR

SCOPE OF WORKS

- The scope of work shall cover the supply, design, manufacture, testing in the factory, packing, insurance, delivery to site (UNIVERSITY ROAD IBA CAMPUS), unloading, installation, testing and commissioning of all components with all the necessary accessories in accordance with this technical specification.
- Contractor to bear travelling, boarding, and lodging costs for Factory Acceptance Tests at manufacturers premises.

1.0 DISTRIBUTION BOARDS GENERAL

The distribution boards shall be of sheet steel fabricated suitable for flush / surface mounting on wall, totally enclosed dust tight an damp proof**.** The shall be complete in all respect, with accessories, factory assembled, tested and finished all according to the specification and painted with moisture proof powder paint.

The distribution board shall be front operation type or as directed by client / consultant.

The sheet steel shall be properly de-rusted, de-greased finished with powder coating over an anti-corrosive base. The thickness of powder coating shall not be less than 100 microns and finished in color approved by the client / Architect / Consultant.

Be rated for 400/230 volts. 3 phase, 4 wire, 50 Hz system.

be designed for flush mounting of all instruments of the front side.

Have all fixing brackets, plates for mounting & components Electro galvanized (CD coated).

Have incoming and outgoing cable termination in bottom, and top respectively with terminal black / line up terminals etc.

The busbars shall be imported tinned copper.

The DB shall have minimum of 20% extra physical space (minimum space of two breakers) including bus bar extensions knock outs covered with black plates for installation of additional breaker of medium frame size used in the panels.

All hardware shall be of metric sizes.

All dimensions shall be in multiple of 10 mm and not in fractions thereof.

All doors shall be effectively double earthed.

The Distribution board shall be fabricated with 14 SWG or thick sheet steel. All the components shall be mounted on a common component mounting plate, fixed inside the enclosure and DB shall be provided with. Screwed sheet steel front plate. The enclosure shall be provided with rubber gasketting having lockable hinged door with cam fastener.

The distribution board shall be supplied complete with all installation material as recommended by the manufacturers. The short circuit level shall be as shown on drawing. Use of back up fuses for meeting the short circuit level is not permitted.

2.0 COMPONENTS

Circuit Breakers.

The C.B shall be triple pole / single manual reset type, with temperature compensated overload release and instantaneous magnetic short circuit release.

Ammeter and Voltmeters.

All meters shall be flush mounting, moving, iron, spring controlled. The front dimensions shall be 96 x 96 mm. The meters shall have accuracy class 1.5. The ammeter shall be suitable for connection to 5 Amp secondary of current transformers. The ammeters and voltmeter shall have measuring range as indicated on the drawings.

Current Transformer.

Air cooled, ring type current transformers (CT) shall be provided having transformation ratio as indicated on the drawings. CT's shall be of accuracy class 1.0.

Selector Switches

Ammeter and voltmeter selector switches shall be complete with front plate grip and R-Y-B and OFF positions for ammeters and RY-YB-BR-RN and OFF position for voltmeter.

Indication Lamps.

Indicating lamps and selector switches shall be suitable for flush mounting complete with bases, 230 volt incandescent lamps and shall have rosettes of red color for on condition.

2.0 INSPECTION & TESTS.

All equipment shall be subject to inspection and witness testes by Consultants at supplier's work. This shall include. Inspection of compliance specification.

- Over voltage and insulation test.
- Operational test.
- Any other test necessary for the purpose.

3.0 DRAWINGS

Drawing and circuit diagrams shall be supplied to Client / Consultants for approval before manufacturer commences work.

Dimensioned plans, elevations, sections, Single Line Diagram, and details, including required clearances and service space around equipment. Include the following:

- Tabulation of installed devices with features and ratings.
- Enclosure types and details.
- Outline and general arrangement drawing showing dimensions sections, and weights of each assembled section.
- Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
- Ampere rating of buses.
- Short-time and short-circuit current rating of switchgear assembly. (Test reports)
- Nameplate legends.
- Features, characteristics, ratings, and factory settings of individual over current protective devices and auxiliary components.

- Three-line diagram to include field connection points.
- Wiring Diagrams: Power, signal, metering, and control wiring etc

SECTION 26 27 26
WIRING DEVICES

PART - 01
1.0 GENERAL

1.1 Co-ordinate with architectural and other services drawings and site conditions for exact locations of switch, socket, etc.

1.2 Use single pole switches rated for 10 Amp. / 20 Amp. At 250 volts AC, unless specially noted on drawings / BOQ.

1.3 The covering plate for switches shall have specified color.

1.4 All switches shall be grid types.

1.5 Contractor to submit samples of switches to get approval technically and aesthetically.

PART – 02
PRODUCT

2.0 ONE WAY SWITCH

2.1 Each switch shall make and break contact between the “live” wire only.

2.2 Use owner furnished switches unless specifically indicated otherwise.

2.3 Submit appropriate sample an obtain color approval prior to ordering.

3.0 SWITCH SOCKET OUTLET

3.1 For indoor type, use 3 pin, 13 Amp, 250 V AC type switches socket outlet mount this outlet on sheet steel outlet box or as per BOQ /Drawing.

4.0 STEEL SHEET BOXES FOR SWITCHES AND OUTLETS

4.1 Use all steel boxes made from 16 SWG galvanized steel. The boxes shall have necessary arrangements to receive exact sizes of conduits and for connecting earthing wire / cables.

4.2 Earth each steel boxes with proper earth wire / cable.

4.3 Get approval of samples of their quality and thickness.

4.4 Use boxes of sufficient depths to accommodate all connecting cable.

5.0 JUNCTION BOXES AND PULL BOXES.

5.1 Use junction boxes and pull boxes made out from 16 SWG galvanized steel only. Use proper sized boxes to facilitate pulling of cables. Cover of these boxes shall be accessible and designated for quick removal.

5.2 Do not install these boxes at finished locations. If necessary, reroute these conduits.

5.3 Supports these boxes independently to building structure with no weight bearing on conduit.

5.4 Except those shown on drawing, use junction box & pull boxes wherever it is necessary to pull the cable / wire conveniently.

6.0 G.I BOXES

GI boxes to be provided with brass earth terminal to facilitate earth wire connection. The boxes to have sufficient number of knockout. The boxes thickness shall be 1.5mm minimum and shall comply with BS 4662. Boxes to have adjustable lug for proper installations and alignment of wiring accessories. Extension ring to be used where the box is deep inside the civil works.

7.0 ISOLATORS

All external isolators (wherever required) must have IP-65 protection rated for 50 deg. ambient temperature. Isolators installed indoor shall be IP 23 rated. Provision of padlock shall be provided for isolators.

PART – 03
EXECUTION

6.0 INSTALLATION

The mounting heights for the electrical equipment and accessories shall be coordinated with the furniture layout and shall be as per site requirements to Architect's instructions. In generals the mounting heights from FFL to center of fixtures shall be as shown on drawings

DIVISION – 26 51 00

LIGHTING FIXTURES

1. GENERAL

1.1 All light fixtures shall be owner furnished unless mentioned otherwise contractor to install and connect only.

1.2 All lighting fixtures complete with lamps, accessories, installation materials, etc. shall be furnished and installed. The fixtures shall be designed and built to give reliable service continuously at the normal voltage and current rating.

1.3 The manufacturer's type and catalogue number where specified shall serve as illustration of the type of fixture required and any other approved equivalent fitting shall be acceptable. The equivalency shall be based on certified photometric data, as well as on construction material, shape, finish, etc. The Contractor shall submit complete technical details and/or samples of each lighting fixture specified and obtain approval of the Architect before commencing with placement of order.

1.4 External lighting shall be weather proof type complying with general requirement.

1.5 These shall have protection category of IP55 min except under water and floor up light which shall have protection of IP67.

2. INSTALLATION

2.1 Fixture location shown on drawing are diagrammatical, verify exact locations from architectural, ceiling and elevation plans, coordinate space conditions for fixing with other trades.

2.2 Refer electrical & Architectural drawings for mounting heights of various fixtures.

2.3 Use 3x1C-2.5 sq. mm flexible PVC insulated PVC sheathed cables respectively between outlet box and fixtures.

2.4 Screws for fixing Purpose shall be chromium plated.

2.5 Get approval of suspension / hanging rods prior to its manufacture for installation of light fixtures where shown on drawing.

DIVISION 28 46 21.11

ADDRESSABLE FIRE ALARM SYSTEM

1. GENERAL

1.1 The work shall consist of furnishing, installation, testing & commissioning of a complete early detection, intelligent, analogue, soft addressable fire alarm system as shown on the drawings, specified herein and stated in the BOQ.

1.2 All the equipment provided under this section shall conform to the relevant DIN/IEC/BS-54, NFPA-72 standards. The contractor shall furnish with the tender bid complete details/type of equipment, material etc.

2. SUBMITTALS

Data of system/components with complete technical literature.

Shop drawings in compliance with applicable standards. The drawings shall be duly signed and stamped by the supplier confirming compliance.

Cause and Affect Matrix

3. TECHNICAL REQUIREMENTS

SYSTEM DESCTIPTION

The fire detection and alarm system shall comprise of soft addressable, modular, main fire alarm control panel, optical smoke & heat sensors, sounders, manual call points, etc. All devices shall have their own built-in fault isolators. All signals will be transmitted in digital format. The system shall be capable to allow modifications with the minimum of disruption using panel mounted QWERTY keyboard as well as PC based software to facilitate future changes.

All components and devices shall be from the single manufacturer approved by the Consultant.

All system sensors, sounders, call points shall be connected on two-wire loop circuits (as shown in the typical schematics). Removal or disconnection of any component from the loop shall not affect the functioning and performance of other components and the system. Loop shall be fully functional and none of the loop components be disabled in case of one short or break in the loop.

System shall be automatically addressable type i.e. all the devices on the loops of the FACP shall be allocated addresses automatically at the time of system power-up.

Each loop shall be capable of up-to 100 devices on the loop with a maximum loop length of 2 kM. This shall be verified with manufacturer recommendations. Each loop shall have provision to add 15 devices.

Facilities shall be provided to constantly monitor and check the following conditions:

- Status of power supply to the loops;
- For open-circuit, short-circuit, earth fault and any other fault condition in the loop wiring;
- For communication failure and errors in all cards and loops
- For faults in keyboard and printer circuits.

All devices shall be assigned a label as per scheme approved by the Engineer. In case of fire, fault or warning, the label of device sensing threshold shall appear on visual display unit of the panel.

Any event i.e. fire, fault or warning shall be recorded with time, date and place of occurrence in the memory of FACP. These events shall either be displayed on the FACP and/or printed, as required. Provision shall be done at the fire alarm control panels to silence the loop powered alarm sounders, but the visual indication shall remain until

the system is reset. The detectors shall have auto learn sensitivity adjustments.

The system shall have the capability to generate status reports of all detectors to indicate system conditions whether normal, faulty or contaminated.

Programming software shall be able to show exact loop wiring structure to indicate loop and location of spur.

Activation of the fire alarm system shall as a minimum, directly initiate some or all of the following to be agreed as a part of the overall cause an affect strategy.

- Signal to all elevator machine rooms indicating fire status to control lifts (Recall function)
- Release doors normally locked/or held open by electric devices.

4. FIRE ALARM CONTROL PANEL

The panel shall be modular computer controlled complete with, but not limited to, the following elements:

- Visual display unit capable of displaying 8 lines 40 characters backlit display. VGA or high quality display will be preferred.
- Provision to link with external printer.
- Built-in QWERTY keyboard.
- Key switch to prevent un-authorized operation of keypad.
- Integral sealed lead acid battery and charger, with 72 hours back up in the event of mains supply failure.
- Essential controls – delay, panel reset, audible alarm off, verify/cancel fault buzzer. Fire, Pre-Alarm, Trouble, Disconnection lamps.

- Indications – Lamps for CPU failure, abnormal condition & failure of power supply/ battery.
- The system shall facilitate following features as a minimum:

  - Overview of device configuration.
  - Last 1000 system events
  - Current fault and warning logs.
  - Interrogation of sensor cleanliness
  - On/Off, Enable/ disable sensors, zones, sounders, interface unit channels.
  - Status of detectors
  - Alarm counters
  - Printer on, off, line feed and test facilities.

All control buttons and keyboard shall be enclosed behind a lockable cover.

System Event Printer

An external 80 column dot matrix printer with system PC is required.

The printer shall provide the following:

- Hard copy of event occurring as programmed.
- Status read out of every addressable point
- Devices tested on a walk test
- Contaminated detectors needing replacement
- Single point scan printout of analogue values
- Hard copy of historic log.

Smoke-purpose Detectors:

These shall comply with the requirements of EN 54: Part 5 and Part 7 and shall be fixed temperature or fixed temperature heat with rate of rise sensing element. It should be fully compliant with EN54 part 5 and Part 7 to provide grade A1 sensitivity. The optical element shall detect visible smoke from slow smoldering fires. Smoke sensing design shall comply with EN 54 part 7. Optical sensing shall be carried out by means of an Infra-red LED transmitting a pulse of light across an angled chamber.

Manual Call Point:

The manual call point shall have an inbuilt short circuit isolator and an inbuilt microprocessor. All electronic devices contained within the MCP shall be hermetically sealed so as to prevent damage from hostile environment conditions as dust and humidity.

MCP that are located in public areas a transparent cover shall be provided as a protection to prevent inadvertent activation.

The MCP shall have a plastic pane which shall be resettable. The device can be tested functionally without the need to either remove the front cover or actual activation, with a special test key, supplied with each MCP.

These devices will comply fully with EN 54 part 1.

Alarm Sounder

Alarm sounders shall be capable of providing a minimum sound level of 85 dBA at 1 meter. The sounder shall be capable of providing 4 different sound signals.

Each sounder shall include its own microprocessor to handle loop communications and monitoring of the internal sound element during an

alarm condition. This shall allow faulty devices to be automatically identified during testing. All associated electronic components shall be hermetically sealed to provide protection from hostile operating environments.

Repeat Panel

The Panel shall repeat all of display messages and functions (except programming) as provided on main panel. Connection of Repeat Panel to FACP shall be on the loop wiring supervised for short circuit and open circuit.

Batteries

Batteries shall be provided and shall be the dry sealed lead-acid maintenance-free type. With primary power disconnected, the batteries shall have ample capacity to operate the fire alarm system for a period of 72 hours with alarm condition for a minimum period of 30 minutes.

Interface Units

These shall be provided to link with other systems for activation during fire conditions. All intended actions as described in these specifications shall be initiated automatically. The interface units shall preferably loop powered, if otherwise a power supply source shall be included with the system.

EXECUTION

Installation

The entire fire alarm system shall be installed in accordance with applicable standards and manufacturer's / client recommendations. Cable for fire alarm system shall be 2-core, 1.5sq.mm, shielded with drain wire, fire resistant to BS type CWZ.

Testing

Fire alarm system shall be tested in accordance to Local Civil Defense

regulations and put into operation by the manufacturer or his authorized representative in the presence of engineer. Fault and alarm conditions shall be simulated, and all data and alarm indicators checked with full events recorded on system printer according to the testing procedure.

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PRICING PREAMBLES & INSTRUCTIONS

a) The bidders are required to fill in all sections of the BOQ, columns including all appendices. Tenders not containing the above may be considered liable to rejection.

b) All equipment proposed to be supplied shall be strictly from the "List of Approved Manufacturer" (if provided) unless otherwise communicated or specified and supported by suitable manufacturer's catalogue/literature etc., with the model selected with make, origin and performance data clearly marked. Also submit quoted equipment capacities at specified conditions. Any deviation shall be clearly highlighted on separate sheets with columns of specified & proposed.

c) All bidders are advised to quote strictly as per specifications. Any alternative or deviations from specifications proposed shall be provided in the form of a separate quotation. Any tender not quoting as per specifications may be considered liable to rejection.

d) All tenders shall be accompanied by one additional copy of the main proposal and the priced BOQ marked 'DUPLICATE', shall be returned duly filled. (02 Hard Copies of the Tender Documents to be submitted by the Bidder)

e) All specifications, drawings and other documents supplied by the Employer/Consultant for the purpose of bidding shall be returned with the tender bid with all pages duly stamped & signed. Tenderers unable to bid shall also return complete bid documents on the date of opening of the tender.

f) The Contractor shall be required to Supply, installation, tasting and commissioning everything necessary to provide a complete operational system as specified.

g) All items mentioned in the Bill of Quantities (BOQ) consist of furnishing all plant, labour, equipment, appliances, and materials required for completing the items/works in strict accordance with relevant specifications as described in the Contract Documents and Drawings.

h) A price is to be entered against each item in the Bill of Quantities whether quantities are entered or not. Items against which no price is entered will be considered as covered by the other items in the Bill of Quantities.

i) General direction and descriptions of works and materials given in the details, Drawings and Specifications are not necessarily repeated in the Bill of Quantities. Reference is to be made by the tenderer to the details, Specifications and Drawings for their information and the same should be allowed for in their rates.

j) Generally, the following shall be deemed to be included in the prices submitted with all items herein:

- Cost of equipment, including the cost of all necessary controls, instrumentation, appurtenances, etc. required to make the equipment operational, as specified.
- Cost of specified spares or if not specified then cost of manufacturer recommended spares for 3 years of normal operation.
- Cost of all assistance needed by the client or installation contractor to install the equipment.
- Cost of commissioning and testing the equipment as specified and maintenance for 01 year of the date of commissioning

- Cost quoted shall be inclusive of each thing for successful delivery at site.

- Cost of transportation, lifting, insurance, shifting to transport the equipment and all costs in connection therewith including but not limited to, cartage, delivery, unloading, unpacking, returning packing, handling, hoisting to any height, lowering, octroi charges etc. from the manufacturer's works to the project site / locations, as specified.

- All overheads and profits including Income Tax and S.S.T etc.

- Being a BOQ based on **PKR** / FOR Basis , no escalation in prices shall be acceptable what so ever reason and contract shall be amount shall considered as final.

- Supply of Operation and Maintenance Manuals and shop drawings (03 Hard Copies)

k) This Bill of Quantities is to be read in conjunction with the Conditions of the Contract, Drawings and Specifications prepared by the Consultants, as being mutually explanatory.

l) Any discrepancies noticed by the tenderers between the Bill of Quantities, the intent of the Drawings and Specifications and the scope work, shall be brought to the attention of the Consultant/Engineer prior to submitting the tenders who shall notify their clarifications/decision to all the tenderers. No claims of whatsoever nature shall be admissible during or after the contract period for any misunderstandings, ambiguities due to above, which have not been notified to the Consultant/Engineer prior to submission of his priced tenders.

m) Where special risks, liabilities and obligations cannot be dealt with as above, then the additional moneys required by the Tenderer to cover such special

risks, liabilities and obligations are to be separately stated in a letter accompanying the Tender. Tenderer shall list each and every clause number from the Conditions of Contract and the Specification that they wish to price in this way, together with the price in the Tender. Any risk, obligation or liability arising from any clause of the Conditions of the Contract or the Specifications or from the works detailed on the Drawings which has not been specifically priced in the said letter of the Tenderer shall be deemed to be included in the billed prices.

INSTITUTE OF BUSINESS ADMINSTRATION, KARACHI
UNIVERSITY ROAD MAIN CAMPUS, KARACHI

VOLUME - IIA (TECHNICAL SPECIFICATIONS FOR CONSTRUCTION OF GIRLS HOSTEL BLOCK I & II)

1- TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

CLIENT:

Institute of Business Administration Karachi

Leadership and Ideas for Tomorrow

PLANNING & DEVELOPMENT OF PROJECT

I N D E X

A- TECHNICAL SPECIFICATIONS

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DIVISION 01 14 00

WORK RESTRICTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Division 1 Specification Sections, apply to this Section.

1.2 USE OF SITE

A. General:

The Contractor shall have full use of the site of the works, during construction period. However, the Contractor's use of site is limited only by the Employer's right to perform work or to retain other Contractors to do so.

B. Use of Site: Limit work and activities to the area of the Site as defined on Drawings in areas indicated. Do not disturb areas outside the Site or in which the work is indicated.

- Limits: Confine constructions operations to areas where work is permitted.
- The Employer Occupancy: Allow for the Employer occupancy of Site.
- Driveways and Entrances: Keep driveways and entrances serving premises clear and available to the Employer, the Engineer and their employees, other Contractors always engaged in work on the Site and emergency vehicles. Do not use these areas for parking or storage of materials.
- Schedule deliveries to minimize use of driveways and entrances.

- Schedule delivery to minimize space and time requirements for storage of materials and equipment on-site.

C. OCCUPANCY REQUIREMENTS

- **Partial Employer Occupancy:** The Employer reserves the right to occupy and to place and install equipment in completed areas of the Site, before substantial completion, provided such occupancy does not interfere with the Contractor's completion of the Works. Such placement of equipment and partial occupancy shall not, by itself, constitute completion or acceptance, nor Taking-Over of any part of the Works.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not Used)

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DIVISION 01 43 00

QUALITY ASSURANCE – QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Division 1 Specification Sections, apply to this Section.

1.2 QUALITY ASSURANCE PROGRAM

A. Provide and maintain an effective Quality Assurance Program that complies with Clauses 36, 37, 38 and 39 entitled "Materials, Plant and Workmanship" of the Part I, General Conditions of the Contract.

1.3 SCOPE OF PROGRAM

A. The Contractor shall establish a Quality Assurance Program to perform sufficient inspection and tests of all items of work, including that of his suppliers and subcontractors, to insure conformance to applicable Technical Specifications and Drawings with respect to the materials, workmanship, construction, finish, functional performance, and identification.

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DIVISION 01 32 00

PART – A- CONSTRUCTION PROGRESS DOCUMENTATION

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Division 1 Specification Sections, apply to this Section.

B. Refer to Conditions of Contract and Agreement for definitions and specific dates of Contract Time.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Program.
2. Construction Program.
3. Submittals Schedule.
4. Daily construction reports.
5. Monthly progress reports.
6. Material location reports.
7. Field condition reports.
8. Accident reports.
9. Special reports.
10. Wage book and time sheet records.

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DIVISION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting:

- Shop Drawings.
- Other miscellaneous submittals.

1.3 SUBMITTAL PROCEDURES

A. **General:** Electronic copies of CAD Drawings of the Contract Drawings will not be provided by the Engineer for the Contractor's use in preparing submittals.

B. **Coordination:** Coordinate preparation and processing of submittals with performance of construction activities.

- Transmit each submittal sufficiently in advance of performance of related procurement and construction activities, allowing ample time for review and re-submittal, if necessary, to prevent delays to the Works.
- Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

- Coordinate transmittal of different types of submittals for related parts of the Works so processing will not be delayed because of need to review submittals concurrently for coordination.

C. **Processing Time:** Allow enough time for submittal review, including time for re- submittals, as follows. Time for review shall commence on the Engineer's receipt of submittal.
Allow 7 days for processing each submittal.

D. **Identification:** Place a permanent label or title block on each submittal for identification.

- Indicate name of firm or entity that prepared each submittal on label or title block.
- include the following information on label for processing and recording action taken:

➢ Contract name.
➢ The Employer's name.
➢ Date.
➢ Name and address of the Engineer.
➢ Name and address of the Contractor.
➢ Name and address of subcontractor.
➢ Name and address of supplier.
➢ Name and address of manufacturer.
➢ Unique identifier, including revision number.
➢ Number and title of appropriate Specification Section.
➢ Drawing number and detail references, as appropriate.

E. **Deviations:** Highlight, encircle, or otherwise indicate and identify on submittals, deviations from the Contract Documents.

F. **Additional Copies:** Unless additional copies are required for final submittal, and unless the Engineer observes non-compliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

- For submittals requiring concurrent review, submit one extra copy in addition to specified number of copies to the Engineer.
- Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

G. **Transmittal:** Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form attached to a cover letter. The Engineer will discard, without review, submittals received from sources other than the Contractor.

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DIVISION 01 78 39

RECORD (AS-BUILT) DOCUMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Record (As- Built) Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Miscellaneous Records.

1.3 SUBMITTALS

A. **Record Drawings:** Submit copies of Record Drawings as follows:

1. Initial Submittal: Submit two sets of plots from Record CAD Drawing files and the original marked-up Record Prints. The Engineer will initial and date one set of plots and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. The Engineer will return one set of plots and Record Prints together with review comments, for completing, printing, binding, and final submittal.
2. Final Submittal: After incorporating the Engineer's initial submittal review comments, submit:

a. Original marked-up Record Prints set.

b. Sets of (As-Built) Drawings as follows:

1) One (1) Set electronic format: (in CD-ROM)

2) Two (2) bound sets of prints (A2 Size)

B. **Record Specifications:** Submit two (2) copies of Record Specifications,

including addenda and contract modifications.

C. Miscellaneous Records: Submit two (2) sets of original miscellaneous records.

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DIVISION 31 10 00

GRABBING, LEVELLING & GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including Conditions of Contract apply to this Section.

1.2 SUMMARY

A. This Section includes construction clearing, grubbing, grading, levelling & dewatering.

B. Related Sections include the following:

- Division 1 Section "Temporary Facilities"
- Division 2 Section "Site Clearing."
- Division 2 Section "Earthwork" for excavating, backfilling, and site grading.

1.3 PERFORMANCE REQUIREMENTS

A. CLEARING & GRUBBING :

1. **Scope** : The work shall consists of clearing the designated area of all trees. Down timber, snag bushes & other vegetations, rubbish and other objectionable material and shall include grubbing stumps, roots and matted roots and disposal of all spoil materials resulting from the clearing and grubbing. It shall include the removal and disposal of all structures that protrude encroach upon or otherwise obstruct the work, except when otherwise provided for on the plans or directed by the Engineer to be saved.

2. **Location** : The Engineer will define the limit of areas where clearing and

grubbing is to be done.

3. **Disposal:** All wood and bushes shall be disposed within 15 days after cutting or felling unless otherwise approved.

4. **Protection & Restoration:** The Contractor Shall prevent all damage to pipes, conduits, wires, cables or structures above or below ground. The Contractor shall so control his operations as to prevent damage to trees and shrubs which are to be preserved.

5. **Payment**: the payment shall be made as per BOQ item.

B. LEVELLING & GRADING: The work to be done include all earth work to be done with required levels, elevations as marked on drawing or as established by the Engineer .

The work to be done shall be inclusive of performing the required excavation and filling of the area

C. DE-WATERING:

- **Dewatering Performance:** Design, provide, test, operate, monitor, and maintain a dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.

- Work includes removing dewatering system when no longer needed.
- Maintain dewatering operations to ensure erosion is controlled, stability of excavations and constructed slopes is maintained, and flooding of excavation and damage to structures are prevented.
- Prevent surface water from entering excavations by grading, dikes, etc

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DIVISION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including Conditions of Contract apply to this section.

1.2 SUMMARY

This Section includes the following:

1. Preparing and grading sub-grades for slabs-on-grade and pavements.
2. Excavating and backfilling for buildings and structures.
3. Subsurface drainage backfills for walls and trenches.
4. Excavating and backfilling trenches and pits within building lines.
5. Excavation support and protection not otherwise provided for in other sections of the Specification.

1.3 DEFINITIONS

A. **Excavation:** consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials removed.

B. **Backfill:** Soil materials used to fill an excavation.

1. **Initial Backfill:** Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. **Final Backfill**: Backfill placed over initial backfill to fill a trench.

C. **Borrow:** Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. **Unauthorized Excavation:** Unauthorized excavation consists of removing materials beyond indicated sub grade elevations or

dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, will be at the Contractor's expense.

E. **Structures:** Buildings, footings, foundations, retaining, walls, slabs, tanks, curbs.

F. **Utilities:** Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

G. **Bedding Course:** Layer placed over the excavated sub-grade in a trench before laying pipe.

H. **Fill:** Soil materials used to raise existing grades generally.

I. **Sub-grade:** Surface or elevation remaining after completing excavation, or top surface of a fill or backfill or sub grade layer, immediately below subbase, drainage fill, slab-on-grade, or topsoil materials.

1.4 SUBMITTALS

A. **Pre-construction Records:** Before an excavation is started:

1. Ground levels shall be agreed at suitable intervals with the Engineer.
2. Surface materials and conditions shall be recorded in presence of the Engineer and where appropriate, the Employer or occupiers of the land.
3. The Contractor shall take photographs to illustrate existing damage or conditions, which may prove contentious at the time of reinstatement.
4. This information shall be neatly presented and submitted to the Engineer.
5. Any significant details of any existing natural or piped subsoil drainage

or other underground features shall be identified to the Engineer as work proceeds.

1.5 SOIL MATERIALS

A. **General:** Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. **Satisfactory Soils:** ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 75 mm in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. **Unsatisfactory Soils:** ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

- Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. **Backfill and Fill:** Satisfactory soil materials.

E. **Sub grade Layer:** Satisfactory roadway soil materials, but conforming with the following requirements:

1. Size: 100 percent passing a 75mm sieve and not more than 18 percent passing a 0.075 mm sieve.
2. Organic Matter: Not more than 5 percent; AASHTO T 267.
3. Maximum Dry Density: Not less than 1.7; AASHTO T 180.
4. CBR: Not less than 15 percent; AASHTO T 193.
5. Maximum Plasticity Index: 12 percent.
6. The top 150 mm sub grade material should not contain more than 0.2% total sulphate content and 0.05% total chloride content.

F. **Controlled Fill:** Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; AASHTO M 57; with at least 90 percent passing a 38 mm sieve and not more than 12 percent passing a 0.075 mm sieve.

G. **Bedding:** Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 25 mm sieve and not more than 8 percent passing a 0.075 mm sieve.

H. **Drainage Fill:** Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 38 mm sieve and 0 to 5 percent passing a 2.36 mm sieve.

I. **Filter Material:** Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm sieve and 0 to 5 percent passing a 4.75 mm sieve.

PART 2 - EXECUTION

2.1 PREPARATION

A. Shore, support and protect buildings, structures, utilities, sidewalks, pavements, and other facilities, on or adjacent to the Project site, from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect sub grades and foundation soils. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement

of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

2.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared sub grades, and from flooding Project site and surrounding area.

B. Protect sub grades from softening, undermining, washout, and damage by rain or water accumulation.

C. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Install a dewatering system to keep sub grades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

2.3 EXCAVATION SUPPORT AND PROTECTION

A. Design, provide, install, monitor, and maintain at the Contractor's sole risk and responsibility, excavation support and protection systems capable of resisting soil and hydrostatic pressure and supporting sidewalls of excavations.

B. Work includes removing when no longer needed.

C. Install and remove without damaging existing structures, utilities, pavements, and other facilities adjacent to excavations. Install excavation support and protection systems as excavation works proceed, in a manner acceptable to the Engineer.

D. Locate clear of permanent construction to permit access for subsequent construction operations and inspections.

E. Trim excavation as required and fill voids behind with soil, and compact.

F. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure excavation support and protection remains stable.

G. Remove excavation support and protection systems when construction has progressed sufficiently. Remove in stages to avoid disturbing underlying soils and damaging adjacent structures, utilities, pavements, and other facilities.

H. Promptly repair or replace as directed and approved by the Engineer, adjacent work, structures, utilities, pavements and other facilities, damaged or displaced by installing or removing excavation support and protection systems.

2.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to sub grade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, boulders, and obstructions.

- If excavated materials intended for backfill, fill, embankment, or sub grade layer include unsatisfactory soil materials and rock, replace with satisfactory soil materials, as applicable.
- Excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other encountered items indicated or directed to be removed; together with other materials not classified as unauthorized excavation; including intermittent drilling, blasting if permitted, ram hammering, ripping and other acceptable means and methods.

- Excavation includes removal and disposal of unsatisfactory soils and any surplus satisfactory soils.

2.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm. Extend excavations a sufficient distance from permanent structures for working space requirements. Place blinding concrete, where indicated, immediately after excavating to final grades.

- Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement or concrete. Trim bottoms to required lines and grades to leave solid base to receive other work.
- Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 25 mm. Do not disturb bottom of excavations intended for bearing surface.

2.6 EXCAVATION FOR PAVEMENTS AND SITE IMPROVEMENTS

A. Excavate surfaces under roadways, parking lots, walks, pedestrian pavements, lawns, planted areas and the like, to indicated cross sections, elevations, and grades.

2.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

- Set out trenches so that they do not encroach below a line drawn at an angle from the horizontal of the nearest lower edge of any adjacent building foundation, as follows:

➢ In Dry Stable Soils: 45 degrees.

➢ In Wet Clays, or Soils below Water Table: 30 degrees.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 300mm higher than top of pipe or conduit, unless otherwise indicated.

- Clearance:300mm on each side of pipe or conduit, unless otherwise indicated.

C. **Trench Bottoms:** Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape sub grade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench sub grade.

- For pipes and conduit less than 150 mm in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed sub grade.
- For pipes and conduit 150 mm or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
- Excavate trenches 150 mm deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. **Trench Bottoms:** Excavate trenches 100 mm deeper than bottom of pipe elevation to allow for bedding course. Remove projecting stones and sharp objects along trench sub grade. Hand excavates for bell of pipe.

- Excavate trenches 150 mm deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2.8 APPROVAL OF SUBGRADE

A. Notify the Engineer when excavations have reached required sub-grade.

B. If the Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill, fill or sub-grade layer material as applicable, and as directed.

- Additional excavation and replacement material will be paid for according to contract provisions for changes in the Work.

C. Proof rolls expansive sub-grade areas with heavy pneumatic tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated sub-grades.

D. Reconstruct sub-grades damaged by rain, accumulated water, or construction activities, as directed by the Engineer.

2.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by the Engineer.

B. Fill unauthorized excavations under other construction or utility pipe as directed by the Engineer.

2.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrows materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

B. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

2.11 BACKFILL

Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.

2.12 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 450 mm of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 100 mm thick, concrete-base slab support for piping or conduit less than 750 mm below surface of roadways and vehicular pavements. After installing and testing, completely encase piping or conduit in a minimum of 100 mm of concrete before backfilling.

D. Place and compact initial backfill of satisfactory soil material, free of particles larger than 25 mm, to a height of 300 mm over the utility pipe or conduit.

- Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final sub grade.

H. Install warning tape directly above utilities, 300 mm below finished grade, except 150mm below sub grade under pavements and slabs.

2.13 FILL AND EMBANKMENT

A. **Preparation:** Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fill and embankment material.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontals so fill and embankment material will bond with existing material.

C. Place and compact fill and embankment material in layers to required elevations as follows:

- Under footings and foundations, use controlled fill.
- Under building slabs, ramps, and steps, use controlled fill.
- Under roadways and vehicular pavements, use embankment material.
- Under walks and pedestrian pavements, use satisfactory soil material.
- Under lawns and planted areas, use satisfactory soil material.

2.14 MOISTURE CONTROL

A. Uniformly moisten or aerate sub grade and each subsequent backfill, fill or embankment layer before compaction to within 2 percent of optimum moisture content.

- Do not place backfill, fill or embankment material on surfaces that are

muddy.

- Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry density.

2.15 COMPACTION OF BACKFILLS, FILLS AND EMBANKMENT

A. Place soil materials in layers not more than 200 mm in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm in loose depth for material compacted by hand-operated tampers.

B. Place soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact backfills and fills to not less than the following percentages of maximum dry density according to ASTM D 1557:

D. Compact backfills and fills to not less than the following percentages of maximum dry density according to ASTM D 698:

- Under structures, building slabs, ramps and steps, scarify and recompact top 300 mm of existing sub grade and each layer of backfill or fill material at 100 per cent.
- Under walks and pedestrian pavements, scarify and recompact top 150 mm below sub grade and compact each layer of backfill or fill material at 100 per cent.
- Under lawns or unpaved areas, scarify and recompact top 150 mm below sub grade and compact each layer of backfill or fill material at 85 per cent.

2.16 GRADING

A. **General:** Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to

cross sections, lines, and elevations indicated.

- Provide a smooth transition between adjacent existing grades and new grades.
- Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. **Site Grading:** Slope grades to direct water away from buildings and to prevent ponding. Finish sub grades to required elevations within the following tolerances:

- Lawn or Unpaved Areas: Plus, or minus 25 mm.
- Walks and Pedestrian Pavements: Plus, or minus 25 mm.
- Roadways and Vehicular Pavements: Plus, or minus 25 mm.

C. **Grading inside Building Lines:** Finish sub grade to a tolerance of 13 mm when tested with a 3 m straightedge.

2.17 SUBSURFACE DRAINAGE

A. **Subsurface Drain:** Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 150 mm course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in a minimum of 300mm of filter material and wrap in drainage fabric, overlapping sides and ends at least 150mm.

B. Compact each course of filter material to 95 percent of maximum dry density according to ASTM D 1557.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 300 mm of final sub grade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 150 mm.

D. Compact each course of filter material to 95 percent of maximum dry

density according to ASTM D 1557.

E. Place and compact impervious fill material over drainage backfill to final subgrade.

2.18 DRAINAGE COURSE

A. Under slabs-on-grade, install drainage fabric on prepared sub grade according to manufacturer's written instructions, overlapping sides and ends. Place drainage course on drainage fabric and as follows:

B. Under slabs-on-grade, place drainage course on prepared sub grade and as follows:

- Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry density according to ASTM D 1557.
- When compacted thickness of drainage course is 150mm or less, place materials in a single layer.
- When compacted thickness of drainage course exceeds 150mm, place materials in equal layers, with no layer more than 150 mm thick or less than 75 mm thick when compacted.

2.19 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test sub grades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Foundation and Footing Sub grades: At foundation and footing sub grades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing sub grades may be based on a visual comparison of sub grade

with tested sub grade when approved by the Engineer.

D. Testing agency will test compaction of soils in place according to ASTM D 698, ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, ASTM D 4429, and AASHTO T 180, as applicable. Tests will be performed at the following locations and frequencies.

- Paved and Building Slab Areas: At sub grade and at each compacted fill and embankment layer, at least one test for every 200 sq. m or less of each type of paved area or building slab, but in no case fewer than three tests.
- Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 30 m or less of wall length, but no fewer than two tests.
- Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 50 m or less of trench length, but no fewer than two tests.

E. When testing agency reports that backfills, fills, sub grades, or embankments have not achieved degree of compaction specified, scarify, and moisten or aerate, or remove and replace with satisfactory soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. **Protecting Graded Areas:** Protect newly graded areas from traffic, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances were completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

- Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

D. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. **Disposal:**

- Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and dispose of at designated spoil areas on the Employer's property (disposal area will be within a 6-km proximity to the construction area).
- Transport surplus satisfactory soil to designated storage areas on Employer's property. Stockpile or spread soil as directed by the Engineer.
- Remove waste material, including unsatisfactory soil, trash, and debris, and dispose of at designated spoil areas on the Employer's property (disposal area will be within a 6-km proximity to the construction area).

B. MEASUREMENT AND PAYMENT

- The measurement of levelling and grading shall be the net volume excavated between the finished level and the original ground level and no measurement shall be made for fill.
- All costs and charges whatsoever in connection with carrying out the excavation and filling and what soever operation necessary for the proper

and satisfactory execution of the work as specified herein shall be taken as being included in and covered by the rate for and as per quoted in BOQ.

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DIVISION 31 31 16

TERMITE CONTROL

PART 1 – GENERAL

A. General provisions of the Contract, including Conditions of Contract apply to this Section.

1.1 SUMMARY

B. This Section includes the following for termite control:

1. Termite prevention
2. Soil treatment
3. Wood protection

1.2 TERMITE PREVENTION

A. Avoid creation of conditions that invite termites wherever possible. Take the following measures:

1. Remove stumps, roots, wood, and other cellulose materials from the building site before commencing construction.
2. Remove cellulose materials from around the foundation before final backfill.
3. Promptly remove form boards and grade stakes used in construction from site.
4. Allow no contact between building woodwork and soil or fill material.

A. Locate exterior woodwork a minimum of 15 cm above ground and beams in crawl spaces at least 45 cm above ground to provide ample space to make future inspections.

B. Make foundation areas accessible for inspection if possible.

C. If wood that contacts the soil, such as fence posts and foundation elements, use pressure treated wood.

5. Design ventilation openings in foundations to prevent dead air pockets and to help keep the ground dry.

6. Direct water away from the structure through proper grading.

7. Assure that the roof drainage system directs all water away from the foundation.

8. Avoid plantings near the foundation. Any tree that has the potential to grow to a height of 12 meters or taller shall not be planted within 15 meters of the foundation.

1.3 DEFINITIONS

A. EPA: United States Environmental Protection Agency.

B. PMP: Pest Management Professional

1.4 SUBMITTALS

A. Product Data: For termiticide and borate.

- Include the EPA-Registered Label for termiticide and borate products.

B. Product Certificates: For termite control products, signed by product manufacturer.

C. Qualification Data: For Installer of termite control products.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:

- Date and time of application.
- Moisture content of soil before application.
- Brand name and manufacturer of termiticide.

- Quantity of undiluted termiticide used.
- Dilutions, methods, volumes, and rates of application used.
- Areas of application.
- Water source for application.

E. Wood Treatment Application Report: After application of borate is completed, submit report for Owner's record information, including the following:

- Date and time of application.
- Brand name and manufacturer of borate.
- Quantity of undiluted borate used.
- Dilutions, methods, volumes, and rates of application used.
- Areas of application.
- Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A PMP who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment like that indicated for this project and whose work have a record of successful in-service performance.

B. Regulatory Requirements: Formulate and apply termiticide, and label with a US EPA registration number, to comply with EPA regulations and authorities having jurisdiction.

C. Document any applicable local codes or authorities and ensure that all relevant work complies.

D. Implement applicable provisions of the Quality Control program as

established in Section 01401, "Contractor Quality Control."

1.6 WARRANTY

A. Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, retreat soil and repair or replace damage caused by termite infestation.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 TERMITICIDES

A. Soil Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or amusable, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation for review and acceptance by the COR.

- The Department of State currently authorizes Thermidor and Premise as soil termiticide.
- Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA Registered Label.

B. Wood Protection Termiticide:

1. Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or mulcible,

concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation for review and acceptance by COR.

2. The Department of State currently authorizes TimBor and BoraCare for preventive wood treatment.
3. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA Registered Label.
4. Protect vegetation from contact with Timbor and BoraCare.

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DIVISION 32 16 00

CONCRETE CURBS AND SIDEWALKS

PART 1 - GENERAL

Drawings and General Provisions of the Contract, including Conditions of Contract and Division 1 Specifications Sections, apply to this Section.

1.1 SUMMARY

This Section includes the following:

A. Pre-cast concrete curbs and units.

Related sections include the following:

A. Division 3: Section 03300 “Cast-in-place Concrete”.

1.2 SUBMITTAL

A. The Contractor shall submit for approval, samples of each of the proposed units together with the manufacturer’s certificates and details of the method of manufacture and materials to be used. The Engineer’s approval of the samples will not be considered final, and the Engineer may reject any pre-cast units delivered to the Site, which do not, in his opinion, meet the required standards.

1.3 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.

B. Fabricator Qualifications: Shall comply with the following requirements:

C. Has sufficient production capacity to produce required units without

delaying the work.

D. Is experienced in manufacturing pre-cast concrete curbs units and tiles similar to those indicated for this project and can demonstrate a record of successful in-service performance.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pre-cast units to Project Site in such quantities and at such times to ensure continuity of installation. Store units at Project-site in such a way as to prevent cracking or other physical damage.

PART 2 - PRODUCT

2.1 CONCRETE

A. All concrete shall conform with the relevant requirements of Section 03300 - "Cast in-place Concrete" and shall be produced by an approved commercial ready-mix plant. All In-situ and pre-cast concrete shall have 28 days compressive strength on cylinder equal to 21 MPa, except base course and backing concrete which shall be 17 MPa with a maximum aggregate size equal to 60 mm.

B. Mortar shall conform with all relevant requirements of Section 03300 - " Cast-in place Concrete “and shall consist of cement and fine aggregate having the same proportions as that used in the concrete construction.

2.2 REINFORCEMENT

A. Reinforcing steel shall conform with the requirements of Section 03300 Part 2 Products: "Steel Reinforcement".

2.3 PRECAST CONCRETE UNITS

A. All pre-cast units shall be manufactured to the dimensions shown on the Drawings. Manufacturing tolerances shall be 3 mm in any one

dimension. End and edge faces shall be perpendicular to the base.

B. Each pre-cast curb or gutter unit shall normally be 500 mm in length and this length shall be reduced to 250 mm or as directed, where units are to be installed along curves of less than 10 m radius.

C. For horizontal curves of radius less than 10 m, curb and gutter units shall be manufactured to the radius shown and, in such circumstances, straight elements or portions of straight elements shall not be used. Bullnoses and curved faces shall be of constant radius with a smooth change from radius to plain face.

D. Surfaces of pre-cast units that will be exposed to view after installation shall be true and even, with a dense finish of uniform texture and color, free from cracks, holes, fins, staining or other blemishes or defects. Units failing to meet these requirements will be rejected. Surfaces that will not be exposed to view after installation shall have all fins and irregular projections removed and all cavities, minor honeycombing and other defects made good with mortar after the units have been saturated with water for at least 3 hours.

E. Pre-cast units shall be cast upside down in approved steel molds under conditions of controlled temperature and humidity. The units shall be steam cured, or cured by another method approved by the Engineer, until the concrete attains the full specified 28-day strength.

2.4 PREFORMED EXPANSION JOINT FILLER

A. Preformed expansion joint filler shall conform to AASHTO M 33.

2.5 EPOXY ADHESIVE

A. Epoxy adhesive (for use in attaching pre-cast units to existing concrete

pavement surfaces) shall be 2 components epoxy of high viscosity and rapid setting characteristics, conforming to AASHTO M237, Class II.

2.6 DUCTS

A. Ducts (if required under sidewalks or medians) shall consist of uPVC plastic pipe conforming to ASTM D 2750, Type II. If jacking is required, duct shall be approved galvanized steel tube.

2.7 BEDDING

A. Bedding material shall conform to the relevant requirements of Section 02721 - "Aggregate Sub-base Course" for Class A or Class B granular material.

PART 3 - CONSTRUCTION AND INSTALLATION

3.1 CONSTRUCTION AND INSTALLATION

Pre-cast Concrete Curbs:

A. Forms for the concrete base shall be approved wood or steel. All forms shall be sufficiently strong and rigid and securely staked and braced to obtain a finished product correct to the dimensions, lines and grade required. Forms shall be cleaned and oiled before each use. If approved, forms for the concrete base may be omitted and the concrete placed directly against undisturbed excavated faces.

B. Base course concrete shall be placed, compacted and shaped to the sections shown on the Drawings. Concrete shall be compacted with an approved internal type of vibrator or if approved, by hand spudding and tamping. Edges shall be rounded, if necessary, by the use of wood molding or by the use of an edger as applicable. The concrete base shall be finished to a true and even surface with a wood float. Concrete shall be membrane or water cured for at least 7 days before pre-cast units are

placed thereon.

C. Pre-cast units shall be soaked in water immediately before installation. Units shall be set accurately in position in mortar on the concrete base. Joints between pre-cast units shall not be mortared unless otherwise shown on the Drawings. Units shall be closely spaced, and every 10 m run shall be provided with an expansion joint.

D. Where curbs or gutters are installed on existing concrete pavement and using epoxy resin adhesive, the installation procedures shall conform with those specified for raised pavement markers in Section 02760 - "Airfield Marking ".

E. After curbs have been installed, steel forms shall be erected and concrete backing, if required, shall be placed as shown on the Drawings. Pavement courses shall not be laid against curbs until the concrete backing has membrane or water cured for at least 14 days.

3.2 ERECTION TOLERANCE

A. Tolerances on tangent sections of curb and gutter shall be tested using a 4 m straightedge. The finished surface of concrete shall not deviate from the straightedge between any 2 contact points by more than 5 mm. curved sections shall be true to the specified radius plus or minus 5 mm and all joints shall be flush and neat in appearance.

B. The area adjacent to completed and accepted curbs and gutters shall be backfilled with approved material to the top edges of the curbs or gutters, or the elevations shown on the Drawings. Backfill shall be placed and compacted to 95% AASHTO T 180 maximum density.

C. The smoothness of paved areas shall be tested using a 4 m

straightedge. The finished surface of concrete shall not deviate from straightedge between any two contact points by more than 5 mm. Sections of defective paving shall be removed and replaced as directed at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. Remove and replace work that does not comply with specified requirements.

B. Additional testing and inspecting, at the Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

C. The area adjacent to completed and accepted curbs and gutters shall be backfilled with approved material to the top edges of the curbs or gutters, or the elevations shown on the Drawings. Backfill shall be placed and compacted to 95% AASHTO T180 maximum density. The smoothness of paved areas shall be tested using a 4 m straightedge. The finished surface of concrete shall not deviate from straightedge between any two contact points by more than 5 mm. Sections of defective paving shall be removed and replaced as directed at the Contractor's expense.

3.4 FIELD QUALITY CONTROL

A. Remove and replace work that does not comply with specified requirements.

B. Additional testing and inspecting, at the Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS

A. Repair pre-cast concrete curbs and tiles to match color, texture, and uniformity of surrounding pre-cast concrete curbs and tiles if permitted by the Engineer.

B. Remove and replace damaged pre-cast concrete curb units and tiles if repairs do not comply with requirements.

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DIVISION 32 14 00

UNIT PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes the following:

1. Concrete pavers set in aggregate setting bed.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for compacted sub grade and sub base course, if any, under unit pavers.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Concrete pavers.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of unit paver indicated.

- Include similar samples of material for joints and accessories involving color selection.

C. Samples for Verification: Full-size units of each type of unit paver indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

- Provide samples with joints grouted and cured, showing the full range of colors to be expected in the completed Work.

D. **Qualification Data:** For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects/Consultants and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. **Installer Qualifications:** An experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. **Source Limitations:** Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. **Mockups:** Before installing unit pavers, build mockups for each form and pattern of unit pavers 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 the completed Work, including same base construction, special features for expansion joints, and contiguous work as indicated:

- Build mockups in the location and of the size indicated or, if not indicated, as directed by the Consultant.
- Notify the Consultant 7 days in advance of dates and times when mockups will be constructed.
- Demonstrate the proposed range of aesthetic effects and workmanship.
- Obtain the Consultant's approval of mockups before starting unit pavers

installation.

- Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- Demolish and remove mockups when directed.
- Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect unit pavers and aggregate during storage and construction against soiling or contamination from earth and other materials.

B. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strapping.

PART 2 - PRODUCTS

2.1 COLORS AND TEXTURES

A. **Colors and Textures:** As shown on drawings and as selected by the Consultant from the manufacturer's full range.

2.2 UNIT PAVERS

A. Concrete Pavers: Solid, interlocking paving units, ASTM C 936, made from normal- weight aggregates in sizes and shapes indicated. Interlocking Paving should be installed on 30-50 mm thick sand setting bed over 250 mm thick sub-base. The minimum thickness of concrete pavers shall be 60mm. Concrete pavers shall be tested for compressive strength, abrasion resistance, absorption, and dimensional tolerance. The test results shall comply with the requirements specified in ASTM C 936.

2.3 ACCESSORIES

A. **Precast Concrete Edge Restraints:** Precast concrete curbing, made from

normal- weight aggregate, in shapes and sizes indicated.

2.4 AGGREGATE SETTING-BED MATERIALS

A. **Graded Aggregate for Subbase:** Sound crushed stone or gravel complying with ASTM D 448 for Size No. 57.

B. **Graded Aggregate for Subbase:** ASTM D 2940, subbase material.

C. **Graded Aggregate for Base:** Sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

D. **Graded Aggregate for Base:** ASTM D 2940, base material.

E. **Sand for Leveling Course:** Sound, sharp, washed natural sand or crushed stone complying with gradation requirements of ASTM C 33 for fine aggregate.

F. **Stone Screenings for Leveling Course:** Sound stone screenings complying with ASTM D 448 for Size No. 10.

G. **Sand for Joints:** Fine, sharp, washed natural sand or crushed stone with 100 percent passing 1.18 mm sieve and no more than 10 percent passing 0.075 mm sieve.

- Provide sand of color needed to produce required joint color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with the Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Where pavers are to be installed over waterproofing, examine waterproofing installation, with the waterproofing Installer present, for

protection from paving operations. Examine areas where waterproofing system is turned up or flashed against vertical surfaces and horizontal waterproofing. Proceed with installation only after protection is in place.

3.2 PREPARATION

A. Vacuum clean concrete substrates to remove dirt, dust, debris, and loose particles.

B. Remove substances, from concrete substrates, that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

C. Proof-roll prepared sub grade surface to check for unstable areas and areas requiring additional compaction. Proceed with unit paver installation only after deficient sub grades have been corrected and are ready to receive subbase for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

For concrete pavers, a block splitter may be used.

D. **Joint Pattern:** Herringbone.

E. Tolerances: Do not exceed 0.8 mm unit-to-unit offset from flush

(lippage) nor 3mm in 3m from level, or indicated slope, for finished surface of paving.

3.4 AGGREGATE SETTING-BED PAVER APPLICATIONS

A. Compact soil sub grade uniformly to at least 95 percent of ASTM D 1557 laboratory density.

B. Place geotextile over prepared sub grade, overlapping ends and edges at least 300 mm.

C. Place aggregate subbase in thickness indicated. Compact by tamping with plate vibrator and screed to depth required to allow setting of pavers.

D. Place aggregate subbase over compacted sub grade. Provide compacted thickness indicated. Compact subbase to 100 percent of ASTM D 1557 maximum laboratory density and screed to depth required to allow setting of pavers.

E. Place geotextile over compacted base course, overlapping ends and edges at least 300 mm.

F. Place leveling course and screed to a thickness of 25 to 38 mm, taking care that moisture content remains constant, and density is loose and constant until pavers are set and compacted.

G. Treat leveling base with soil sterilizer to inhibit growth of grass and weeds.

H. Set pavers with a minimum joint width of 1.6 mm and a maximum of 3 mm, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 10 mm with pieces cut to fit from full-size unit pavers.

- When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

I. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 16- to 22 kN compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

- After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
- Before ending each day's work, fully compact installed concrete pavers to within 900 mm of the lying face. Cover open layers with non-staining plastic sheets overlapped 1200 mm on each side of the lying face to protect it from rain.

J. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

K. Do not allow traffic on installed pavers until sand has been vibrated into joints.

L. Repeat joint-filling process 30 days later.

3.5 REPAIR

Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

------x-x-x------

DIVISION 03 30 00

CAST IN PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes, but is not limited to, the following:

1. Foundations and footings.
2. Drilled piers
3. Slabs-on-grade
4. Fill for steel deck
5. Walls
6. Duct banks.
7. Equipment pads and bases.
8. Fill for steel pan stairs.
9. Landscape concrete paving for walkways and bands and Others.

C. The structural concrete elements shall be designed in accordance to the following codes and regulations:

1. 1997 Uniform Building Code.
2. Building Code Requirements for structural Concrete (ACI-318M-02) and Commentary (ACI 318RM-02).

D. The Contractor is to carry out the structural design of the various

project components following the basic design criteria stated in article 1 .2D.

REFERENCES:

American Concrete Institute (ACI):

ACI 117	Specifications for Standard Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 301	Specifications for Structural Concrete for Buildings
ACI 315	Standard Practice for Detailing Reinforced Concrete Structures
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347	Formwork for Concrete
ACI 504R	Guide to Joint Sealants for Concrete Structures

American Society for Testing and Materials (ASTM):

ASTM A 82	Standard Specification for Steel Wire Reinforcement, Plain, for Concrete
ASTM A 496	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTMA 615M	Standard Specification for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement
ASTMA 706M	Standard Specification for Low-Alloy Steel Deformed and Plain Bars
ASTM A 780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Standard Specification for Concrete Aggregates

ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C 127	Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
ASTM C 128	Standard Test Method for Density, Relative Density Specific Gravity) and Absorption of Fine Aggregate
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Standard Specification for Portland Cement
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

British Standards:

BS 812	Testing Aggregates
BS 882	Specification for Aggregates from Natural Sources for Concrete
BS 1881	Methods of Testing Concrete
BS 1199 and 1200	Specification for Building Sands from Natural Sources
BS 4027	Specification for Sulfate-Resisting Portland Cement
BS 4449	Specification for Carbon Steel Bars for the Reinforcement of

	Concrete
BS 8110	Structural Use of Concrete Part 1 (1997): Code of Practice for Design and Construction, Part 2 (1985): Code of Practice for Special Circumstances, Part 3 (1985): Design Charts for Singly Reinforced Beams, Doubly Reinforced Beams and Rectangular Columns
BS 8666	Specification for Scheduling, Dimensioning, Bending and Cutting of Steel Reinforcement for Concrete
EN 197	Part 1: Cement. Composition, Specifications and Conformity Criteria for Common Cements

1.3 SUBMITTAS

The Contractor's design deliverables should include but not limited to the following:

A. Detailed structural working drawings for concrete items showing the general arrangement, elevations, plans, sections and connection and reinforcement details.

Fully detailed structural calculation showing statical system, computer models, including input file data, using reputable software, and clear graphical illustration of straining actions, deformations along with design of all sections. The design calculations should abide by the design codes and design criteria mentioned in article 1.2D with clear reference to the grade of materials to adopt in the construction in light of the actual availability so that the later substitution are to be restricted.

B. **Steel Reinforcement Shop Drawings:** Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar

schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

C. **Formwork Shop Drawings:** Prepare shop drawings for formwork indicating fabrication and erection of forms for specified finish concrete surface. Show form construction including jointing, especial form joints or reveals, location and pattern of form tie placement. Prepare formwork drawings by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. The Engineer's review is for general architectural applications and features only. Design and engineering of formwork for structural stability and efficiency are the Contractor's responsibility.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

D. **Product Data:** For proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, water stops, joint systems, curing compounds, dry-shake finish materials, and others as requested by the Engineer.

E. **Design Mixes:** For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

F. **Material Test Reports:** From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials.

G. **Material Certificates:** Signed by manufacturers and contractor certifying that each of the following items complies with specified requirements:

- Cementitious materials and aggregates.

- Form materials and form-release agents.
- Steel reinforcement and reinforcement accessories
- A copy of the manufacturer's test certificate for ultimate strength, elongation and cold bending, together with the chemical analysis of the steel shall be submitted to the Engineer for each consignment of reinforcing steel delivered to the Project site.
- Fiber reinforcement
- **Admixtures:** Material certificates in lieu of material laboratory test reports when permitted by the Engineer. Material certificates shall be signed by the manufacturer and the Contractor, certifying that each material item complies with specified requirements. Provide certification from admixture manufacturers that chloride content complies with specified requirements.
- Water stops.
- Curing materials
- Floor and slab treatments.
- Bonding agents.
- Adhesives.
- Vapor retard ers.
- Epoxy joint filler.
- Joint-filler strips.
- Repair materials

H. **Samples:** Samples of materials as requested by the Engineer, with names, sources, and descriptions, including, but not limited to, the following:

- Color finishes.
- Normal-weight aggregates.

- Water stops, re injectable hosing, water swelling gaskets.

1.4 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.

B. **Codes and Standards:** Comply with 2001 Manual of Concrete Practice Parts 1, 2, 3, 4 & 5, and CRSI "Manual of Standard Practice" except where more stringent requirements are shown or specified.

C. **Concrete Quality Control Engineer:** Appoint a full-time Concrete Quality Control Engineer (CQCE) to ensure that concrete is properly produced, placed, cured and protected.

- The CQCE shall be authorized to:

a. Postpone concreting operations until outstanding requirements are corrected.

b. Reject materials or workmanship that do not conform to this Specification.

c. Prevent the use of equipment that could cause improper construction relative to this Specification.

d. Stop any work that is not being done in accordance with specified requirements.

e. Report within 24 hours and provide records to and as required by the Engineer upon discovery of non-compliance.

D. The Contractor shall operate a Quality Assurance System in accordance with ANSI Q9002. This Quality Assurance Manager shall be responsible for the preparation of a Quality Plan for approval of the operations specified in this Section. The Quality Plan shall include, among other things, the list and schedule of the Quality Control audits that the Quality Assurance Manager or his designee shall make.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

- Avoid damaging coatings on steel reinforcement.
- Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.

PART 2 – PRODUCTS

2.1 FORM MATERAIL

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. **Forms for Unexposed Finish Concrete:** Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. **Forms for Textured Finish Concrete:** Units of face design, size, arrangement, and configuration to match the Engineer's control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. **Forms for Cylindrical Columns and Supports:** Metal, glass-fiber-reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications. Provide units with sufficient wall

thickness to resist wet concrete loads without deformation.

E. **Form Release Agent:** Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form release agent with rust inhibiters for steel facing materials.

F. **Form Ties:** Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that shall leave no metal closer than 38 mm to the plane of the exposed concrete surface. No permanent metallic part shall have less concrete cover than the reinforcement. Provide ties that, when removed, will not leave holes larger than 25 mm in diameter in the concrete surface. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

G. **Chamfer Strips:** Wood, metal, PVC, or rubber strips 20mm x 20mm, size as indicated on drawing.

2.2 STEEL REINFORCEMENT

A. **Reinforcing Bars:** ASTM A 615M, Grade 60 (420 MPa) specified yield strength, or BS 4449 grade 460 Type 2 deformed, uncoated. One test per 5000 m length delivered to site.

B. **Plain-Steel Wire:** ASTM A 82, as drawn.

C. Only new material shall be furnished. On receipt and at time of installation, material shall be free of loose rust and loose mill scale, deleterious amounts of salts and coatings that reduce or destroy bond. Tight rust and mill scale or surface irregularities are acceptable if the weight and dimensions, including height of deformations and tensile

properties, of a test specimen that has been wire-brushed by hand, are not less than those required by the applicable Standards.

D. Reinforcement shall be accurately bent, cut or formed to the dimensions and configuration shown on Drawings and within the tolerances specified in ACI 315. Reinforcement shall be bent cold using pin sizes in accordance with ACI 318. Bars may be preheated only if prior approval has been requested and received. Reinforcement shall not be recent or straightened without prior approval.

- Reinforcement having a reduced section, kinks, visible transverse cracks at bends, or otherwise damaged in any way shall not be used. Galvanized steel shall not be used for reinforcement.
- Reinforcement shall not be welded unless specifically shown on Drawings or permitted as an exception and then only after approval of the welding method appropriate to the grade of steel and the type of welding rod to be used.

2.3 REINFORCEMENT ACCESSORIES

A. **Bar Supports:** Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

- For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless- steel bar supports.
- Other reinforcement supports shall consist of concrete spacer blocks made of the same materials, to the same specified requirements and with the same inherent properties as the parent material with the

exception that the maximum aggregate size shall be appropriate for the thickness of cover to the reinforcement.

B. **Joint Dowel Bars:** Plain-steel bars, ASTM A 615M, Grade 60 (420 MPa). Cut bars true to length with ends square and free of burrs.

C. Mechanical Splices (Couplers) of deformed high yield steel bars are to consist of two seamless steel sleeves and interconnecting high tensile steel stud with plastic protection caps for threaded section of sleeve. To be tested and the test to exceed 135% of the specified yield strength of grade 60 bar.

2.4 CONCRETE MATERIALS

A. Portland Cement: Cement shall be low alkali with chemical composition in accordance with Table 1 of ASTM C 150 or EN 197: Part 1. The magnesia content shall be limited to 4 percent by weight of cement, as tested in accordance with ASTM C 114. Use one brand of cement throughout Project unless otherwise approved by the Engineer. Manufacturer's test certification shall be supplied for each delivery of cement and shall confirm that the cement complies with the above requirements and shall be submitted by the Contractor not later than the day of delivery of the cement. The Engineer shall have the right to call for tests, the cost of which are to be borne by the Contractor, on each delivery of cement to confirm that the cement meets the following requirements.

1. Use Ordinary Portland Cement (OPC) conforming to ASTM C150, Type I. Cement meeting the requirements of rapid hardening Portland cement shall not be used and the heat of hydration shall not exceed 325 kj/kg when tested in accordance with ASTM C 186. C3A content shall be a maximum of 8 percent by weight as tested in accordance with ASTM C 114.

2. Moderate sulphate: According to ASTM C150 type II.
3. Sampling shall be carried out in accordance with EN 196: Part 7.
4. Test cement for fineness by air permeability apparatus in accordance with ASTM C 204 to meet the requirements of ASTM C 150.
5. Test cement for soundness, Autoclave expansion in accordance with ASTM C151.
6. Use white Portland cement in concrete for columns supporting polished precast concrete panel.

B. **Normal-Weight Aggregates:** Aggregates shall be from approved sources and shall conform to the requirements of ASTM C 33 and BS 882. Petrographic analyses shall be made in accordance with ASTM C 295. Aggregates for exposed concrete shall be from a single source and shall not contain substances that cause spalling. Only aggregates not susceptible to alkali aggregate reaction shall be used. The Contractor shall supply samples of the materials for approval by the Engineer and each aggregate source shall be subject to monitoring by the Engineer. Grading of aggregate shall be to the completion of BS 882.

1. **Coarse Aggregate:** Coarse aggregate size shall be 20 mm nominal and those retained on a 5mm sieve and shall consist of crushed or uncrushed gravel or crushed stone and shall be selected, re crushed, finish screened and washed with water meeting the requirements of Paragraph 2.4 as necessary to comply with the following:

Frequency of Tests	Test Description	Standard	Limit
Initial	Los Angeles Loss (Grading A or B)	ASTM C 13 1	25% max.
1 per day	Clay Lumps and	ASTM C 14	1.0%

	Friable Particles	2	maximum
1 per day	Material Finer than 75 Microns	ASTM C 117	1.0% maximum
1 per 7 days	Water Absorption	ASTM C 127	2.0% maximum
1 per 3 days	Chlorides as Cl	BS 812	0.03% maximum
1 per 3 days	Sulfates as SO3	BS 812	0.3% maximum
1 per 30 days	Magnesium Sulfate Soundness Loss (5 cycles)	ASTM C 88	5.0% maximum
1 per 3 days	Elongation Index	BS 812	25% maximum
1 per 7 days	Specific gravity		Minimum 2.6
1 per 2 days	Moisture Content		

* Additionally, limits specified in Paragraph 2.12.H for the total salt content of concrete shall not be exceeded.

2. **Fine Aggregate**: Fine aggregate, those passing a 5mm sieve, shall consist of crushed gravel, crushed stone, or natural sand with rounded or surrounded particles and shall be washed as necessary to comply with the following:

Test Description	Standard	Limit
Clay Lumps and Friable Particles	ASTM C 142	1.0% maximum
Material Finer than 75 Microns	ASTM C 117	maximum 3% for natural sand and 51 for crushed sand with no plastic fines
Water Absorption	ASTM C 128	1.0% maximum
Chlorides as Cl	BS 812	0.06% maximum
Sulfates as SO3	BS 812	0.30% maximum
Organic Impurities	ASTM C 40	Lighter than Standard

* Additionally, limits specified in Paragraph 2.12 for the total salt content of concrete shall not be exceeded.

3. Certification: Obtain from each proposed source of supply Test Certification to confirm that the aggregates comply with the above requirements. The following information shall be provided:

a. Quarry location.

b. Aggregate type.

c. Petrographic analysis report.

d. Grading curve.

e. Shape and surface texture.

f. Flakiness index.

g. 10 percent fines value.

h. Impact test.

i. Shell content.

j. Chloride and sulfate content.

k. Relative density.

l. Water absorption value and moisture content.

m. Silt, clay, and dust content.

n. Results of reactive silica tests.

o. Organic impurities (fine aggregate only).

4. Testing:

a. When a source of supply for each aggregate type had been established, samples of materials delivered to Project site shall be taken for testing in accordance with BS 812 as follows:

- Tests for clay, silt and dust, and sieve analysis shall be carried out for every 20 tons of fine aggregate and every 40 tons of coarse aggregate.
- Chemical analyses shall be carried out on every 100 tons of aggregate.

b. The Engineer shall have the right to call for additional samples at any time for testing of aggregates delivered to the Project site or of aggregates at the source of supply in order to confirm that the aggregates meet the above requirements.

5. **Transportation:** During transportation to the Project site, all aggregates shall be protected from wind-borne contaminants. If these contaminants are present at time of delivery to the Project site, then the aggregates shall be washed with water meeting the requirement of Paragraph 2.4.F. Transport vehicles shall be cleaned of possible contamination due to previous use.

6. **Storage:** Aggregates shall be stored (under shade) on hard concrete floors or other approved materials having sufficient slope to ensure adequate drainage of aggregate before being used for concrete and each size and type shall be stored in separate heaps without

intermixing. Storage shall prevent contamination of the aggregates by foreign material including windblown dust. Fine and coarse aggregates shall be separated by permanent substantial partitions. Methods of storing, shading and cooling aggregates shall be approved by the Engineer.

7. **Water:** Water used for mixing concrete, ice production, washing and cooling aggregates, and curing concrete shall be free from impurities, oil, acid, salts, alkali, organic matter, and other potentially deleterious substances in accordance with AASHTO T26 and when tested in accordance with ASTM D 512 and ASTM D 516. Additionally, the limits specified in Paragraph 2.12.H for the total salt content of the concrete shall not be exceeded.

- Once a source of satisfactory supply has been established, further tests shall be made daily with a portable electrical conductivity probe calibrated against the satisfactory supply. If the conductivity exceeds that of the satisfactory supply, then further chemical tests shall be performed.

8. **Lightweight Aggregate:** ASTM C 330.

- Nominal Maximum Aggregate Size: 20 mm.

2.5 ADMIXTURES

a. Admixtures containing Chlorides shall not be used.

b. **General:** No admixture shall be used in the concrete without the Engineer's written approval and under no circumstances shall admixtures containing chlorides or other corrosive agents be allowed. Admixture compatibility with the type of cement used shall be proven.

c. The Contractor shall perform a trial batch and casting to substantiate the manufacturer's claims of workability, retardation and

air entrainment (0 to 1.0 percent maximum), as specified in Article 2.14. Admixtures shall comply with the following standards: ASTM C494/C494 M, EN 934 and EN 480. Also, admixture shall comply with EN 12878 for pigments of cement.

d. **Air-Entraining Admixture:** No air entraining agent shall be used.

e. Admixtures shall be incorporated into the mix design strictly in accordance with the manufacturer's written instructions.

f. **High-Range Water-Reducing Admixture (Superplasticizer):** ASTM C 494, Type G.

- If necessary, and only with the Engineer's approval, a naphthalene sulphonate retarding superplasticizer shall be used to increase workability of the concrete and retard the initial set.
- Products: To produce fluid concrete with a slump value at least 200 mm, easily flowing, but at the same time free from segregation and having the same water/cement ratio as that of a no slump concrete with admixture. The product shall result in concrete that remains workable for a minimum of 3 hours at +20 deg C and for a minimum of 1 hour at +40 degree.
- Obtain from the retarding super plasticizer supplier, details of the material for review by the Engineer and confirmation that it is in accordance with specified requirements. Confirmation shall be obtained that the retarding super plasticizer is compatible with any pozzolan that is used.
- Glare-Reducing Agent: For landscape concrete paving, provide material for reducing glare. Comply with ASTM D 209.

g. **Water-Reducing Admixture (Plasticizer):** ASTM C 494, Type

h. **Water-Reducing and Accelerating Admixture:** ASTM C 494, Type E.

i. **Water-Reducing and Retarding Admixture:** ASTM C 494, Type D.

j. **Corrosion-Inhibiting Admixture:** Commercially formulated, mixed cathodic and anodic inhibitor based on Amines and Alcohol; capable of forming a protective barrier and absorbed on the reinforcement surface of concrete for protecting steel bars and minimizing chloride reactions with steel reinforcement in concrete.

2.6 WATERSTOPS

a. **Waterstops:** Provide flat, waterstops at construction joints below earth level and or for water structures and other joints. Waterstops shall be sized to suit joints.

- Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricates corners, intersections, and directional changes.
- Select profile from five subparagraphs below. Insert others if required.
- Profile: Flat, dumbbell with center bulb.
- Profile: Flat, dumbbell without center bulb.
- Profile: Ribbed with center bulb.
- Profile: Ribbed without center bulb.
- Profile: As indicated.

b. **Fine-Graded Granular Material:** Clean mixture of crushed stone, crushed gravel, and manufactured of natural sand; ASTM D 448, Size 10, with 100 percent passing a 4.75 mm sieve and 10 to 30 percent passing a 0.15 mm sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.

c. **Sand Cushion:** Clean, manufactured or natural sand.

d. **Absorptive Cover:** Burlap cloth made from jute or kenaf weighing approximately 0.29 kg/sq. m and complying with AASHTO M182, Class 2.

e. **Moisture-Retaining Cover (Impervious Sheeting):** One of the following, complying with ASTM C 171:

- Waterproof paper.
- Polyethylene film.
- Polyethylene-coated burlap.

f. **Evaporation Control:** Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

g. **Colored Wear-Resistant Finish:** Packaged dry combination of materials consisting of Portland cement, graded aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground non-fading mineral oxides interground with cement. Color shall be as selected by the Engineer from manufacturers' standards, unless otherwise indicated.

2.7 REPAIR MATERIAL

a. **Repair Underlayment:** Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 3 mm and that can be feathered at edges to match adjacent floor elevations.

- Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
- Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

b. Aggregate: Well-graded, washed gravel, 3 to 6 mm or coarse sand as recommended by underlayment manufacturer.

c. Compressive Strength: Not less than 30 MPa at 28 days when tested according to ASTM C 109M.

d. **Repair Topping:** Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 6 mm.

- Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
- Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
- Aggregate: Well-graded, washed gravel, 3 to 6 mm or coarse sand as recommended by topping manufacturer.
- Compressive Strength: Not less than 40MPa at 28 days when tested according to ASTM C 109M.

2.8 CONCRETE MIXES

a. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

- Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

b. Use a qualified independent testing agency acceptable to the Engineer for preparing and reporting proposed mix designs for the laboratory trial mix basis.

- Do not use the same testing agency for field quality control.

c. Submit written reports to the Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed and approved by the Engineer.

d. Design mixes to provide normal-weight concrete with the following properties unless otherwise indicated on Drawings:

e. Blinding Concrete: Proportion normal-weight concrete mix as follows:

- Compressive Strength (28 Days): 14MPa.
- Maximum: water cement ratio: 0.55.

f. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:

- Compressive Strength (28 Days): 40 MPa
- Maximum water cement ration: 0.4

g. Slab-on-Grade: Proportion normal-weight concrete mix as follows:

- Compressive Strength (28 Days): 30 MPa.
- Maximum water cement ratio:0.40

h. Light-weight concrete for topping steel deck: Proportion light-weight concrete mix with maximum specific gravity (1800 kg/cu.m) as follows:

- Compressive Strength (28 Days): 30 MPa.
- Maximum water cement ratio: 0.4
- Minimum cement content: 350 kg/cu.m.

2.9 Cement Content:

1. Structural concrete shall contain a minimum of 355 kg/cu. m of Ordinary Portland Cement (OPC) plus silica frame if needed. All concrete below ground shall have protective coating as specified.
2. Blinding/mudmat concrete shall contain sufficient OPC to obtain the specified design strength.

2.10 Water-Cement Ratio: The free water-cement ratio shall not exceed 0.40. The water-cement ratio shall be the water content divided by the cement. The water- cement ratio shall be continuously checked at the mixer with due allowance made for water contained in the aggregates. Under no circumstance shall water be added between the mixer and the place of concrete placement. The Engineer may require that the water-cement ratio be checked during tests performed on fresh concrete

samples taken at the time of placement as specified.

2.11 Slump Limits: The slump of concrete mixes shall be such that the concrete can be transported, placed into the forms, and compacted without segregation in accordance with Article 3.8. If no superplasticizer is required, the slump at time of placement shall be 50-75 mm as measured in accordance with ASTM C 143.

2.12 Total Salt Content:

1. Chlorides: The total chloride content (sum of both acid soluble and water soluble chlorides) of the concrete from all sources, expressed as chloride ion, shall not exceed 0.15 percent by weight of dry cement, when tested in accordance with BS 1881.
2. Sulfates: The total sulfate content of the concrete from all sources, expressed as SO3, when tested in accordance with BS 1881, shall not exceed 3 percent by weight of dry cement

2.13 Initial Setting Time:

1. The initial setting time shall be not less than one hour after the production concrete is discharged into the form. With a maximum time between mixing and placing concrete of one hour, the total time between mixing and initial set shall be a minimum of 2 hours. There shall be a maximum setting time of 6 hours.
2. When trial mixes are made to determine the workability of the concrete, the initial setting time of the cement paste shall be determined using the method defined in ASTM C 191 but at the maximum allowable temperature and with same proportions of retarding superplasticizer as specified in this Specification.

2.14 Test Construction:

1. Test Foundation: A test foundation footing and plinth shall be cast on grade to the details provided by the Engineer in

accordance with specified requirements. This shall be performed before any permanent works are constructed. The concrete shall be cured for the period required in Article 3.13, after which an epoxy coating shall be applied to that part of the plinth which would normally be above ground and a bitumen coating applied to the remainder of the plinth and the footing, all in accordance with Article 3.17.

2. Test Floor Slab: A 3 m by 4 m test area of 150 mm thick floor slab constructed of above ground reinforced concrete in accordance with this Specification shall be cast on grade and given a Class U4 finish as specified in Paragraph 3.11.E. The concrete shall be cured for the period specified in Article 3.13.

A. **Cementitious Materials:** Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Silica fume: 5%

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

C. Admixtures: Use admixtures according to the manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious

materials ratio below 0.50.

A. All to be as required and approved by the Engineer, for placement and workability. Use admixtures in accordance with the manufacturer's instructions. Ensure that the correct quantity of admixture is always used. The equipment to be used for dispensing and the method of incorporating the admixture into the concrete shall be subject to approval. The dispensing unit shall be translucent so that the operator can see the discharge of the admixture.

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice.

2.16 CONCRETE MIXING

A. **General**: Concrete production shall be in accordance with ACI 304. A checklist for concrete production shall be produced, such as that used by the NRMCA or approved equal.

1. Batching of materials shall be by weight. All weighing equipment shall be calibrated and documentation shall be provided to establish that the accuracy is continuously maintained in accordance with the requirements of ACI 304. Batching scale accuracy shall be in accordance with the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau or approved equal.

2. Furnish the necessary equipment and establish accurate procedures for determining the quantities of free moisture in the aggregates. Moisture determinations shall be made daily and whenever there is an apparent change in the moisture content. The moisture content shall be recorded. The moisture of aggregates shall be utilized in adjusting the weight of aggregate added to the mix. The water added to the mix shall be similarly adjusted.

B. **Job-Site Mixing:** All concrete mixed on Project site shall be in a batch mixer of approved size and design complying with ACI 304 and producing a uniform distribution of the materials throughout the mixed concrete in accordance with ASTM C 94 uniformity test. The contents of the drum shall be completely discharged before re-charging. After all the materials are in the mixer, mixing shall continue until the whole of the materials are uniformly distributed and the mass is of uniform color and consistency. In the case of concrete that contains silica fume with a density between 400-650 kg/cu. m, the mixing time shall be 50 percent greater than the requirement for concrete without silica fume.

1. Whenever mixing is to be suspended for half an hour or longer, the drum of the mixer shall be thoroughly washed out with clean water. Provide a competent operator who shall be in continuous control of the mixer. No retempering of concrete, which has partially hardened, by the addition of cement, aggregate, or water shall be allowed.

   Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

D. MIXED CONCRETE

1. Ready-Mixed concrete shall comply with the requirements of ASTM C 94 or BS 5328 and as follows:

- Concrete shall be centrally mixed off site and transported in an agitator truck. Truck mixing shall not be permitted.
- The plant and trucks shall be certified as meeting the requirements of the NRMCA Check List or approved equal.
- Details and information regarding the supplier proposed by

the contractor shall be submitted to the Engineer for approval.

- The sewer of ready mixed concrete shall not subsequently be charged without further approval of the Engineer

2. When air temperature is between 30 deg.C and 32 deg.C, delivery time from the time water is added to the mix until it is placed in its final position in the form shall not exceed 60 minutes. When air temperature is above 32 deg.C, delivery time shall not exceed 45 minutes.

3. Before discharging concrete at the point of delivery, provide the Engineer with a delivery ticket for each batch of concrete containing the following information as a minimum:

- Name or number of off-site concrete depot.
- Serial number for ticket.
- Date.
- Time of dispatch.
- Truck number.
- Name of Supplier.
- Grade or mix description of concrete.
- Type of cement.
- Cement content.
- Water/cement ratio.
- Nominal maximum size of aggregate.
- Source of aggregate, maximum size, weight of fine and coarse aggregate.
- Type or name of admixture, if included.
- Quantity of concrete in cubic meters.
- Certifying that chlorides and sulfate contents are within specified

limits and stating their values.

- Amount of concrete in cubic meter

PART 3 - EXECUTION

3.1 FORMWORK

- Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads. Design of formwork shall be the sole responsibility of the Contractor.
- Construct formwork so that concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
- Class A, 4 mm.

A. Construct forms tight enough to prevent loss of concrete mortar.

B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

C. Do not use rust-stained steel form-facing material.

D. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

E. Provide temporary openings for cleanouts and inspection ports where

interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

F. Chamfer exterior corners and edges of concrete receiving applied waterproofing membranes.

G. Do not chamfer corners or edges of concrete unless otherwise indicated.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form release agent, according to the manufacturer's written instructions, before placing reinforcement.

L. Where it is required to use internal ties and spacers, their type, spacing and use shall be to the, approved of the Engineer. In no circumstances shall these ties protrude out of the finished concrete, all ties must be cut back into the structural concrete and the surface made good to satisfy the requirements of the minimum spacing and cover.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

- Install anchor bolts, accurately located, to elevations required.
- Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
- Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. **General:** Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 10 deg.C for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. The Engineer shall be notified when the Contractor intends to remove any formwork at least 6 hours prior to starting the process.

C. Leave formwork, for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved the following:

- 28-day design compressive strength.
- At least 70 percent of 28-day design compressive strength.
- Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
- Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

D. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material

will not be acceptable for exposed surfaces. Apply new form release agent.

E. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Engineer.

3.4 SHORES AND RESHORES

A. Comply with ACI 318M, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete.

C. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. **Vapor Retarder:** Place, protect, and repair vapor retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

B. **General:** Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

C. Lap joints 150 mm and seal with manufacturer's recommended mastic or pressure- sensitive tape. Cover vapor retarder/barrier with sand cushion and compact to depth indicated.

3.6 STEEL REINFORCEMENT

A. **General:** Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Avoid cutting or puncturing vapor retarder/barrier and waterproofing membranes during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

C. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

D. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

E. Shipping and Storage:

1. Reinforcement shall be handled and shipped in a manner to avoid bending or other damage to the bars. Bars shall be bundled, separated in sizes and clearly marked by diameter size preferably for one placement, in accordance with the placement schedule and as follows:

a. Bars for separate buildings or large structures shall not be bundled together. Bars for small structures may be bundled together but each bar or group of bars that have the same piece mark shall be tagged and coded.

b. Metal tags or approved equal shall be provided and labeled with legible markings.

c. All bundles shall be tagged at each end. Tags shall show piece marks corresponding to the mark numbers on the placement drawings and on the bar list.

d. Bars shall be bundled in the largest size practical for handling and shipping.

2. Reinforcement shall be stored 1m above ground on platforms, skids or other approved supports and suitably spaced. Contact with the soil shall be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion.

F. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

G. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement on concrete blocks of a size to give the correct cover to the reinforcement. Concrete spacer blocks shall be made of the same materials, to the same specified requirements and have the same inherent properties as the parent material, but with the exception that the maximum aggregate size shall be appropriate for the thickness of cover to the reinforcement.

1. Chairs made of reinforcement shall be used to support the top mats of slab reinforcement and they shall be so dimensioned as to be stable during concreting operations. The chairs shall themselves be supported on concrete blocks as specified above.

H. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Ties at intersections shall be made with 1.5 mm diameter annealed wire with wire ends directed into concrete, not toward exposed concrete surfaces.

I. Concrete Cover:

1. Concrete cover to reinforcement shall be as indicated on Drawings but shall not be less than the following:

a. Cover for all concrete below grade and waterproofed shall be 50 mm.

b. Cover for all other exterior exposed concrete faces shall be 50 mm.

c. Cover for all other interior protected faces shall be 40 mm, except slabs which shall be 25 mm.

2. Cover to reinforcement shall be checked before any concrete is cast. The bending of reinforcement at a cold joint is not permitted. Concrete cover shall be checked with a cover meter as soon as formwork is removed.

J. All lap splices shall be in accordance with ACI 318 class B tension lap splice unless otherwise shown on Drawings. All reinforcement bars shall be developed in accordance with ACI 318 unless otherwise shown on Drawings. Welded wire fabric shall be lapped 1.5 mesh plus the extension on the wires unless otherwise shown on Drawings.

3.7 JOINTS

A. **General:** Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints.

1. Locate and install construction joints so that they do not impair strength or appearance of the structure and are acceptable to the Engineer. Unless otherwise shown or approved, provide and locate construction joints in accordance with ACI 301. Where construction joints are indicated in construction documents, no deviation shall be allowed without the approval of the Engineer. Additional joints shall be kept to a minimum and must be approved by the Engineer. The joint surface shall be roughened to remove laitance without disturbing the coarse aggregate by pressure jetting with air and water or by wire brushing. The joint shall be clean prior to placing fresh concrete. The

new concrete shall be well worked against the old concrete to ensure a good joint.

2. The use of expanded metal or other perforated material is prohibited in construction joints.

3. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

4. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders.

6. Space vertical joints in walls as indicated, or as required by the Engineer.

7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

8. Waterstops: Provide waterstops in construction joints. Install waterstops to form a continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to the manufacturer's printed instructions.

C. **Contraction Joints in Slabs-on-Grade:** Form weakened-plane contraction joints, sectioning concrete into areas. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 3 mm. Repeat

grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3 mm wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. **Isolation Joints in Slabs-on-Grade:** After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface.
2. Terminate full-width joint-filler strips not less than 12 mm or more than 25 mm below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. **Dowel Joints:** Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

F. **Score Joints for Landscape Concrete Paving**: As shown on Drawings.

G. Unless otherwise indicated on design drawings, joint sealing shall be in accordance with ACI 504R.

3.8 WATERSTOPS

A. **Self-Expanding Strip Waterstops:** Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into

place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. **General:** Comply with ACI 301, ACI 304, and ACI 318.

B. **Inspection:** Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work. Concrete shall not be placed until the condition of the reinforcement, other embedded items, and the formwork has been inspected and approved by the Engineer.

C. **Transportation:** Concrete, after being discharged from the mixer, shall be transported as rapidly as possible to its final position in the Work by agitator trucks, which shall prevent adulteration, segregation, loss of workability or contamination of the ingredients. The containers that convey the concrete shall be kept clean and free from hardened or partially hardened concrete.

1. The addition of water at the point of discharge is prohibited and trucks shall have the water tank completely disconnected from the drum.
2. The use of chutes, spouts, skips and pumps shall be permitted if approval is obtained. Under no circumstances shall any aluminum pipe or other conveying equipment containing aluminum be allowed to contact fresh concrete when it is conveyed to its point of placement.
3. Method of pouring and pouring sequence shall be submitted by the Contractor to the Engineer's approval.

D. **Placing Concrete in Forms:** Deposit concrete in forms continuously or in horizontal layers no deeper than 450 mm and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while the preceding layer is still plastic to avoid cold joints. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

1. Concrete shall not be dropped into place from a height exceeding 1.5 m nor through dense reinforcing steel, which could cause segregation of the coarse aggregate. Structural concreting against open excavation will not be permitted as the concrete cannot be coated afterwards.
2. When vertical lifts of concrete are interrupted or delayed for more than one hour, the surface of the unfinished concrete shall be thoroughly cleaned and washed with cement grout immediately before fresh concrete is added and the first layer of new concrete placed shall not exceed 150mm depth and particular care shall be taken with compaction of this new layer to ensure good bond.
3. Method of pouring and pouring sequence shall be submitted by the Contractor to the Engineer's approval.

E. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by the Engineer.

F. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

G. Deposit concrete in forms in horizontal layers no deeper than 600 mm and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than

the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 150 mm into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

H. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open- textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

I. **Compaction and Vibration:** Full compaction of the concrete shall be achieved throughout the entire depth of the layer. It shall be thoroughly worked against the formwork and around the reinforcement and successive layers shall be thoroughly bonded together. Air bubbles formed during the mixing and casting shall be expelled particular care shall be taken where sloping formwork is used.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with

ACI 309.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 150 mm into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, avoid over vibration and limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

J. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Maintain reinforcing in proper position during concrete placement.

K. **Hot-Weather Placement:** When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 25 deg.C. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is the Contractor's option.

2. Concrete temperature shall not exceed 32 deg. C and the temperature differential shall not exceed 25 deg. C.
3. No concreting operation shall be carried out at ambient temperature of 40 deg. C or more.
4. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
5. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
6. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to the Engineer.
7. Shade mixing plant and trucks, aggregates, water tank, and cement silo.
8. Paint white the mixing plant, trucks, water tank, and cement silo.
9. Insulate the water tank and supply piping.
10. Provide necessary shades over and around the concrete being poured to prevent sun rays from coming into direct contact with the surface of the concrete and the formwork for a period of about 7 days (minimum from the time of pouring concrete).
11. Concrete placing shall be completed as quickly as possible to reduce transit time.
12. Curing of exported concrete shall be immediately carried out.

3.10 FINISHING FORMED SURFACES

A. **Rough-Formed Finish (Class F1):** Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. Concrete surface texture is that imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 7 mm in

height rubbed down or chipped off. This finish class is not applicable to elements where backfill is to be placed against the concrete.

B. **Smooth-Formed Finish (Class F2):** Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed. No ledges shall be permitted at the position of joints in the formwork.

C. **Smooth-Rubbed Finish (Class F3):** Provide smooth-rubbed finish not later than 1 day after form removal on scheduled concrete surfaces that have received smooth- formed finish treatment. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. **Grout-Cleaned Finish (Class F4):** Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.

1. Combine one part Portland cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland cement and white Portland cement in amounts determined by trial patches so that final color of dry grout shall match adjacent surfaces.

2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean

burlap. Keep damp by fog spray for at least 36 hours after rubbing.

3.11 FINISHING FLOORS AND SLABS

A. **General:** Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. **Scratch Finish (U1):** Apply scratch finish to monolithic slab surfaces receiving concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured in accordance with ASTM E 1155M. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

C. **Nonslip Broom Finish (U2):** Apply a nonslip broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with the Engineer before application.

D. **Float Finish (U3):** Apply float finish to monolithic slab surfaces receiving trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or

both. Consolidate surface with power- driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured in accordance with ASTM E 1155M. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

E. **Trowel Finish (U4):** Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film finish coating system. This finish is also applicable to tops of buried foundations since they have to be subsequently coated.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances in accordance with ASTM E1155M of the following:

a. Specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15.

b. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-grade.

c. Specified overall values of flatness, F(F) 30; and levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and levelness, F(L) 15; for suspended slabs.

d. Specified overall values of flatness, F(F) 45; and levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and levelness, F(L) 24.

2. Grind smooth any surface defects that would telegraph through applied floor covering system.
3. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 3 m long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:
   a. 7 mm.
   b. 5 mm.
   c. 3 mm.

F. **Trowel and Fine Broom Finish (U5):** Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

G. **Colored Wear-Resistant Finish (U6):** Apply a colored wear-resistant finish to monolithic slab surface indicated.

1. Apply dry shake materials for the colored wear-resistant finish at a rate of 5 kg/sq. m, unless a greater amount is recommended by material manufacturer.
2. Cast a trial slab approximately 3 m square to determine actual application rate, color, and finish, as acceptable to the Engineer.
3. Following placement, vibrating and leveling, float the concrete with a wooden float to “open” the surface and allow the excess moisture and air to escape.
4. Once the sheen has disappeared, apply floor hardener as a dry shake onto the wet surface. Apply approximately one-half of the material and then float into the surface with a wooden float.
5. Following the first float, apply the balance of the material and float in the same fashion.
6. Once the surface is firm enough to take foot traffic, use a power float to

finish the surface to a smooth and non-slip finish.

7. After floating, apply a trowel finish as specified. Cure slab surface with a curing compound recommended by the dry shake material manufacturer. Apply the curing compound immediately after the final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. **Filling In:** Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. **Curbs:** Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. **Equipment Bases and Foundations:** Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

D. **Steel Pan Stairs:** Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

E. Tolerance and concrete dimensions for in-situ concrete members shall, under no circumstances, exceed the permissible ones as indicated in the ACI.

3.13 CONCRETE PROTECTION AND CURING

A. **General:** Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-

weather protection during curing.

B. **Evaporation Retarder:** Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 1 kg/sq. m x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. **Formed Surfaces:** Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. **Unformed Surfaces:** Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 300 mm lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture- retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 300 mm, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using

cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture- retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

E. **Curing Methods:** Cure concrete by curing compound, by moist curing, by moisture- retaining cover curing, or by combining these methods, as specified below.

1. Horizontal Surfaces: Horizontal surfaces shall be saturated with water and then treated with curing compound. Apply curing compound as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. The surfaces shall then be bonded and flooded with water or draped with wet burlap together with a perforated soaker hosepipe, covered with white impervious sheeting held firmly in place along all edges and kept continuously wet for the duration of the curing period.

2. Vertical Surfaces: Vertical timber formwork shall be draped with wet burlap as soon as concrete is placed. Vertical surfaces shall be treated with curing compound as soon as formwork is removed, draped with wet burlap, covered with white impervious sheeting held firmly in place along all edges and kept continuously wet for the duration of the curing period. Care shall be taken to avoid drying winds.

3. Impervious Sheeting: Impervious sheeting shall be in accordance with ASTM C 171.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

A. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid epoxy joint filler full depth in saw-cut joints and at least 50 mm deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Concrete exposed by the removal of formwork shall be inspected by the Engineer before any remedial work, subsequent coating or other treatment that would hinder the proper inspection of the concrete is carried out. Any concrete not complying with this requirement shall be liable for rejection.

B. Concrete not meeting the specified requirements shall be removed and rebuilt without delay unless the Engineer approves that a repair may be satisfactorily affected. This agreement shall not preclude the subsequent rejection of the repaired work by the Engineer. The proposed method for removal and replacement of defective work shall be submitted to the Engineer for approval for each concrete placement before the removal commences.

C. All repairs approved by the Engineer shall be performed by a subcontractor specialized in the repair of concrete in the Middle East

and prepared to guarantee the work. Any repair method submitted for approval shall produce a result that is as impermeable as the original concrete. Subsequent tests on the repaired concrete shall be carried out at the discretion of the Engineer in order to establish the quality of the repair, particularly at the joint between the original and the repaired concrete.

D. **Defective Concrete:** Repair and patch defective areas when approved by the Engineer. Remove and replace concrete that cannot be repaired and patched to the Engineer's approval.

E. **Patching Mortar:** Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a 1.2 mm sieve, using only enough water for handling and placing.

F. **Repairing Formed Surfaces:** Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 13 mm in any dimension in solid concrete but not less than 25 mm in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than

surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the Engineer.

G. **Repairing Unformed Surfaces:** Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.25 mm wide or that penetrate to reinforcement or completely through un-reinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 6 mm to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 25 mm or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 20 mm clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 25 mm or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

H. Perform structural repairs of concrete, subject to the Engineer's approval, using epoxy adhesive and patching mortar.

I. Repair materials and installation not specified above may be used, subject to the Engineer's approval.

3.16 CONCRETE PROTECTION - RAFT, FOUNDATION, WALLS, COLUMN NECKS AND OTHER BURIED STRUCTURES

A. All foundations, rafts, pile caps, strap and tie beams, column necks, etc., in contact with the soil or binding shall be protected by one layer of non-reinforced SBS (20%) modified membrane as specified below.

B. The blinding and concrete surfaces to which the membrane is to be applied shall be clean, smooth, dry, free of fins, sharp edges, loose and

foreign materials, oil and grease.

C. All imperfections, depressions, hollows, etc shall be made good and prepared to receive the tanking/water proofing membrane.

D. Cement sand fillet 50 x 50 mm shall be provided at all internal corners and all external corners shall be chamfered to provide smooth transition.

E. The shoring system wall shall be shotcrete and if need be plastered to obtain an even, smooth surface for the application of tanking as recommended by the applicator and as approved by the Engineer. After the shotcrete/plaster has cured and dried for at least 3 days, the surface shall be cleaned of all grease, oil, dust, loose material, etc and shall present a sound and smooth surface in one straight plane, free of any sharp protrusions or depressions and any extraneous matter.

F. The horizontal membranes shall be protected by a layer of slip-sheet of minimum 200 gm/m2 and a layer of cement sand screed of minimum 30 mm thickness against damage from reinforcement and site traffic. The area of the membrane laid at any one time should not exceed that which can be protected by screed in the same period. Care should be exercised in the sequence of laying screed to ensure that the membrane laid is damaged due to site traffic or other trade works or any other cause.

G. The membrane laid vertically shall be protected by a continuous wall of extruded polystyrene boards 25 mm thick spot bonded all along the edges and the centre of the boards to the membrane as recommended by the manufacture and/or as directed by the Engineer to prevent any damages from wall reinforcements and formwork.

H. Extreme care shall be taken not to damage the membrane during the erection of reinforcement steel and shuttering for wall. The area

of the membrane/polystyrene that is outside the limits of concrete shall be protected as approved by the Engineer.

I. A layer of 3 mm thick sand cement screed for horizontal layers and a layer of Protection board for vertical layers shall be used to protect the membrane from damage against back filling for all foundation members other than the basement walls (which shall be protected as detailed above).

J. The priming of the surfaces, the laying of the membrane, laps and joining of the membrane and application shall be as per the recommendations of the manufacturer and to the approval of the Engineer.

K. The treatment/termination of the membrane at the top most position above ground level shall be as recommended by the applicator and subject to the approval of the Engineer.

L. Alternative waterproofing systems may be submitted to the Engineer for review and approval. Submittal shall include technical data and case histories sufficient for the Engineer to do a technical evaluation of the proposed systems.

M. Install membrane system in accordance with the membrane manufacturer's instructions.

N. Submit the following to the Engineer for approval before beginning the work:

1. List of all membrane materials, joint compounds, and concrete surfaces to be used in the Work. List shall identify the specific products by manufacturer and catalog number.

2. Procedures for material storage and handling, surface preparation, environmental control, application sequence, overlap dimensions, touch-up and repair, curing, and inspection of the

membrane system. The membrane manufacturer's published instructions and installation details shall be attached as part of submitted procedures. Conflicts between the material manufacturer's recommendations and Contract Documents shall be noted in writing to the Engineer for resolution.

3. Cleaning and installation verification forms for daily inspection records. A detailed cleaning and installation verification report in accepted form shall be completed each day during the work and submitted for record. The final verification report shall include a statement of completion conformance verifying that the required materials were used and that the accepted application procedures and specified requirements were followed.

4. Details concerning corners, bottom slab to wall tie-ins, slab/wall/roof penetrations, terminations, control joints, expansion joint, and crack control.

5. Manufacturer material safety data sheets for all materials used in the execution of the work.

O. Arrange for the material manufacturer's technical representative to be present at the beginning of work and to qualify installation personnel in the installation of the manufacturer's waterproofing products.

P. **Joints:** Unless otherwise shown on design drawings, joints shall be designed and constructed in accordance with ACI 504R. Details and positioning of joints, together with the materials to be used, shall be submitted for the Engineer's approval.

1. Waterstops shall be in accordance with Paragraph 2.8A. Jointing of waterstops shall be made by welding in an approved fashion. Lapping of waterstops at joints and the use of adhesives for jointing

purposes will not be permitted unless approved by the Engineer. Waterstops shall not be perforated or damaged. Concrete shall be carefully placed and compacted to ensure dense impervious concrete, particularly around the ribs of waterstops. At all joints except for expansion joints as indicated on Drawings, the concrete shall be placed up to the centerline of the waterstop. All starters to walls of watertight construction shall be cast using hung formwork so that the concrete in the starters is placed simultaneously with the concrete in the slab

3.17 GROUTING

A. **Preparation:** Concrete foundation top shall be cleaned of dirt, laitance, oil and grease. Anchor bolt boxes and sleeves shall be cleaned of all polystyrene and other deleterious material. The surface of the concrete shall be thoroughly wetted just prior to grouting but shall contain no excess water, particularly in the bolt boxes and sleeves.

B. Materials:

1. Type G1: For interior bases protected from weather and saline bearing waters and not subject to heavy or vibratory loads, grout shall consist of one part Portland cement to two parts well graded sand by volume. Sand shall comply with Paragraph 2.5.C.2.A retarding superplasticizer may be used if necessary to obtain the correct fluidity in high ambient temperatures.
2. Type G2: For all heavily loaded structural column bases and equipment bases subjected to vibratory loads, a proprietary non-shrink, non-metallic high strength grout especially formulated for high-temperature work.
3. Type G3: For all other exterior work exposed to potential saline ingress, a proprietary general purpose non-shrink grout, especially

formulated for high temperature work.

C. Placement:

1. The manufacturer's recommendations shall be followed for proprietary grouts. The temperature of the grout at time of placement shall not exceed 25 deg.C (77 deg. F) and the temperature of the elements in contact with the grout shall not exceed 40 deg.C (104 deg. F) . To obtain the required temperatures, it may be necessary to do the following:

a. Shield the materials from the direct rays of the sun.

b. Mix materials with flaked ice.

c. Cool base plates with water but ensure that anchor bolt pockets are free from water.

d. Require certification of plant and trucks to meet requirements

2. Grout strength shall not be less than 30 N/sq.mm at 28 days. Document to Engineer that this strength is being achieved. Grouting shall not proceed until the steel work or equipment has been leveled and plumbed with the bases being supported in the meantime by steel packers and shims.

3. Completely fill anchor bolt sleeves with grout before placing grout under base plates. The gravity grouting method shall be used wherein the flowable self- leveling grout is poured on one side of a base until it flows out at the opposite side. Packers and shims used to level bases shall be removed after the grout has set and the resulting pocket repaired with similar grout.

3.18 WATER-RETAINING CONSTRUCTION

A. **General:** Water-retaining construction shall comply with this Specification.

B. **Joints:** Joints shall be designed and constructed in accordance with

ACI 504R. Details and positioning of joints, together with the materials to be used, shall be shown on the Drawings.

1. Water stops shall be in accordance with Paragraph 2.6.A. Jointing of water stops shall be made by welding in an approved fashion. Lapping of water stops at joints and the use of adhesives for jointing purposes shall not be permitted unless specifically authorized. Water stops shall not be perforated or damaged. Concrete shall be carefully placed and compacted to ensure dense impervious concrete, particularly around the ribs of water stops. At all joints the concrete shall be placed up to the centerline of the water stop. All starters to walls of watertight construction shall be cast using hung formwork so that the concrete in the starters is placed simultaneously with the concrete in the slab.

C. **Coating:** Coat inside faces of structures containing waters with protective coating as per section 07162.

D. **Testing:** In addition to the testing required in Paragraph 3.19.C, further tests to determine the watertightness of the structure shall be performed in accordance with BS 8007. The structure shall be filled with fresh water to the designed level and after a period to allow for absorption of water, the faces remote from the liquid shall be inspected for leaks over a 7-day period. Any defects shall be repaired by an approved method, which could involve demolition and rebuilding, or lining of the structure.

3.19 QUALITY CONTROL AND TESTING

A. General:

1. Testing Laboratory:

a. Employ an independent testing agency to perform tests and to submit test reports.

b. Be responsible for taking, identifying and delivering to the test laboratory all test samples called for in this Specification. The testing laboratory shall be responsible for the testing. Collect all test results and deliver them to the Engineer in the format and detail as specified.

2. Testing Laboratory Qualifications: The testing laboratory shall be accredited by NAMAS or an equivalent National Standard and shall have a Quality System in accordance with ANSI Q9001.

B. **Quality Control - Testing on Fresh Concrete:** Compressive Strength Test for Structural Concrete:

a. Sampling, curing and testing shall be performed using the relevant procedures in ASTM C 31, ASTM C 39, and ASTM C 172.

1) Samples for production of concrete cylinders shall be taken at the point of placement at the average rate of one per 25 cu. m of concrete placed, with a minimum of one sample taken every day that the mix is used. A sample shall consist of six 150 mm cylinders molded and stored for laboratory-cured test specimens except when field-cured test specimens are required. Three cylinders are for testing at 7 days after casting, three for testing at 28 days after casting.

2) If frequency of testing provides fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

3) When total quantity of a given class of concrete is less than 25 cu. m, the Engineer may waive strength testing if adequate evidence of satisfactory strength is provided.

4) When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in- place concrete.

b. Records: Records shall be kept of the mix details and position in the works of all batches of concrete and of all samples taken for cylinders and other specimens and of their test results. A copy shall be supplied to the Engineer within 24 hours after recording/testing. Records shall contain, but not be limited to, the following information:

1) Date, time, location, and volume of pour.
2) Concrete temperature (at time of placement).
3) Cement type and manufacture.
4) Concrete type and class.
5) Aggregate type and source.
6) Admixture details.
7) Water/cement ratio

c. For the 28-day tests, the concrete will be deemed to comply with the specified design strength if the average strength determined from all sets of 3 consecutive tests is at least equal to the specified design strength and no individual strength test falls below the specified design strength by more than 3.5 N/sq. mm. Any concrete not complying with the specified design strength shall be at risk for removal and replacement at the Contractor's expense.

d. The 28-day cylinder crushing results shall be grouped consecutively in groups of 40 and each group shall have a standard deviation less than 3.5 N/sq. mm. If the standard deviation is greater than or equal to 3.5 N/sq. mm, then concrete production shall be investigated by the Engineer and further tests on trial mixes may be

required.

e. Tests shall be carried out at 7 days to establish a relationship between the 7-day and 28-day strengths. This relationship shall be used to interpret future test results in order to predict the corresponding 28-day strength. The Engineer shall be advised without delay of any 7-day test result indicating that the corresponding 28-day strength will likely fail to meet the specified strength so that any necessary action can be taken to minimize the effect of such possible failure.

5. Salt Content: The total concentration of sulfates and chlorides in fresh concrete shall be measured at least once a week for all structural grades of concrete. Tests shall be in accordance with BS 1881. Concentrations of each ion shall not exceed the limits specified in Paragraph 2.12. If these limits are exceeded, the concrete pour from which the samples were taken shall be rejected and further tests performed on the casted concrete in accordance with Paragraph 3.19.C to determine the total extent of the problem.

6. Slump: Slump tests shall be performed in accordance with ASTM C 143. There shall be a minimum of one test at the point of discharge for each day's pour for each type of concrete. Additional tests shall be performed when concrete consistency appears to have changed

C. **Quality Control - Testing on Hardened Concrete:**

1. General: The Engineer may request samples to be taken and tests carried out on any hardened structural grade concrete as specified below if he suspects that the concrete does not meet the specified requirements. If the tests confirm that the concrete does not meet the requirements of this Specification, then the Engineer may require the concrete to be removed at the Contractor’s expense. If the tests confirm

that the concrete meets the requirements of this Specification, then the cost of taking the samples shall not be at the Contractor's expense.

2. Compressive Strength Tests: The Engineer may request cores to be drilled from a particular pour. 100 mm diameter cores shall be drilled as requested, in accordance with ASTM C 42, and sent for crushing. If the cores from that pour have an average compressive strength less than 85 percent of the characteristic strength or any individual core has a compressive strength less than 75 percent of the characteristic strength, it shall be evidence that the concrete from which it was taken is not in accordance with the specified requirements.

3. Concrete Cover: The Engineer may check the concrete cover over the reinforcement with a cover meter. Any indication that the cover is generally less than the requirements specified in Paragraph 3.6 shall be checked by limited surface concrete removal. If it is confirmed that the actual cover is generally less than specified, then the concrete shall be removed at the Contractor's expense. In the case of localized lack of cover and where appearance is not important, a repair shall be effected by removal of the inadequate cover and the cutting back of concrete for 50 mm behind the reinforcement. Resurfacing of the concrete with the specified cover shall be carried out as a repair by a specialist subcontractor as specified in Article 3.16.

4. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be used but shall not be used as the sole basis for acceptance or rejection.

5. Additional Tests: The testing agency shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as

directed by the Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

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DIVISION 04 20 00

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section covers the work of concrete masonry assemblies and includes:

1. Non-fire rated masonry assemblies.
2. Fire rated masonry assemblies.
3. Reinforced masonry assemblies.

B. This Section includes unit masonry assemblies consisting of the following:

1. Concrete Masonry Units.
2. Mortar and Grout Materials.
3. Ties and Anchors.
4. Miscellaneous Masonry Accessories.
5. Mortar and Grout Mixes.
6. Joint Reinforcement.

a. Horizontal reinforcement.

b. Vertical reinforcement.

C. Products installed, but not furnished, under this Section include the following:

1. Hollow-metal frames in unit masonry openings, furnished under Division 8, Section "Custom Steel Doors and Frames."
2. Steel Lintels for Unit Masonry Specified in Division 5 “Metal Fabrications”.
3. Manufactured regrets in masonry joints for metal flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."

1.3 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the net-area compressive strengths (f'm) at 28 days indicated in part 2.

1. For Concrete Unit Masonry: As follows, based on net area:

a. f'm = 10.3 MPa.

1.4 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: Shop drawings including full details of masonry works for different assemblies and covering anchorage to concrete elements cavity walls and flashings, masonry reinforcement, bond pattern, joints, horizontal joint reinforcement, openings, lintels and other details as the Engineer may require.

C. Samples: For the following:

1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
2. Accessories embedded in the masonry.
3. Reinforcing bars and accessories.

D. Qualification Data: For firms and persons specified in "Quality

Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. **Material Test Reports:** From a qualified independent testing agency employed and paid by contractor or manufacturer indicating and interpreting test results relative to compliance of the following proposed masonry materials for compliance with requirements indicated:

1. Each type of masonry unit required.

a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.

b. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Mortar complying with property requirements of ASTM C 270.

3. Grout mixes, Include description of type and proportions of grout ingredients.

F. **Material Certificates:** Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.

a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.

b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to test methods stated in Clause 1.5/F of this Section.
4. Each material and grade indicated for reinforcing bars.
5. Each type and size of anchor, tie, and metal accessory.
6. Each type and size of joint reinforcement.

1.5 QUALITY ASSURANCE

A. **Contractor** shall perform a survey and inspection of foundations for compliance with dimensional tolerances. Full comprehensive report shall be submitted to the Engineer prior to commencing building masonry assemblies on foundations.

B. **Quality System**: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Engineer and the Employer.

C. **Testing Agency Qualifications**: To qualify for acceptance, an independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of agency- submitted criteria conforming to ASTM C1093, that it has the experience and compatibility to satisfactorily conduct the testing indicated without delaying the work.

D. **Mockups:** Before installing unit masonry, build mockups 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 the completed Work:

1. Locate mockups in the locations indicated or, if not indicated, as directed by Engineer.
2. Build mockups of reinforced assembly, double walls, typical cavity wall and single-wythe wall areas as shown on Drawings.
3. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Engineer in writing.
7. Approved mockups will become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are in an air-dried condition.

1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2 - PRODUCT

2.1 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows for each form of concrete masonry unit required**.**

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless indicated as bullnose.
3. Provide bullnose units for outside corners, unless otherwise indicated.
4. Types of concrete masonry shall be as follows:

a. Use solid blocks for all below-grade assemblies.

b. Use solid blocks for walls, partitions or wythes to be finished with mechanically attached dimension stone cladding.

c. Use solid blocks or units for 4” thick partitions.

d. Use units open from both sides for reinforced masonry assemblies.

e. Use cellular blocks (open from one side) for other assemblies.

B. **Concrete Masonry Units:** ASTM C 90 and as follows**:**

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified in Clause 1.3/A of this Section.
2. Weight Classification: Normal weight.
3. Provide moisture-controlled units. All masonry units shall be factory cured.
4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

a. Where units are to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

5. Cement: ASTMC 150, Type I, Gray color.
6. Aggregates: Do not use aggregates made from pumice, scoria, or tuff.

2.2 MORTAR AND GROUT MATERIALS

A. **Portland Cement:** ASTM C 150, Type I. Provide gray color.

B. **Hydrated Lime:** Do not use Lime.

C. **Pre-Packaged Portland Cement Mix:** Pre-Packaged blend of Portland cement, water, and aggregate complying with requirements specified in this Article combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142. Compressive strength at 28 days shall not be less than 5 MPa (minimum cement sand ratio 1:3-4 by volume).

D. **Aggregate for Mortar:** ASTM C 144.

1. White-Mortar Aggregates: Natural white sand or ground white stone.

E. **Aggregate for Grout:** ASTM C 404.

F. **Water:** Potable.

2.3 REINFORCED STEEL BARS

A. **Deformed High Yield Steel Bars:** BS 4449, Grade 460.

B. **Reinforcing Bar Positioners:** Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 4.8-mm steel wire, hot-dip galvanized after fabrication.

a. Provide units with either two loops or four loops as needed for number of bars indicated or calculated.

2.4 TIES AND ANCHORS, GENERAL

A. **General:** Provide ties and anchors, specified in subsequent articles that comply with requirements for metal and size of this Article, unless otherwise indicated.

B. **Wire:** As follows:

1. Stainless-Steel Wire: ASTM A 580, Type 304.
2. Wire Diameter: 6.4 mm.

C. **Stainless Steel Sheet:** As follows:

1. Stainless-Steel Sheet: ASTM A 167, Type 304.
2. Stainless-Steel Sheet Thickness: 2.8 mm.

D. **Stainless-Steel Plates, Bars, and Dowels:** ASTM A 167, ASTM A 276, or ASTM A 666, Type 304; temper as required to support loads imposed without exceeding allowable design stresses.

2.5 ADJUSTABLE ANCHORS FOR CONNECTING TO STRUCTURAL STEEL FRAME

A. **General:** Provide two-piece assemblies as described below, allowing vertical or horizontal differential movement between wall and frame

parallel to plane of wall but resisting tension and compression forces perpendicular to it.

1. Manufacturer's standard anchors with crimped 6.4 mm diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 25 mm of masonry face and as follows:
2. Welding to Steel Structural Framing: Comply with requirements specified in Division 5, Section "Structural Steel".
3. Touch-Up Painting: Paint welds with two coats of zinc rich paint to ASTM A 780.

B. **Wire Diameter:** 6.4 mm.

2.6 ANCHORS FOR CONNECTING TO CONCRETE

A. **General:** Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section: Dovetail anchor section formed from 1.6-mm thick, stainless- steel sheet.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 25 mm of masonry face, made from 6.4-mm diameter.

2.7 MORTAR AND GROUT MIXES

A. **General:** Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. All cement used shall be ordinary Portland (ASTM C 150, Type I).

B. **Pre-blended, Dry Mortar Mix:** Furnish dry mortar ingredients in the form of a pre- blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

1. Standard: ASTM C270, lime-free Portland cement based.
2. Wet Mix Life: Less than 1.5 hours.
3. Initial Adhesion at 28 days: Not less than 0.3 N/mm2.
4. Bending Strength: Around 1 N/ mm2.
5. Compressive Strength: Not less than 5 ±1 N/ mm2.
6. Minimum Cement Sand Mix: 1:3
7. Testing: ASTM C 780.

b- **Mixed Mortar:** Comply with ASTM C 270 as follows:

1. Bending Strength: Around 1 N/ mm2.
2. Compressive Strength: Not less than 5 ±1 N/ mm2.
3. Minimum Cement Sand Mix: 1:3.
4. Testing: ASTM C 780.
5. Limit Cementitious materials in mortar to Portland cement and lime.
6. Do not add lime to the mix. Approved liquid admixtures that substitute the performance of lime may be added to the mix.

Grout for Unit Masonry: Comply with ASTM C 476. Unless otherwise specified, use grout of consistency indicated or, if not otherwise indicated, of consistency (fine or coarse) at time of placement that will completely fill spaces intended to receive grout.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with ASTM C 476 for

dimensions of grout spaces and pour height.

2. Provide grout with a slump of 200 to 275 mm as measured according to ASTM C 143.
3. Use fine grout (maximum size of coarse aggregate is 10 mm) in grout spaces less than 100 mm in least horizontal dimension, unless otherwise indicated.
4. Use coarse grout in grout spaces 100 mm or more in least horizontal dimension, unless otherwise indicated.
5. The Contractor shall submit laboratory design mix of concrete grout to obtain performance specified in of this Sub-Clause. Minimum cement content shall be 300 kg/m^3.
6. Compressive Strength: Minimum 17.5 MPa at 28 days.
7. Grout shall be mixed in proportions according to approved design mix to obtain compressive strength specified using the minimum quantity of water to ensure the necessary fluidity and to render it capable of penetrating the work.
8. Concrete grout shall be used or filling hollow cells in bond beams, under concrete lintels and bond beams, in window and door jambs and other locations for reinforced masonry assemblies as specified. Grout shall be mechanically mixed in drum mixers in volumetric proportions with only enough water shall be added to the mixture to produce a mixture which is flowable, but which will not show an excess of water when placed.

2.10 JOINT REINFORCEMENT

A. **General:** Provide joint reinforcement formed from the following:

1. Stainless-steel wire, ASTM A 580, Type 304.

B. **Description:** Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 3 m, with prefabricated corner and tee units, and complying with requirements indicated below:

1. Wire Diameter for Side Rods: 4.8 mm.
2. Wire Diameter for Cross Rods: 4.8 mm.

C. For single-wythe masonry, provide type as follows with single pair of side rods:

1. Truss design with continuous diagonal cross rods spaced not more than 407 mm o.c.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions, with installer present for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. For the record, prepare written report, listing conditions detrimental to performance.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. **Thickness:** Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specification.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. **Wetting of Brick:** Wet brick before laying. Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

1. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arrises, do not exceed 3 mm in 3 m, nor 5 mm in 6 m, nor 6 mm in 12 m or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 3 mm in 6 m, nor

in 12 m or more. For vertical alignment of head joints, do not exceed plus or minus 3 mm in 3 m, nor 6 mm maximum.

2. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 3 mm in 6 m, nor 6 mm in 12 m or more. For top surface of bearing walls, do not exceed 2 mm in 3 m, nor 1.0 mm within width of a single unit.

3. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls, and partitions, do not exceed 6 mm in 6 m, nor 10 mm in 12 m or more.

4. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 5 mm nor plus 10 mm.

5. Variation in Mortar-Joint Thickness: Do not vary from bed-joint thickness indicated by more than plus or minus 3 mm, with a maximum thickness limited to 12 mm. Do not vary bed-joint thickness from bed-joint thickness of adjacent course by more than 3 mm. Do not vary from head-joint thickness indicated by more than plus or minus 3 mm. Do not vary head-joint thickness from adjacent head-joint thickness by more than 3 mm. Do not vary from collar-joint thickness indicated by more than minus 3 mm or plus 10 mm.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other

locations.

B. **Bond Pattern for Exposed Masonry:** Lay exposed masonry in the following bond pattern; do not use units with less than nominal 100-mm horizontal face dimensions at corners or jambs.

1. One-half running bond with vertical joint in each course centered on units in courses above and below.

C. **Connection Between Walls And Partitions:** walls and partitions should generally be bonded, tied or dowelled to one another at angles and junctions. Where it is necessary for a partition to be connected to an adjacent wall, this should be done by toothing or block bonding unless otherwise specified

D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 50 mm. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 100-mm horizontal face dimensions at corners or jambs.

E. **Stopping and Resuming Work:** In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

F. **Built-in Work:** As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

G. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

1. At exterior frames, insert extruded polystyrene board insulation

around perimeter of frame in thickness indicated, but not less than 19 mm to act as a thermal break between frame and masonry.

H. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

I. Fill cores in hollow concrete masonry units with grout 600 mm under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

J. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3. At fire-rated walls or partitions, install firestopping joint filler as specified in this Section in joint between top of partition and underside of structure. Fill joints at both faces with fire rated elastomeric silicone sealants to comply with a UL-listed joint system at head of wall. Comply with requirements of Division 7, Section “Joint Sealants”.

K. Lay walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.

2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
4. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 10-mm joints.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. **General:** Provide continuous masonry joint reinforcement as indicated below.

Install entire length of longitudinal side rods in mortar with a minimum cover of 16 mm on exterior side of walls, 13 mm elsewhere. Lap reinforcement a minimum of 150 mm.

1. Space reinforcement not more than 406 mm o.c.
2. Space reinforcement not more than 203 mm o.c. in foundation walls and parapet walls.
3. Provide reinforcement in mortar joint 1 block course above and below wall openings and extending 305 mm beyond openings.

a. Reinforcement above is in addition to continuous reinforcement.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL JOINTS

A. **General:** Install control joints in unit masonry at maximum intervals of 6.00 meters length and where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake joints in exposed faces.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake joint.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete.

3.8 FIRE RATED MASONRY ASSEMBLIES

A. **Fire Rating:** As indicated on Drawings.

B. **Thickness:** As required to satisfy fire rating indicated but not less than

thickness indicated on Drawings.

C. **Unit Type:** As required to satisfy fire rating indicated in compliance with requirements specified in this Section.

D. Care shall be exercised to solidly fill all joints, vertical and horizontal, with mortar.

E. Joints: To structure above or adjoining are to be prefabricated, fire rated joint system comprising fire rated compressible filler and fire rated joint sealant on each face of the assembly, labeled by UL as rated for fire rating indicated.

F. Penetrations through fire rated masonry walls shall be sealed and treated with material systems as specified in Division 7, Section "Through Penetration Fire Stop Systems".

G. Where required, expansion joints through fire rated concrete masonry walls or at the intersection between concrete masonry walls and other walls or partition shall be 60 or 120 minutes fire rated construction. Use firestop joint filler as specified in this Section and fire rated joint sealant on each face of the assembly. Comply with Division 7, Section "Joint Sealants".

H. All accessories used in construction of fire rated assemblies shall be certified as suitable for use in fire rated masonry assemblies of rating indicated.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. **Temporary Formwork and Shores:** Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout.

Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. **Placing Reinforcement:** Comply with requirements of requirements of Division 3, Section “Cast-In-place concrete”.

C. **Grouting:** Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Comply with requirements of ACI 530.1 or Section 2104.6 in the Uniform Building Code (UBC) for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.10 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 15 mm in width between masonry and structural member, unless otherwise specified. Keep open space free of mortar or other rigid materials.

2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 620 mm o.c. vertically and 920 mm o.c. horizontally.

4. Fill space with compressible joint filler and seal edges flush with joint sealant, unless otherwise indicated. Comply with Division 7, Section "Joint Sealants".

3.11 ANCHORING MASONRY TO CONCRETE COLUMNS AND WALLS

A. Anchor masonry to concrete where masonry abuts or faces concrete columns or walls, comply with the following:

1. Anchor masonry to concrete with metal anchors embedded as specified in masonry joints and attached to concrete.

2. Space anchors as indicated, but not more than 420 mm o.c. vertically and 915 mm o.c. horizontally.

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. **Pointing:** During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. **In-Progress Cleaning:** Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

3.14 LINTELS

A. Concrete Lintels:

1. Precast lintels: Comply with requirements of Division 3, Section "Plant Precast Structural Concrete".

2. Cast-In-Place Concrete lintels: Comply with requirements of Division 3, Section "Cast-In-Situ Concrete". C. Provide steel lintels where openings up to 610 mm wide are indicated.

D. Provide reinforced concrete lintels where shown and where openings of more than 610 mm are shown without structural steel or other

supporting lintels.

E. Provide minimum bearing of 200 mm at each jamb, unless otherwise indicated.

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DIVISION 05 52 13

PIPE AND TUBE RAILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. **General:** In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:

1. Structural Steel: AISC S335, "Specification for Structural Steel Buildings allowable Stress Design and Plastic Design with Commentary."
2. Cold-Formed Structural Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."

B. **Structural Performance of Handrails and Railings:** Provide handrails and railings complying with requirements of ASTM E 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935.

C. **Thermal Movements:** Provide exterior handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and

nighttime-sky heat loss.

1. Temperature Change (Range): 35 deg. C, ambient; 65 deg. C, material surfaces.

D. **Control of Corrosion:** Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. **Product Data:** For the following:

1. Manufacturer's product lines of mechanically connected handrails and railings.
2. Grout, anchoring cement, and paint products.

B. **Shop Drawings:** Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.

1. For installed handrails and railings indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weather tight place, and protect from damage.

PART 2 – PRODUCTS

2.1 METALS

A. **General:** Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. **Steel and Iron:** Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

a. Black finish, for welded assemblies

b. Galvanized finish for mechanical assemblies.

c. Type F, or Type S, Grade A, Schedule 80, unless higher grade and weight are required by structural loads.

2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.

3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

4. Iron Castings: Malleable iron complying with ASTM A 47M, Grade 22010.

C. **Fittings, Brackets, Flanges, and Anchors:** Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

1. For Welded Assemblies: Provide non-galvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

2. For Mechanical Assemblies: Provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. **Welding Electrodes and Filler Metal:** Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. **Fasteners for Anchoring Handrails and Railings to Other Construction:** Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction

indicated and capable of withstanding design loads.

1. For steel handrails, railings, and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

C. **Fasteners for Interconnecting Handrail and Railing Components:** Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for handrails and railings indicated.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. **Cast-in-Place, chemical and Post-installed Anchors:** Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency acceptable to the Engineer.

1. Cast-in-place anchors.
2. Chemical anchors.
3. Expansion anchors.

2.3 GROUT AND ANCHORING CEMENT

A. **Non-shrink, Nonmetallic Grout:** Premixed, factory-packaged, non staining, noncorrosive, nongaseous grout complying with ASTM C

1107. Provide grout specifically recommended by the manufacturer for interior and exterior applications.

2.4 FABRICATION

A. **General:** Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

2.5 STEEL FINISHES

A. General: Unless otherwise indicated on Drawings, pipe and tube railings specified under this Section shall be galvanized and factory painted.

B. **Galvanizing After Fabrication:** Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. Preparation for Shop Priming: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic- phosphate process.

E. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

3.3 RAILING CONNECTIONS

A. **Non-welded Connections:** Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. **Welded Connections:** Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. **Expansion Joints:** Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 50mm beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 150 mm of post.

3.4 ANCHORING POSTS

A. Unless otherwise indicated on drawings, use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following material, mixed and placed to comply with anchoring material manufacturer's written instructions:

1. Non-shrink, nonmetallic grout.

B. Cover anchorage joint with flange of same metal as post, attached to post as follows:

1. By set screws.

C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 3 mm build-up, sloped away from post.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

A. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with post installed anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces

1. Connect flanges to railing ends using non-welded connections.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide brackets with 38-mm clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
4. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.7 CLEANING

A. **Touchup Painting:** Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

B. **Galvanized Surfaces:** Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.8 PROTECTION

A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so

that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

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DIVISION 08 14 00

WOODEN DOORS

PART 1 - GENERAL SECTION

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, trim for openings, and louvers.

1. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate doors to be factory finished and finish requirements.

C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:

1. Faces of factory-finished doors with opaque finish. Show the full range of colors available.

D. Samples for Verification: As follows:

1. Corner sections of doors approximately 200 by 250 mm with door faces an edgings representing the typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.

2. Louver blade and frame sections, 150 mm long, for each material and finish specified.

1. Frames for light openings, 150 mm long, for each material, type, and finish required.

1.4 QUALITY ASSURANCE

A. Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.

B. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's written instructions.

1. Individually package doors in plastic bags or cardboard cartons.

2. Individually package doors in cardboard cartons and wrap bundles of doors in plastic sheeting.

B. Mark each door with individual opening numbers used on Shop Drawings. Use removable tags or concealed markings.

1.6 WARRANTY

A. Door Manufacturer's Warranty: Provide written Warranty, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 6.5 mm in a 1100-by-2100-mm section or that show telegraphing of core construction in face veneers exceeding 0.25 mm in a 75- mm span, or

do not comply with tolerances in referenced quality standard.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect during the following period of time after the date of Substantial Completion:

a. Semi-solid-core Interior Doors: Two years.

PART 2 - PRODUCTS

2.1 WOODS, GENERAL

A. Woods shall be marked-on as Class-1 stocks which shall be properly treated, adequately seasoned and free from roy or insect attack, splits, shakes or checks, warping, twisting, chipping, loose knots and waming. Provide woods of wane-free edges. Woods shall conform to the requirements of BS EN No. 942; plywood to BS EN No. 636.

B. **Preservative Treatment:** All woods and plywood used shall be preservative treated. Application is to be carried out after cutting and machining, but before assembly, by a 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.

C. Softwoods

1. Douglas Fir: Yellowish Brown wood of average intensity not less than 570 kg/m3 at 12% moisture content.

2. Whitewood: White/pale Yellowish Brown wood of average intensity of 470 kg/m3.
3. Or as directed by the Architect.

D. Hardwoods

1. White Oak Wood: Yellowish Brown, fine-grained wood of strong, compact, homogenous fibers and uniform texture. Average intensity shall not be less than 720 kg/m3 at 12% moisture content. Or as directed by the Architect.

E. Plywood

1. General: Shall be highest grade to BS EN 636, designated as veneer, with minimal imperfections as peeled. Moisture content shall not exceed 12%. Thickness shall be as specified. Employ plywood glued with INT glues to BS 1203.
2. Softwood Plywood: All layers shall be of softwood.
3. Hardwood Plywood: White Oak plywood; White-Oak veneer 0.90 mm thick minimum shall be factory hot-applied at exposed face of door, cut and match of veneer shall be selected by the Consultant.

2.2 ACCESSORY MATERIALS

A. Preservative treatment: Type listed in BS 1282 (except coal tar creosote) obtained from approved manufacturer to provide protection against termites and other destroying organisms.

B. Adhesives: Close contact type to BS EN 301 or BS EN 302, suitable for the purpose and compatible with preservative treatment.

2.3 NON-FIRE RATED SEMI-SOLID-CORE FLUSH WOOD DOORS

A. **General:** Non-fire-rated flush wood doors shall be swinging-type side-hinged to jambs of frames with hand of doors as indicated on Drawings, fabricated to the general tolerances of BS No. 4787 and shall consist of a frame (door leaf frame) consisting of stiles and rails constructed of Douglas fir and a core constructed of a lower-density softwood (Whitewood). Core strips shall cover, at least, 67% of door leaf area (Semi-solid core).

B. **Door Leaf Frame:** Stiles and rails shall be of dimensions as indicated on Drawings but in no case shall the width be less than 140 mm for mortise stile or less than 100 mm for other stile and rails, before lipping. Door-leaf-frame components shall be continuously lipped at outer edges with 20 mm thick lipping constructed of White Oak wood. Oak lipping shall be fixed to stiles and rails in continuous glued tongue- and-groove joints. Stiles, rails and lipping of door leaf frame shall be constructed in one piece, no jointing or splicing shall be permissible. Joints between stiles and rails shall be glued mortise-and-tenon.

C. **Semi-Solid Cores:** Shall be horizontal rails of White wood, of uniform width. Ratio of solid to vacant shall be 2:1. Horizontal core rails shall be in one pieces. Throughout door leaf height, at least, two horizontal core rails shall be mortise-and- tenon jointed and glued to stiles.

D. **Facing:** Facing material shall be 6 mm thick plywood glued with waterproof glue under pressure to both sides of core. Facing material shall extend flush and uniform, in both directions, between inner edges of lipping. Extend facing in one piece; no jointing or splicing shall be

permissible. Type of facing material shall be as follows:

1. Doors of Opaque Finish: Softwood plywood

E. **Thickness of Doors:** Unless otherwise indicated on Drawings, finish thickness of flush non-fire-rated wood doors shall be 45 mm; thickness of stiles, rails and core strips shall be 33 mm and 45 mm wood lipping.

2.4 LOUVERS AND LIGHT FRAMES

A. Metal Louvers: As follows:

1. Blade Type: Vision proof, inverted V.

2. Metal and Finish: Extruded aluminum with clear anodic finish, 25micron thick minimum.

2.5 HARDWARE

A. Hardware shall be as indicated in Hardware Sets and Door Schedule and as specified in Division 8, Section "Door Hardware".

2.6 FABRICATION, GENERALLY

A. Flush wood doors shall be fabricated in accordance with details shown on Drawings, requirements of this Section, general tolerances of BS No. 4787 and other in-contradicting requirements of BS No. 1186: Part 2.

B. Carefully plan and layout the work to erect wood doors and to accommodate the work of other trades.

C. Finish wood shall be smoothly dressed and sanded prior to assembly of door inner frames and shall be free from open joints, hammer and machine marks and other defects or surface blemishes.

D. Re-treat all treated wood which is sawn along the length, ploughed, thickness, 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.

E. Finish and cut wood at exact dimensions as required. Stile and rails shall be connected only in glued mortise-and tenon joints with horizontal core strips assembled and jointed at their locations between rails, along stiles. The resulting frame shall be robust, firm and square.

F. Facing material shall be glued to core and frame. No nail-fixing exposed or concealed, for facing material shall be permissible. The assembly shall be glued under pressure with waterproof casein glue and be thoroughly dried and seasoned.

G. Join lipping at outer perimeter of frame in continuous tongue-and-groove joints with glue.

H. Factory machine doors for hardware that is not surface applied. Locate hardware as indicated on approved shop drawings. Comply with final hardware schedules, door frame shop drawings, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

I. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Louvers: Factory install louvers in prepared openings.

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DIVISION 08 51 13

ALUMINUM WINDOW

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 DEFINITIONS

A. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.

1.3 PERFORMANCE REQUIREMENTS

A. **General:** Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:

1. Size indicated on Drawings.

B. **Structural Performance:** Provide aluminum windows capable of withstanding the following, including wind loads based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Structural Test, at basic wind speed indicated:

1. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length 19 mm, whichever is less, at design pressure based on structural computations.
2. Basic Wind Speed: As indicated in meters per second at 10 m above grade.

   Determine wind loads and resulting design pressures applicable to Project according to the following, based on mean roof heights above grade as indicated on Drawings:

a. Uniform Building Code, 1997 Edition, Exposure C, Basic Wind Speed 130 km/hr.

C. **Air Infiltration:** Maximum rate not more than indicated when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.

1. Maximum Rate: 2 cu. m/h x sq. m of area at an inward test pressure of 300 Pa.

D. **Water Resistance:** No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.

1. Test Pressure: 20 percent of positive design pressure, but not more than 580Pa.

E. **Thermal Transmittance:** Provide aluminum windows with a whole-window U-value maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to AAMA 1503 and ASTM E 1423.

1. U-Value: shall not exceed U-value specified for glass insulating units specified in Division 8, Section "Glazing".

F. **Sound Transmission Class:** Provide glazed windows rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

G. **Thermal Movements:** Provide aluminum windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints,

failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base Consulting calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 35 deg C, ambient; 65 deg C material surfaces.

H. **Life-Cycle Testing:** Test according to AAMA 910 and comply with AAMA/ WDMA 101/I.S.2.

1.5 SUBMITTALS

A. **Product Data:** Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. **Shop Drawings:** Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:

1. Joinery details.
2. Flashing and drainage details.
3. Weather-stripping details.
4. Glazing details.
5. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional Consultant responsible for their preparation and used to determine the following:

a. Structural test pressures and design pressures from basic wind speeds indicated.

b. Deflection limitations of glass framing systems.

C. **Samples for Initial Selection:** For units with factory-applied color finishes.

D. **Samples for Verification:** For aluminum window components required, prepared on Samples of size indicated below.

1. Main Framing Member: 300-mm- long, full-size sections of extrusions with factory-applied color finish.
2. Hardware: Full-size units with factory-applied finish.
3. Weather Stripping: 300-mm- long sections.
4. Consultant reserves the right to require additional samples that show fabrication techniques, workmanship, and design of hardware and accessories.

E. Qualification Data: For manufacturer, Installer, and testing agency.

1. Installer Experience: List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product endorsed by the manufacturer's representative.

F. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

G. **Product Test Reports:** Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of down-sized test units will not be accepted.

H. **Maintenance Data:** For operable window sash, operating hardware, weather stripping and finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. **Quality System:** Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.

B. **Manufacturer Qualifications:** A firm experienced in manufacturing items specified in this section similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to manufacture required units.

C. **Installer Qualifications:** An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1. A qualified firm specializing in performing the work of this Section with minimum three years documented experience and that is approved, authorized, or licensed by the product manufacturer to install his product and that is eligible to receive manufacturer's warranty. Include project names and addresses, names and addresses of Consultants and Employers, and other information specified

D. **Testing Agency Qualifications:** An independent testing agency, acceptable to Consultant, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. **Source Limitations:** Obtain aluminum windows through one source from a single manufacturer.

F. **Fenestration Standard:** Comply with AAMA/W DMA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

G. **Mockups:** Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup in building envelope wall in locations selected by Consultant.
2. Build one mockup of each type of windows indicated on Drawings.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion as judged solely by the Consultant, otherwise dismantle mockups, remove site and install permanent works.

H. **Pre-installation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. **Field Measurements:** Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. **Special Warranty:** Provide written warranty signed by Manufacturer and Contractor in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.
2. Structural failures including excessive deflection.

3. Water leakage, air infiltration, or condensation.
4. Faulty operation of movable sash and hardware.
5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
6. Insulting glass failure.

B. Warranty Period: 5 years from date of Substantial Completion.

C. Warranty Period for Metal Finishes: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. **Aluminum Extrusions:** Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 150-MPa ultimate tensile strength, not less than 110-MPa minimum yield strength, and not less than 2.00 mm thickness at any location for the main frame and sash members.

B. **Fasteners:** Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components

1. Reinforcement: Where fasteners screw-anchor into aluminum less than 3.2 mm thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, non-corrosive, pressed-in, splined grommet nuts.
2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners

that match finish of member or hardware being fastened, as appropriate.

C. **Anchors, Clips, and Accessories:** Aluminum, nonmagnetic stainless steel, or zinc- coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. **Reinforcing Members:** Aluminum or nonmagnetic stainless steel, complying with ASTM B 456 for Type SC 3 severe service conditions, provide sufficient strength to withstand design pressure indicated.

E. **Sliding-Type Weather Stripping:** Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.

1. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon--fabric or aluminum-strip backing complying with AAMA 701/702 requirements.

F. **Compression-Type Weather Stripping:** Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when aluminum window is closed.

1. Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864 fabricated from EPDM.

G. **Replaceable Weather Seals:** Comply with AAMA 70 1/702.

H. **Sealant:** For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.2 GLAZING

A. **Glass and Glazing Materials:** Refer to Division 8 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

B. **Glazing System:** Manufacturer's standard factory-glazing system that produces weather tight seal or as indicated in Division 8 Section "Glazing".

2.3 HARDWARE

A. **General:** Provide manufacturer's standard hardware fabricated from aluminum, designed to smoothly operate, tightly close, and securely lock aluminum windows and sized to accommodate sash or ventilator weight and dimensions. Cadmium- plated hardware is not permitted. Do not use aluminum in frictional contact with other metals. Where exposed, provide extruded, cast, or wrought aluminum with clear anodized satin finish.

B. **Hardware, General:** Comply with AAMA 902.

C. **Sill Cap/Track:** Extruded aluminum with finish matching that of window track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior

D. **Locks and Latches:** Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

E. **Roller Assemblies:** Low-friction design.

F. **Four- or Six-Bar Friction Hinges:** Comply with AAMA 904.

1. Locking mechanism and handles for manual operation.

2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, non-staining, non-corrosive, durable material.

G. **Limit Devices:** Provide limit devices designed to restrict sash or ventilator opening.

1. Safety Devices: Limit clear opening to 150 mm for ventilation; with custodial key release.

H. **Horizontal-Sliding Windows:** Provide the following operating hardware:

1. Sash Rollers: Stainless-steel, lubricated ball-bearing rollers with nylon tires.

2. Sash Lock: Spring-loaded, snap-type lock at jambs; two per sash.

I. Projected Windows: Provide the following operating hardware:

1. Hinge: Five-knuckle butt hinge.

2. Lock: Combination lever handle and cam-action lock with concealed pawl and keeper.

3. Limit Device: Concealed friction adjustor, adjustable stay bar limit device; located on jamb of each ventilator.

2.4 FABRICATION

A. **General:** Fabricate aluminum windows, in sizes indicated, that comply with AAMA/WDMA 101/I.S.2 for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal- to-metal contact.

1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
3. Provide hardware with low conductivity for hardware bridging thermal breaks at frame or vent sash.

D. **Weather Stripping:** Provide full-perimeter weather stripping for each operable sash and ventilator.

3.2 INSTALLATION

A. **General:** Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings; and Shop Drawings.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/WDMA 101/I.S.2.

3.3 ADJUSTING

A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather- tight closure. Lubricate hardware and moving parts.

3.4 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

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DIVISION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

B. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Cylinders for locks on aluminum and glass entrance doors.

1.2 SUBMITTALS

A. **Product Data:** Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. **Samples:** For exposed door hardware of each type indicated below, in specified finish, full size. Tag with full description for coordination with the Door Hardware Schedule. Submit samples before, or concurrent with, submission of the final Door Hardware Schedule.

1. Door Hardware: Each piece of hardware indicated in hardware schedule or on Drawings.

2. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

C. **Product Certificates:** Signed by manufacturers of electrified door hardware certifying that products furnished comply with requirements.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

D. **Maintenance Data:** For each type of door hardware to include in

maintenance manuals specified in Division 1.

E. **Warranties:** Special warranties specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

2.1 SCHEDULED DOOR HARDWARE

A. **General:** Provide door hardware for each door to comply with requirements in this Section, and the Door and Hardware sets Schedule annexed at the end of Part 3.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. **Designations:** Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door and Hardware sets Schedule at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. International hardware manufactures have to establish their compliance with these specifications and with international fire codes for fire rated hardware.

2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES AND PIVOTS

A. **Standards:** Comply with the following:

1. Butts and Hinges: BHMA A156.1.
2. Template Hinge Dimensions: BHMA A156.7.
3. Self-Closing Hinges and Pivots: BHMA A156.17.
4. Pivots: BHMA A156.4.

B. **Size:** Provide the following minimum sizes, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

Max: Door Size (mm)	Hinge height (mm)	Standard Weight	Heavy Weight
800 by 2125 by 35	80	3.1	--
900 by 2125 by 35	100	3.3	--
900 by 2285 by 38	113	3.4	4.6
1050 by 2285 by 38	113	3.4	4.6
1200 by 3050 by 38	125	3.7	4.8

C. **Template Requirements:** Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

D. **Hinge Weight:** Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

E. **Hinge Base Metal:** Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel alloy 316, with stainless-steel pin
2. Interior Hinges: Stainless steel alloy 304, with stainless-steel pin.
3. Hinges for Fire-Rated Assemblies: Stainless steel alloy 304, with stainless- steel pin.

F. **Hinge Options:** Comply with the following where indicated in the Door Hardware Schedule or on Drawings:

1. Maximum Security Pin: Fix pin in hinge barrel after it is inserted.
2. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:

a. Out-swinging exterior doors.

3. Corners: 4-mm radius.

G. **Hinges, General:** Shall be full mortise, template, of concealed ball bearing, 5 knuckles, suitable for high frequency applications and of life time warranty.

2.3 LOCKS AND LATCHES

A. **Standards:** Comply with the following: Mortise Locks and Latches: BHMA A156.13.

1. Interconnected Locks and Latches: BHMA A156.12.
2. Auxiliary Locks: BHMA A156.5.
3. Push-Button Combination Locks: BHMA A156.2.
4. Electromagnetic Locks: BH MA A156.23.
5. Delayed-Egress Locks: BH MA A156.24.
6. Exit Locks: BHMA A156.5.

B. **Mortise Locks:** Stamped steel case with stainless steel parts; BHMA Grade 1; Series 1000. Provide mortise locks for exterior doors, throughout the job, except for toilets. All lock shall be ADA compliant Marine grade mortise locks shall be provided in the exterior and in non-air-conditioned areas. Provide ten years product warranty for performance and finish.

C. **Mortise Lock:** Shall be types produced for extra-heavy-duty applications. Lock lever shall be of anti-vandalism design.

D. Where threaded bars are used to assemble the two pieces of lock spindle, minimum inner diameter of threading bar shall be 6 mm.

E. **Interconnected Locks:** BHMA Grade 1; Series 5000.

F. **Auxiliary Locks:** BHMA Grade 1.

G. **Push-Button Combination Locks:** BHMA Grade 1 for cylindrical locks and Grade 2 for mortise locks.

H. **Certified Products:** Provide door hardware listed in the following BHMA directories:

1. Mechanical Locks and Latches: BHMA's "Directory of Certified Locks & Latches."

I. **Lock Trim:** Comply with the following: All trims to have returns. Trims shall be ADA compliant. Trim shall be stainless steel BHMA-630

1. Lever: Wrought, forged, or cast.
2. Escutcheon (Rose): Wrought, forged, or cast.
3. Dummy Trim: Match lock trim and escutcheons.
4. Lockset Designs: Provide the lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:

J. **Lock Functions:** Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:

1. Mortise Locks: BHMA A156.13.
2. Interconnected Locks: BHMA A156.12.

K. **Lock Features:** Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

1. Mortise Locks: Minimum 19-mm latch bolt throw.
2. Deadbolts: Minimum 25-mm bolt throw.
3. Pairs of Doors: 16-mm minimum throw of latch.
4. Fire-Rated Doors: Comply with UL requirements for throw of bolts and latches on rated fire openings.
5. Heavy duty anti friction tongue.
6. Non handed auxiliary guard latch.
7. Adjustable stainless steel armor front.
8. Seven pin interchangeable core cylinder.
9. Corrosion protected steel case.

L. **Rabbeted Doors:** Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.

M. **Backset:** 70 mm, unless otherwise indicated.

N. **Lock Function:** Provide lock functions as described below, but not limited to

1. F-04 Office lock, with faceplate button depressed function.
2. Classroom function for stores
3. F-13 Corridor lock.
4. Provide classroom dead bolts for main doors of toilets and janitors rooms Additional lock function will be required as per function of various rooms.

O. Locks shall have double buttons in face plate. For Office Locks the handle will rotate only when bottom button is depressed or turning key for outside cylinder. For other locks, the bottom button in face plate shall also retract the latch.

P. These requirements for mortise locks shall remain applicable in all respects for wood doors, steel doors and minimum doors.

2.4 DOOR BOLTS

A. **Standards:** Comply with the following:

1. Surface Bolts: BHMA A156.16.
2. Manual Flush Bolts: BHMA A156.16.

B. Surface Bolts: BHMA Grade 1.

1. Flush Bolt Heads: Minimum of 13-mm- diameter rods of brass, bronze, or stainless steel with minimum 300-mm- long rod for doors up to 2100 mm in height. Provide longer rods as necessary for doors exceeding 2100 mm.

C. Flush Bolts: BHMA Grade 1, designed for mortising into door edge.

D. **Bolt Throw:** Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

1. Half-Round Surface Bolts: Minimum 22-mm throw.
2. Interlocking Surface Bolts: Minimum 24-mm throw.
3. Fire-Rated Surface Bolts: Minimum 25-mm throw; listed and labeled for fire- rated doors.
4. Dutch-Door Bolts: Minimum 19-mm throw.
5. Mortise Flush Bolts: Minimum 19-mm throw.

2.5 EXIT DEVICES

A. **Standard**: BHMA A156.3.

1. BHMA Grade: Grade 1.

B. **Certified Products:** Provide exit devices listed in BHMA's "Directory of Certified Exit Devices."

C. **Panic Exit Devices:** Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

D. **Panic Exit Devices:** For non-fire rated doors are to be as specified in Sub-Clause but with facility to hold latchbolts in retracted position so

that the doors may be used as push/pull. Dogging is to be accomplished by a hex key cylinder installed on the body of touch bar devices or a hexagonal key in the hinge and lock cases of cross bar devices

E. **Fire Exit Devices:** Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

F. **Dummy Push Bar:** Nonfunctioning push bar matching functional push bar.

1. Operation: Rigid.

G. **Outside Trim:** Lever with cylinder or Pull with cylinder; unless otherwise indicated material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

H. **Through Bolts:** For exit devices and trim on metal doors and non-fire-rated wood doors.

I. Fire and panic exit devices shall be of concealed latches. No exposed latches shall be accepted.

2.6 CYLINDERS AND KEYING

A. **Standards:** Comply with the following:

1. Cylinders: BHMA A156.5.
2. Key Control System: BHMA A156.5.

B. Cylinder Grade: BHMA Grade 1 or Grade 1A.

C. **Cylinders:** Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Seven.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.

3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

D. **Permanent Cores:** Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key, and usable with other manufacturers' cylinders.

2. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

E. **Construction Keying**: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 4 constructions master keys for Employer/Consultant use.

a. Replace construction cores with permanent cores, as directed by Employer.

b. Furnish permanent cores to Employer for installation.

F. **Keying System:** Unless otherwise indicated, provide a factory-registered keying system complying with the following requirements:

1. Master Key System: Cylinders are operated by a change key and a master key.

G. **Keys:** Provide stainless steel keys complying with the following:

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Employer.

2. Quantity: In addition to one extra blank key for each lock, provide the following:

a. Cylinder Change Keys: Three.

b. Master Keys: Five.

H. **Key Control System:** BHMA Grade 1 system, including key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers. Contain system in metal cabinet with baked- enamel finish.

1. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key- holding panels and pin-tumbler cylinder door lock.

2. Capacity: Able to hold keys for 150 percent of the number of locks.

3. Cross-Index System: Set up by key control manufacturer, complying with the following:

a. Card Index: Furnish four sets of index cards for recording key information. Include three receipt forms for each key-holding hook.

2.7 STRIKES

A. **Standards:** Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Interconnected Locks and Latches: BHMA A156.12.

3. Strikes for Auxiliary Deadlocks: BHMA A156.5.

4. Dustproof Strikes: BHMA A156.16.

B. **Strikes:** Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latch bolts, as recommended by manufacturer.

2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

4. Provide recess type top strikes for bolts locking into head frames, unless otherwise indicated.

5. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non recessed strike for bolt.

C. **Dustproof Strikes**: BHMA Grade 1.

2.8 CARD READER

A. Proximity Reader with Keypad:

1. Technology: Wiengand proximity system compatible with building security system.

2. Housing: Weather resistant ABS plastic housing. Color as selected by Consultant from manufacturer's full line.

3. Keypad: 12 button key pad for entry of Personal Identification Number (PIN) in addition to proximity card.

4. Display Status: 3 LED status display and controllable beeper to indicate reader operation and status.

5. Tamper Detection: Mechanical tamper switch to send signal to security room if reader is completely removed from wall in addition to detecting when reader has been separated from its back plate.

6. Provide all mounting plates, cables, programs and other items required to make card reader work with building security system.

2.11 CLOSERS

A. Closers, General-unless otherwise indicated, provide closers on all fire-rated doors, exterior doors, toilet and locker room doors, sound-retardant doors, corridor doors, doors between heated/cooled and unheated / uncooled areas, elevator equipment room doors, and other door as required. Closer shall be tested for 10 million cycles and will

withstand 57-degree ambient temperature and will be provided with all-weather hydraulic fluid. Closer will be equipped with the function of variable back check and delayed action. Closer will be provided with ten years warranty and warranty against leaks. Closer will be non-banded. Closer will be provided with adjustable with speed and hold open facility. Concealed door closer will be completely and components will minimize tempering and vandalism.

1. Size of Units: Unless otherwise indicated, comply with the manufacturer's recommendation for size of door control unit depending on size of door, exposure to weather and drafts, and anticipated frequency of use.
2. Arms: Provide parallel arms for all overhead closers, unless otherwise indicated. Provide closer unit one size larger than recommended for use with standard arms.
3. Closing Cycle: Comply with requirements of authorities having jurisdiction or the Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)", whichever are most stringent

a. Opening Force: Comply with the following maximum opening-force requirements for locations indicated:

1) Exterior Doors: 67 N.
2) Interior Doors: 22.2N.

4. Construction: Provide marine-grade construction for closers in non-air-conditioned areas and indoor swimming pool areas, consisting of nonferrous and stainless steel components.

B. **Aluminum Entrance Doors:** Provide concealed door closer. Standards: Comply with the following:

1. Closers: BHMA A156.4.

C. Surface Closers: BHMA Grade 1.

D. **Concealed Closers:** BHMA Grade 1.

E. **Certified Products:** Provide door closers listed in BHMA's "Directory of Certified Door Closers".

F. **Door Closers on Fire Rated Doors:** Shall be type that closes the door and positively latch the door.

G. **Hold-Open Closers/Detectors:** Coordinate and interface integral smoke detector and closer device with fire alarm system. Fire rated doors with closers of hold open facility shall release automatically in case of fire based on signal from the fire alarm system (electric release door closer). System of release device for double leaf fire rated doors shall be adjustable so as the inactive leaf shall close prior to the active leaf and that active leave shall positively latch to the inactive leaf at final closing position (electric release door closers and door coordinator).

H. **Flush Floor Plates:** Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.

I. **Recessed Floor Plates:** Provide recessed floor plates with insert of floor finish material for floor closers, unless thresholds are indicated. Provide extended closer spindle to accommodate thickness of floor finish.

J. Weather Comply with manufacturer's written recommendation of exposure to weather. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

H. **Grade:** Door closers shall be from types tested for 10 million cycles of operation and sized for door leafs of minimum weight of 200

kilogram per leaf for both steel doors and external doors.

2.12 PROTECTIVE TRIM UNIT

A. **Standard:** Comply with BHMA A156.6.

B. **Materials:** Fabricate protection plates from the following to match requirement indicate:

1. Stainless Steel: beveled top and 2 sides.

C. Protection Plates, General:

1. Fabricate edge trim of stainless steel to fit door thickness in standard lengths or to match height of protection plates.

D. **Kick Plates:** beveled top and two side edges (B3E). Provide two kick plates for toilet doors. Kick plate will ensure that the door bottom is protected.

a. Metal Plates: Stainless steel, 3.00 mm thick

E. **Armor Plates:** 3 mm thick, 914 mm high by full width of door less clearance for stops on door frame.

F. **Fasteners:** Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine or self-tapping screws.

G. Furnish protection plates sized 38 mm less than door width on push side and 13 mm less than door width on pull side, by height specified in Door Hardware Schedule.

2.13 STOPS AND HOLDERS

A. **Standards:** Comply with the following:

1. Stops and Bumpers: BHMA A156.16.
2. Mechanical Door Holders: BHMA A156.16.
3. Electromagnetic Door Holders: BHMA A156.15.
4. Combination Overhead Holders and Stops: BHMA A156.8.
5. Door Silencers: BHMA A156.16.

B. **Stops and Bumpers:** BHMA Grade 1.

C. **Mechanical Door Holders:** BHMA Grade 1.

D. **Combination Floor and Wall Stops and Holders:** BHMA Grade 1.

E. **Combination Overhead Stops and Holders:** BHMA Grade 1.

F. **Electromagnetic Door Holders for Labeled Fire Door Assemblies:** Coordinate with fire detectors and interface with fire alarm system.

G. **Floor Stops:** For doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic.

1. Where floor or wall stops are not appropriate, provide overhead holders.

H. **Silencers for Wood Door Frames:** BHMA Grade 1; neoprene or rubber, minimum 16 by 19 mm; fabricated for drilled-in application to frame.

I. **Silencers for Metal Door Frames:** BHMA Grade 1; neoprene or rubber, minimum diameter 13 mm; fabricated for drilled-in application to frame.

2.14 DOOR GASKETING

A. **Standard:** Comply with BHMA A156.22.

B. **General:** Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide non-corrosive fasteners for exterior applications a n d elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. **Air Leakage:** Not to exceed 0.000774 cu. m/s per m of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

D. **Smoke-Labeled Gasketing:** Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke- labeled doors.

E. **Fire-Labeled Gasketing:** Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL 10B or NFPA 252.

F. **Sound-Rated Gasketing:** Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

G. **Replaceable Seal Strips:** Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

H. **Gasketing Materials:** Comply with ASTM D 2000 and AAMA 70 1/702.

I. **Weather-stripping and Seal Types:** Unless otherwise indicated, provide the following, or approved equal:

1. Door Shoes: Extruded aluminum, with vinyl seal and integral rain drip.
2. Rain Drips: Extruded aluminum. Unless noted otherwise, provide rain drips for all exterior doors.
3. Automatic Door Bottoms: Extruded aluminum with neoprene insert for doors to achieve STC of 47 or better, as indicated in the hardware schedule.

4. Meeting Stile Seals (Astragal Seals): Extruded anodized aluminum, with silicon seal.

5. Weather-stripping, Smoke Seals, and Sound Retarding Gaskets: Compression-type self-adhesive silicone gasket applied to door stops, white color.

6. Security Astragals: Cam operated, automatic security astragal.

2.15 THRESHOLDS

A. **General:** Unless otherwise indicated, provide standard metal threshold units of type, size, and profile as shown or scheduled. Comply with ANSI/BHMA A156.21.

1. Material: Extruded aluminum, non-slip finish, except as otherwise specified.

2. Exterior Hinged Doors: Provide units not less than 100 mm wide, and not more than 12-mm-high, with beveled edges providing a floor level change with a slope of not more than 1:2, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames, and as follows:

a. For in-swinging doors provide units with interlocking lip and interior drain channel; include hook on bottom edge of door and drain pan.

b. For out-swinging doors provide rabbeted type units with replaceable weather-strip insert in stop. Provide threshold with thermal break when mentioned in the hardware schedule

B. **Exterior Thresholds:** ANSI/BHMA A156.21, extruded aluminum. Provide flat saddle type or interlocking type with resilient insert as shown.

C. **Threshold for Aluminum Entrance Doors:** Manufacturer's standard threshold with cutouts coordinated for operating hardware, with anchors and jamb clips, and not more than 12-mm-high, with beveled edges providing a floor level change with a slope of not more than 1:2, formed

to accommodate change in floor elevation where indicated.

D. **Threshold for Doors with Exit Devices:** Extruded aluminum latching type, with replaceable vinyl inserts.

E. **Interior Thresholds:** Extruded aluminum flat saddle type with smooth surface.

2.16 MISCELLANEOUS DOOR HARDWARE

A. **Standard:** Comply with the following:

1. Auxiliary Hardware: BHMA A156.16.

2. Exit Alarms: BHMA A156.5.

B. **Auxiliary Hardware:** BHMA Grade 1, unless otherwise indicated.

C. **Boxed Power Supplies:** Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

2.17 FABRICATION

A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Consultant.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. **Base Metals:** Produce door hardware units of base metal specified, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. **Fasteners:** Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet

metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Machine or Wood Screws: For the following fire-rated applications:

a. Mortise hinges to doors.

b. Strike plates to frames.

c. Closers to doors and frames.

3. Steel Through Bolts: For the following fire-rated applications, unless door blocking is provided:

a. Surface hinges to doors.

b. Closers to doors and frames.

c. Surface-mounted exit devices.

4. Spacers: For through bolting of hollow metal doors.
5. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.18 BASE METAL

A. Base Metal for hardware and door furniture shall be as follows:

1- Exterior Units: Stainless Steel alloy 316

2- Interior Units: Stainless Steel alloy 304

2.19 FINISHES

A. **Standard:** Comply with BHMA A156.18.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. **Appearance of Finished Work:** Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. **BHMA Designations:** Comply with base material and finish requirements indicated by the following:

1. BHMA 630: Satin stainless steel, over stainless-steel base metal.

3.3 INSTALLATION

A. **Mounting Heights:** Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. **Key Control System:** Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

D. **Thresholds:** Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 ADJUSTING

A. **Initial Adjustment:** Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 75 mm from the latch, measured to the leading edge of the door.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

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DIVISION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Aluminum entrances.
2. Sliding automatic entrances doors.
3. Aluminum windows
4. Structure-Sealant-Glazed curtain walls.
5. Glass visions in doors.

1.3 DEFINITIONS

A. **Manufacturer:** Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

B. **Deterioration of Laminated Glass:** Defects developed from normal use that are attributed to the manufacturing process and not to glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's directions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated glass standard.

C. **Deterioration of Insulating Glass:** Failure of the hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass. Evidence of failure is the obstruction of vision by dust, moisture, or film on the interior surfaces of glass. Improper practices for maintaining and cleaning glass do not comply with the manufacturer's directions

1.4 PERFORMANCE REQUIREMENTS

A. **General:** Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; and other defects in construction.

B. **Glass Design:** Glass thicknesses indicated on Drawings shall be considered as the minimum only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass liters for the various size openings in the thicknesses and strengths (annealed or heat-treated) to meet or exceed the following criteria:

1. Minimum glass thickness, nominally, of liters shall be 6.0 mm.
2. Tinted and heat-absorbing glass thicknesses for each tint indicated shall be the same throughout Project.
3. Minimum glass thicknesses of liters, whether composed of annealed or heat- treated glass, shall be selected so the worst-case probability of failure does not exceed the following:

a. Eight liters per 1000 for liters set vertically or not over 15 degrees off vertical and under wind action. Determine minimum thickness of monolithic annealed glass according to ASTM E 1300. For other than monolithic annealed glass, determine thickness per glass manufacturer's standard method of analysis including applying adjustment factors to ASTM E 1300 based on type of glass.

b. One lite per 1000 for liters set over 15 degrees off vertical and under action of wind and rain.

C. **Thermal Movement:** Allow for normal thermal movement resulting from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components. Base Consulting calculation on materials' actual surface temperatures due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 35 deg C ambient; 65 deg C material surfaces.

D. **Deflection:** Center deflection of loaded glass liters shall not exceed L/10t where L is the short span of the lite in mm and t is the thickness of the monolithic or laminated lite in mm.

E. **Loads on Glass:**

1. Glass shall be of appropriate thickness to withstand the greater of the following pressures, or combinations thereof, acting normal to the surface without center point deflections in excess of those specified. Load combinations shall be per the specific requirements of the 1997 Uniform Building Code:

a. Wind Load: Positive and negative wind load shall be based on the UBC for a basic wind speed of 80 mph (130 km/h), Importance Factor 1.15, and Exposure Category "C".

b. Human Impact Loads: Comply with CPSC 16 CFR 1201 Category II in those locations designated as hazardous locations by UBC Section 2406.4.

2. Calculate glass thickness based upon the following minimum safety factors.

a. Vertical Glazing:

1) Fully Tempered Glass (Type FT): 1.4.

1.5 SUBMITTALS

A. **Product Data:** For each glass product and glazing material indicated.

B. **Samples:** Samples for verification purposes of 300-mm-square samples of each type of glass indicated except for clear monolithic glass products, and 300-mm-long samples of each color required for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system.

C. **Test Reports:**

1. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

2. Compatibility test report from manufacturer of insulating glass

edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

3. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.

D. **Certificates:** Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.

1. Separate certifications are not required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. **Glazing Publications:** Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. AAMA TIR-A7 “Sloped Glazing Guidelines" and "Glass Design for Sloped Glazing".
2. FGMA "Glazing Manual".
3. LSGA "Design Guide".
4. SIGMA TM-3000 "Vertical Glazing Guidelines" and TB-3001 "Sloped Glazing Guidelines".

B. **Safety Glass:** Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

C. **Insulating Glass Certification Program:** Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of Insulating Glass Certification Council (IGCC).

D. **Glazier Qualifications:** Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.

E. **Single-Source Responsibility for Glass:** Obtain glass from one source for each product indicated below:

1. Primary glass of each (ASTM C 1036) type and class indicated.
2. Heat-treated glass of each (ASTM C 1048) condition indicated.
3. Laminated glass of each (ASTM C 1172) kind indicated.
4. Insulating glass of each construction indicated.

F. **Single-Source Responsibility for Glazing Accessories:** Obtain glazing accessories from one source for each product and installation method indicated.

G. **Preconstruction Compatibility and Adhesion Testing:** Submit to sealant manufacturers samples of each glass, gasket, glazing accessory, and glass-framing member that will contact or affect glazing sealants for compatibility and adhesion testing as indicated below:

1. Use test methods standard with sealant manufacturer to determine if priming and other specific preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates.

a. Perform tests under normal environmental conditions during installation. b. Submit not less than 4 pieces of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, insulating units) for adhesion testing, as well as one sample of each glazing accessory (gaskets, setting, blocks and spacers) for compatibility testing.

c. Schedule sufficient time to test and analyze results to prevent delay in the progress of the Work.

d. Investigate materials failing compatibility or adhesion tests and obtain sealant manufacturer's written recommendations for corrective measures, including using special primers.

2. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to Consultant and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glass and glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, and other causes.

1. Where insulating glass units will be exposed to substantial altitude changes, comply with insulating glass fabricator's recommendations for venting and sealing to avoid hermetic seal ruptures.

1.9 WARRANTY

A. **General:** Warranties specified in this Article shall not deprive the Employer of other rights the Employer may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1. Warranty Period: Manufacturer's standard, but not less than 10 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS PRODUCTS

A. **Float Glass:** ASTM C 1036, Type I (transparent glass, flat), Class as indicated below, and Quality q3 (glazing select).

1. Class 1 (clear), for interior glass unless otherwise indicated.
2. Class 2 (tinted, heat-absorbing, and light-reducing), Arctic-Blue B. **Translucent Glass:** Glass that transmits light with varying degrees of diffusion produced by sandblasting of surface of clear float as specified in Sub-Clause A of this Clause so that vision is not clear and light transmittance is lower than clear Glass. Requirements of translucent glass are to be similar to that of ASTM 1036-85, Type 2, Class 1.

2.2 HEAT-TREATED FLOAT GLASS

A. **Fabrication Process:** By horizontal (roller-hearth) process.

B. **Clear, Heat-Treated Float Glass:** ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.

1. Kind FT (fully tempered).
2. Fully Tempered: Kind FT (fully tempered, having a minimum surface compression of 110,000 kPa (16,000 psi.).
3. "Roller distortion" and/or "ripples" shall run in the same direction for the entire Project. Glass shall be heat-treated through the use of a horizontal tempering furnace.

C. **Tinted, Heat-Treated Float Glass:** ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 2 (tinted heat-absorbing and light-reducing), Quality q3 (glazing select), with tint color and performance characteristics for 6.0- mm-thick glass matching those indicated for annealed primary tinted float glass; kind as indicated below:

1. Kind FT (fully tempered) as indicated on Drawings and for the following applications:

a. Exterior liters of exterior double insulating glass units.

b. For low glazing (800mm and below) applications including liters of double insulating glass units.

2.1 COATED FLOAT GLASS

A. **General:** Provide coated glass complying with requirements indicated in this Article.

B. Provide Kind FT (fully tempered) where safety glass is indicated.

C. **Low-e Coated Float Glass:** Float glass with solar-reflective metallic-oxide coating applied on surface #2 or surface #3 of the double insulating unit.

Low-e coating shall be neutral color.

2.3 LAMINATED GLASS

A. **Laminated Glass:** Comply with ASTM C 1172, Kind LT (two liters of fully tempered Type 1 glass) and other requirements specified. Refer to primary and heat-treated glass requirements relating to properties of glass products comprising laminated glass products. Unless otherwise indicated, provide the following types of glass:

1. Laminated Glass 8.76 mm Thick Tinted/Clear:

a. Outer Lite: Fully tempered, minimum 4.0 mm thick. Provide Arctic-Blue color tinted as selected by consultant from manufacturer's standard colors to match existing.

b. 2x0.38 mm PVB interlayer

c. Inner Lite: Clear, fully tempered, minimum 4.0 mm thick.

2. Laminated Glass 13.50 mm Thick Clear/Clear:

a. Outer Lite: Fully tempered, minimum 6.0 mm thick

b. 4x0.38 mm PVB interlayer

c. Inner Lite: Clear, fully tempered, minimum 6.0 mm thick

3. Laminated Glass 6.67 mm Thick Clear/Clear:

a. Outer Lite: Fully tempered, clear glass minimum 3.0 mm thick.

b. 2x0.38 mm PVB interlayer

c. Inner Lite: Clear, fully tempered, minimum 3.0 mm thick.

B. **Interlayer:** Interlayer material as indicated below, and of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

1. Interlayer Material: Polyvinyl Butyral (PVB) sheets, clear, minimum thickness as indicated before.

C. **Laminating Process:** Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets as follows:

1. Laminate liters with polyvinyl butyral interlayer in autoclave with heat plus pressure.

3.3 GLAZING, GENERAL

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions where indicated on Drawings provide minimum necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by referenced standards and Project conditions during installation.

C. Protect glass from edge damage during handling and installation as follows:

1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass liters with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.

2. Remove damaged glass from Project site and legally dispose of offsite. Damaged glass is glass with surface or edge damage or other

imperfections that, when installed, weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass liters.

G. Provide spacers for glass sizes larger than 1270 united mm (length plus height) as follows:

1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with specified performance requirements.

2. Provide 3-mm minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

I. Set glass liters in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

L. Any glass lites installed within 900 mm from adjoining finish floor level (sill glazing) shall be marked as safety in compliance with standard referenced in this Section.

3.4 TAPE GLAZING

A. Position tapes on f ixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. W here framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before eac lite is installed.

F. Where required, apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Where required, apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

C. Install gaskets so they protrude from face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers between glass liters and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of

channel to eliminate dirt and moisture pockets.

3.7 GLASS PARTITIONS

A. Fix partitions firm in place indicated on Drawings at lines indicated, perfectly plumb without deviations from horizontal or vertical lines. Provide firm connections between glass liters of partitions and glass fins. All bolts and anchors shall be tightly screwed without overstressing glass. Use concealed EPDM washers and shims as required and comply with manufacturer's instructions.

3.8 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.

E. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass using materials and methods recommended by glass manufacturer.

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DIVISION 09 24 00

CEMENT PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes the following:

1. Portland cement plaster.
2. Metal Lath suspended ceiling.

1.3 SUBMITTALS

A. **Product Data:** For each product specified.

B. **Samples for Initial Selection:** manufacturer's color charts consisting of actual units or sections of units at least 300 mm square showing the full range of colors, textures, and patterns available for each type of finish indicated.

1. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
2. Include similar Samples of material for joints and accessories involving color selection.

C. **Shop Drawings:** Submit shop drawings for suspended metal lath ceilings including layout and details of ceilings installation

D. **Material Certificates:** certificate signed by manufacturer for each kind of plaster aggregate certifying that materials comply with requirements.

1.4 QUALITY ASSURANCE

A. **Quality System:** Comply with ISO 9001/9002 Quality System as a

minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.

B. **Mockups:** Prior to installing plaster work, construct panels for each type of finish and application required to verify selections made under Sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Consultant.
2. Erect mockups 1200 by 1200 mm by full thickness in presence of Consultant using materials, including lath, support system, and control joints, indicated for final Work.
3. Notify Consultant 7 days in advance of the dates and times when mockups will be constructed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Consultant's approval of mockups before start of plaster Work.
6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Portland cement plaster Work.
7. When directed demolish mockups, remove rubbles from site and replace with permanent works.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver cementitious materials to Project site in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

B. Store materials indoor, under cover, and dry, protected from weather, direct sunlight, surface contamination, aging, corrosion, and damage from construction traffic and other causes.

1.6 PROJECT CONDITIONS

A. **Environmental Requirements, General:** Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.

B. **Warm-Weather Requirements:** Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

C. **Exterior Plaster Work:** Do not apply plaster when ambient temperature is below 4 deg C.

D. **Interior Plaster Work:** Maintain at least 10 deg C temperature in areas to be plastered for at least 48 hours before, during, and after application.

E. **Ventilation:** Provide natural or mechanical means of ventilation to properly dry interior spaces after Portland cement plaster has cured.

F. Protect contiguous work from soiling and moisture deterioration caused by plastering. Provide temporary covering and other provisions necessary to minimize harmful spattering of plaster on other work.

PART 2 - PRODUCTS

2.1 METAL SUPPORTS FOR SUSPENDED CEILINGS

A. **General:** Size metal ceiling supports to comply with ASTM C 1063, unless otherwise indicated.

B. **Post installed Anchors in Concrete:** Anchors of type indicated below, fabricated from corrosion-resistant materials, with holes or loops for attaching hanger wires; and with capability to sustain, without failure, a

load equal to 5 times that imposed by ceiling construction, as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.

1. Chemical anchor.

C. **Wire for Hangers and Ties:** ASTM A 641 M, Class 1 zinc coating, soft temper.

D. **Rod Hangers:** Mild steel, zinc coated.

E. **Flat Hangers:** Mild steel, zinc coated or protected with rust-inhibitive paint.

F. **Channels:** Cold-rolled steel, minimum 1.5-mm- thick base (uncoated) metal and 11.1-mm- wide flanges, and as follows:

1. Carrying Channels: Based on design calculations but not less than 38 mm deep, 0.7 kg/m.

G. **Finish:** ASTM A 653M, Z180 hot-dip galvanized coating for framing where indicated.

2.2 LATH

A. **Expanded-Metal Lath:** Comply with ASTM C 847 for material, type, configuration, and other characteristics indicated below.

1. Material: Fabricate expanded-metal lath from sheet metal conforming to the following:

a. Galvanized Steel: Structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A 653M, Z275 minimum coating designation, unless otherwise indicated.

b. Form: Coil.

c. Special Pieces: For internal corners.

2. Diamond-Mesh L a t h for Plaster Background: Comply with the following requirements:

a. Configuration: Flat.

i. Weight: 1.1 kg/sq. m.

3. Rib Lath for Suspended Ceilings: Comply with the following requirements:

a. Configuration: Flat, rib depth of not over 3 mm.

Weight: 1.8 kg/sq. m.

2.3 ACCESSORIES

A. **General:** Comply with material provisions of ASTM C 1063 and the requirements indicated below; coordinate depth of accessories with thicknesses and number of plaster coats required.

1. Galvanized Steel Components (for internal plaster): Fabricated from zinc-coated (galvanized) steel sheet complying with ASTM A 653M, Z90 minimum coating designation.

B. **Metal Corner Reinforcement:** Expanded, large-mesh, diamond-metal lath fabricated from zinc-alloy or welded-wire mesh fabricated from 1.2-mm-diameter, zinc-coated (galvanized) wire and specially formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.

C. **Cornerbeads:** Small nose cornerbeads fabricated from the following metal, with expanded flanges of large-mesh diamond-metal lath allowing full plaster encasement.

D. **Casing Beads:** Square-edged style, with expanded flanges.

E. **Curved Casing Beads:** Square-edged style, fabricated from aluminum coated with clear plastic, preformed into curve of radius indicated.

F. **Control Joints:** Prefabricated, of material and type indicated below:

1. One-Piece Type: Folded pair of nonperforated screeds in M-shaped configuration, with expanded or perforated flanges.

2. Two-Piece Type: Pair of casing beads with back flanges formed to provide slip-joint action, adjustable for joint widths from 3 to 16 mm.

a. Provide removable protective tape on plaster face of control joints.

G. **Foundation Sill (Weep) Screed:** Manufacturer's standard profile designed for use at sill plate line to form plaster stop and prevent plaster from contacting damp earth, fabricated from zinc-coated (galvanized) steel sheet.

H. **Lath Attachment Devices:** Material and type required by ASTM C 1063 for installations indicated.

2.4 PLASTER MATERIALS

A. **Base-Coat Cements:** Type as indicated below:

1. Portland cement, ASTM C 150, Type I.

B. **Job-Mixed Finish-Coat Cement**: Material and color as indicated below:

1. Portland cement: sand aerated mix

C. **Cement Color:** Gray.

D. **Lime:** do not use lime.

E. **Plasticiser:** ASTM C260.

F. **Sand Aggregate for Base Coats:** ASTM C 897.

G. **Aggregate for Finish Coats:** ASTM C 897 system and as indicated below:

1. Manufactured or natural sand, White in color.

2.5 MISCELLANEOUS MATERIALS

A. **Fiber for Base Coat:** Alkaline-resistant glass or polypropylene fibers, 13 mm long, free of contaminates, manufactured for use in Portland cement plaster.

B. **Water for Mixing and Finishing Plaster:** Potable.

C. **Acid-Etching Solution:** Muriatic acid (10 percent solution of commercial hydrochloric acid) mixed 1 part to not less than 6 nor more than 10 parts water.

1)

D. **Dash-Coat Material:** 2 parts Portland cement to 3 parts fine sand, mixed with water to a mushy-paste consistency.

2.6 PLASTER MIXES AND COMPOSITIONS

A. **General:** Comply with ASTM C 926 for base- and finish-coat mixes as applicable to plaster bases, materials, and other requirements indicated. Do not use lime in plaster mixes.

B. **Base-Coat Mixes and Compositions:** Proportion materials for respective base coats in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.

C. **Fiber Content:** Add fiber to following mixes after ingredients have mixed at least 2 minutes. Comply with fiber manufacturer's written instructions but do not exceed 16 kg/cu. m of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

D. **Three-Coat Work over Metal Lath:** Base-coat proportions as indicated below:

1. Scratch Coat: 1 part Portland cement, 2-1/2 to 4 parts aggregate.
2. Brown Coat: 1 part Portland cement, 3 to 5 parts aggregate.
3. Admixtures and workability aids, as per manufacturer’s printed instructions

E. **Two-Coat Work over Concrete and Concrete Unit Masonry:** Base-coat proportions as indicated below:

1. Base Coat: 1 part Portland cement, 5 parts aggregate, aerating plasticiser as per manufacturer’s recommendation.

F. **Job-Mixed Finish Coats:** Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume per sum of cementitious materials to comply with the following requirements:

1. Proportions using sand aggregates as indicated below:

a. 1 part Portland cement, 4 parts aggregate, aerating plasticiser as per manufacturer's recommendation.

2.7 MIXING

A. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF CEILING SUSPENSION SYSTEMS

A. **Preparation and Coordination:** Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure inserts and other structural anchorage provisions have been installed to receive ceiling hangers in a manner that will develop their full strength and at spacings required to support ceiling.

B. **Hanger Installation:** Attach hangers to structure above ceiling to comply with ML/SFA 920, "Guide Specifications for Metal Lathing and Furring," and with referenced standards.

C. Install ceiling suspension system components of sizes and spacings indicated, but not in smaller sizes or greater spacings than those required by referenced lathing and furring installation standards.

1. Wire Hangers: Space 4-mm- diameter wire hangers not over 1200 mm o.c, parallel with and not over 900 mm perpendicular to direction of carrying channels, unless otherwise indicated, and within 150 mm of carrying channel ends.

2. Carrying Channels: Space carrying channels not over 900 mm o.c. with 1200- mm o.c. hanger spacing.

3. Furring Channels to Receive Metal Lath: Space furring channels not over

500 mm o.c. for 1.8-kg/sq. m flat rib lath.

3.2 PREPARATIONS FOR PLASTERING

A. Clean plaster bases and substrates for direct application of plaster, removing loose material and substances that may impair the Work.

B. Etch concrete and concrete unit masonry surfaces indicated for direct plaster application. Scrub with acid-etching solution on previously wetted surface and rinse thoroughly with clean water. Repeat application, if necessary, to obtain adequate suction and mechanical bond of plaster (where dash coat, bonding agent, or additive is not used).

C. **Dissimilar Backgrounds:** where rendering is to be continued without break across joints between dissimilar solid backgrounds which are in the same plane and rigidly bonded or tied together, cover joints with 150mm wide strip of building paper overlaid with 300mm wide galvanized steel lathing fixed with corrosion resistant fasteners at not more than 600mm centers along both edges.

D. Apply dash coat on concrete and concrete masonry surfaces indicated for direct plaster application. Moist-cure dash coat for at least 24 hours after application and before plastering.

E. Install temporary grounds and screeds to ensure accurate rodding of plaster to true surfaces; coordinate with scratch-coat work.

F. Refer to Division 6 Sections for installing permanent wood grounds, if any.

G. **Surface Conditioning:** Immediately before plastering, dampen concrete and concrete unit masonry surfaces that are indicated for direct plaster application. Determine and apply amount of moisture and degree of saturation that will result in optimum suction for plastering.

3.3 LATHING

A. Install metal lath for the following applications where plaster base coats are required. Provide appropriate type, configuration, and weight of

metal lath selected from materials indicated that comply with referenced ML/SFA specifications and ASTM lathing installation standards.

1. Dissimilar Backgrounds: where rendering is to be continued without break across joints between dissimilar solid backgrounds which are in the same plane and rigidly bonded or tied together, cover joints with 150 mm wide strip of building paper overlaid with 300 mm wide galvanized steel lathing fixed at not more than 600 mm centers along both edges.

3.4 INSTALLATION OF PLASTERING ACCESSORIES

A. **General:** Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and in alignment during plastering. Install accessories of type indicated at following locations:

1. External Corners: Install corner reinforcement at external corners.
2. Terminations of Plaster: Install casing beads, unless otherwise indicated.
3. Control Joints: Install at locations indicated or, if not indicated, at locations complying with the following criteria and approved by Consultant:

a. Where an expansion or contraction joint occurs in surface of construction directly behind plaster membrane.

b. Distance between Control Joints: Not to exceed 5.5 m in either direction or a length-to-width ratio of 2-1/2 to 1.

c. Wall Areas: Not more than 13 sq. m.

d. Horizontal Surfaces: Not more than 9 sq. m in area.

e. Where plaster panel sizes or dimensions change, extend joints full width or height of plaster membrane.

3.5 PLASTER APPLICATION

A. **Plaster Application Standard:** Apply plaster materials, composition, and mixes to comply with ASTM C 926.

B. Do not use materials that are frozen, caked, lumpy, dirty, or contaminated by foreign materials.

C. Do not use excessive water in mixing and applying plaster materials.

D. **Flat Surface Tolerances:** Do not deviate more than plus or minus 3 mm in 3 m from a true plane in finished plaster surfaces, as measured by a 3-m straightedge placed at any location on surface.

E. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, and before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least 150 mm at each jamb anchor.

F. **Sequence plaster** application with installation and protection of other work so that neither will be damaged by installation of other.

G. Plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where interior plaster is not terminated at metal frame by casing beads, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

H. **Corners:** Make internal corners and angles square; finish external corners flush with corner beads on interior work, square and true with plaster faces on exterior work.

I. **Finish Coats:** Apply finish coats to comply with the following requirements

1. Float Finish: Apply finish coat to a minimum thickness of 3 mm to completely cover base coat, uniformly floated to a true even plane with fine-textured finish matching samples approved by the Consultant.

J. **Number of Coats and Thickness:** Excluding dash coats and dubbing out coats apply plaster of composition indicated, to comply with the following requirements:

1. Two Coats: Base and finish coats over the following plaster bases:

a. Concrete unit masonry.

b. Concrete, cast-in-place or precast when surface condition complies with ASTM C 926 for plaster bonded to solid base.

2. Three Coats: Scratch, base and finish coats over metal lath backgrounds and installations.

3. Overall thickness is to be 15.00 mm for internal plaster and 20.00 mm for external plaster.

4. One plaster base coat (15 mm thick) for walls to be finished with ceramic tiles set with thin bed adhesive.

5. One coat work (15 mm thick) for plaster on concrete structural slabs uniformly floated to a true even plane

6. Moist-cure plaster base and finish coats to comply with ASTM C 926, including written instructions for time between coats and curing in "Annex A2 Design Considerations."

3.6 CUTTING AND PATCHING

A. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other work. Repair cracks and indented surfaces. Point-up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.7 CLEANING AND PROTECTING

A. Remove temporary covering and other provisions made to minimize

spattering of plaster on other work. Promptly remove plaster from doorframes, windows, and other surfaces not to be plastered. Repair surfaces stained, marred or otherwise damaged during plastering work. When plastering work is completed, remove unused materials, containers, equipment, and plaster debris.

B. Provide final protection and maintain conditions, in a manner acceptable to Consultant, that ensure plaster work is without damage or deterioration at the time of Substantial Completion.

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DIVISION 09 75 00

STONE SOLING

1. SCOPE

The work under this section of specifications consists of furnishing all plant, labor, equipment, appliances, materials and performance of all operations required in connection with the construction of stone soling in strict accordance with the specifications and Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. STONE

Stone to be used shall comprise of strong, hard, durable stone of the approved size, free from impurities, quarry sap, dust, dirt and solubility characteristics. The stone shall be obtained from approved quarries and shall be sound, free from laminations and weak cleavages.

3. CONSTRUCTION

3.1 Preparation of Sub-grade

Sub-grade shall be formed of suitable materials free of clods, sod, roots, stumps, brush or other objectionable material.

Sub-grade material shall be placed in successive layers not exceeding 6 inch in thickness and each layer shall be thoroughly compacted at optimum moisture content.

The maximum dry weight density of the sub-grade shall not be less than 95% of Modified AASHTO requirements.

3.2 Stone Ballast Soling

The Stone Ballast shall be well graded and broken hard of 3" mesh obtained from an approved quarry.

The stone shall be laid and packed to even grades and well rolled using vibratory roller/plate compactor to a consolidated thickness of not less than 6

inch or as shown on the Drawings.

The whole of the surface of the compacted stone ballast soling will be blinded with morum or any other approved gritty material done dust (Khaka). After the interstices have been filled with smaller size crushed stone, so as to effectively fill in the voids and crevices, soling area may be watered, if necessary and again thoroughly rolled with the same roller to produce a smooth and even surface free from irregularities, true to line and level.

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DIVISION 09 67 16

MARBLE

1. GENERAL

The work under this section of specifications consists of providing all material, labor, plant, equipment, appliances in any floor and at any height and performing all operations required for providing and installing marble natural stone slab for toilet counters, where shown on the drawings, complete in strict accordance with this section of the specification and the applicable Drawings.

2. SUBMITTALS

The Contractor shall submit manufacturer's specifications and other product data for each type of marble stone and fixtures required, including instructions for handling, storage, installation and protection.

Shop Drawings shall be submitted showing sires, dimensions, sections and profiles of slab, arrangement and provisions for jointing, anchoring, fastening and supports and other necessary fixing details. Indicate locations, layouts and pattern arrangements for each stone type and color, Submit three ranges samples 12" x 12" In size of each type of stone showing color, grade, finishing and texture for approval of the Engineer

3. MATERIAL

3.1 GENERAL

Marble shall be compact, dense, meiam or poros rock of lime stone origin obtained from quarries within Pakistan. It shall have a specific gravity of 27 and hardness number on Moh's scale shall range from 3 to 4.

Obtain each marble stone type from a single quarry and ensure consistent color range and texture throughout the work. All pieces shall be of uniform thickness and truly square in shape.

Provide marble slabs/sills and tiles of specified sizes in floors, stair tread & rise •$ and counter tops as shown on drawings.

Provide marble slabs/sills and tiles of type, colour and finish for each area as directed *by* the Engineer.

Provide stone of specified thickness. Saw cut the back surfaces that are meant to be concealed in finished work.

Provide irregular shaped unite, staircase unite and skirting base units to the profiles of required shapes S sizes and polished exposed surfaces wherever specified.

3.2 MARBLE STONE TYPE

All marble stone types are to be selected and approved by the Engineer for quality* colour and texture.

3.3 BEDS AND BACKINGS

Where applicable, standard cementious screed and mortar beds and backings, mixed and proportioned by volume shall be as follows. -

Grey ordinary Portland Cement: 1 part Sand 2 parts

Water, Clean, fresh and free from deleterious substances

3.4 ADHESIVES, GROUTS AND SEALANTS

Proprietary adhesives, joint grouts and sealants of approved type as required and recommended by the manufacturer for specific application shelf be used. The colour of the joint grout and the sealants shall match with the colour of stone

4. DELIVERY, STORAGE AND HANDLING

Materials shall *be* protected from damage during loading, shipment, delivery and storage. Non- staining materials for blocking and packing shall be used Stack marble at site in accordance with manufacturer recommendations and as

required to prevent staining, scratching, etching or breakage.

5. EXECUTION

5.1 FLOORING, SKIRTING/DADO AND STAIR

Apply cement slurry coat over surfaces of concrete substrate immediately prior to placing setting bed Limit area of application to avoid premature drying out. Install setting bed of required thickness and set stone units before initial set occurs. Apply a thin layer of cement paste to bottom of each unit. Set tamp and level units immediately set units in required pattern with uniform joint widths.

Point joints as soon as possible after initial set. force grout into joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces while stiff moist and as the work progresses.

Do not permit traffic on finished surface during setting and for a minimum of 24 hours after final pointing of joints.

5.2 REPAIR AND CLEANING

Remove and replace stone units, which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units, which do not match adjoining stonework or are not in line and level as shown on Drawings. Provide new matching units, install and point joints to eliminate evidence of replacement Re-point defective and unsatisfactory joints to provide neat, uniform appearance.

Clean stonework not less than 6 days after completion of work, using clean water and bristle brushes. Do not use wire brushes, acid or caustic type cleaning agents or other

cleaning compounds which may be detrimental to the stone finish or joint grout.

5.3 PROTECTION

Provide covers, boards, supports and all other necessary materials to protect finished work from collapse, deterioration, discoloration or damage during installation and until contract completion,

5.4 POLISHING

The finished surface shall be chemically polished, acceptable to the Engineer.

6. RELATED WORKS INCLUDED IN THE RELEVANT ITEMS OF BOQ.

The under mentioned works are related to the relevant BOQ items. The cost thereof shall *be* deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- Class 'C' cement concrete screed base and cement sand mortar piaster base under marble floor and skirting/dado etc
- Finishing/grinding, washing & polishing works and all related items and marble tiles.
- 1:2 and 1.4 cement sand roughcast plaster.
- Pointing in marble tiles. cleaning compounds which may be detrimental to the stone finish or joint grout.

5.3 PROTECTION

Provide covers, boards, supports and all other necessary materials to protect finished work from collapse, deterioration, discoloration or damage during installation and until contract completion,

5.4 POLISHING

The finished surface shall be chemically polished, acceptable to the Engineer.

6. RELATED WORKS INCLUDED IN THE RELEVANT ITEMS OF BOQ.

The under mentioned works are related to the relevant BOQ items. The cost thereof shall *be* deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- Class 'C' cement concrete screed base and cement sand mortar piaster base under marble floor and skirting/dado etc.
- Finishing/grinding, washing & polishing works and all related items and marble tiles.
- 1:2 and 1.4 cement sand roughcast plaster.
- Pointing in marble tiles.

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DIVISION 09 65 19

PORCELAIN TILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 DEFINITIONS

A. **Module Size:** Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. **Facial Dimension:** Actual tile size (minor facial dimension as measured per ASTM C 499).

C. **Facial Dimension:** Nominal tile size as defined in ANSI A137.1.

1.3 PERFORMANCE REQUIREMENTS

A. **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:

1. Level Surfaces: Minimum 0.6.

B. **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:

1. Heavy: Passes cycles 1 through 12. Use where indicated in Finishing Schedules.
2. Moderate: Passes cycles 1 through 10. Use for other applications indicated on Schedule where heavy duty is not indicated.

1.4 SUBMITTALS

A. **Product Data:** For each type of tile, mortar, grout, and other products specified.

B. **Shop Drawings:** For the following:

1. Tile patterns and locations.
2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
3. 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.

C. **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.

D. **Grout Samples for Initial Selection:** Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

E. **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.

1. 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.
2. Full-size units of each type of trim and accessory for each color required.
3. Stone thresholds in 150-mm lengths.

F. **Master Grade Certificates:** For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

G. **Product Certificates:** Signed by manufacturers certifying that the products furnished comply with requirements.

H. **Installer Experience:** List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product.

I. **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.

J. **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.

K. **Setting Material Test Reports:** Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

1.6 QUALITY ASSURANCE

A. **Quality System:** Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Consultant and the Employer.

B. **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.

C. **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.

D. **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.

E. **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:

1. Stone thresholds.
2. Cementitious backer units.
3. Joint sealants.
4. Waterproofing.

F. **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.

1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Consultant.
2. Notify Consultant 7 days in advance of the dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Consultant's approval of mockups before proceeding with final unit of Work.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

a. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. 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.

1.9 EXTRA MATERIALS

A. 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.

1. 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.

PART 2 - PRODUCTS

2.1 PRODUCTS,

A. GENERAL

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
2. Retain below with appropriate definitions in referenced part 1 article.
3. NA
4. Tiles are to be highest grade of production in manufacturer's quality

grading system.

B. **ANSI Standards for Tile Installation Materials:** Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. **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:

1. Provide Consultant's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.

D. **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.

E. **Mounting:** W here factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

F. **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.

2.2 TILE PRODUCTS

A. **General Characteristics:** Tiles are to comply with the following general requirements:

1. Floor Tiles:

a. Abrasive Hardness: Minimum Index 253 to ASTM C 501 (unglazed tiles), unless otherwise specified.

b. Bending Strength: Minimum 35 Kg/cm^2 to ASTM C 648

c. Water Absorption: As specified.

d. Chemical Resistance: Unaffected with moderate acids.

e. Tile Rating: For heavy duty floor by a rating system acceptable to the Consultant.

2. Wall Tiles:

a. Water Absorption: Maximum 6% to ASTM C 373.

B. **Unglazed Paver Tile:** Provide flat tile complying With the following requirements:

1. Composition: Porcelain mix.
2. Construction: Color-through.
3. Water Absorption: Less than 0.5% to ASTM C 373.
4. Surface Finish: Matt or Polished as indicated on Drawings.
5. Facial Dimensions: As indicated on Drawings.
6. Thickness: minimum 9.0 mm for tiles and 8.50 mm for fittings.
7. Face: Plain with Square or cushion edges.

C. **Wall Tile:** Provide flat tile complying with the following requirements:

1. Module Size: As indicated on Drawings.
2. Water Absorption: Less than 6% to ASTM C373.
3. Thickness: minimum 8.0 mm.
4. Face: Plain with modified square edges or cushion edges.

C. **Trim Units:** Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:

a. Base for Portland Cement Mortar Installations: Coved.

b. Wainscot Cap for Thin-Set Mortar Installations: Surface bull nose.

c. External Corners for Thin-Set Mortar Installations: Surface bull nose.

d. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

D. **Thickness of Tiles:** Specified thickness of tiles excludes thickness of keying patterns on back.

Background/Base: 15mm thick 1:4 cement/sand render on concrete or concrete block works 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. Color to architects approval.

Movement joints: All internal corners; Width: 6mrn

Accessories: all exposed edges and corners to have performed rounded edges

2.3 PORCELAIN WALL TILING

Background/Base: 15mrn thick 1:4 cement/sand render on concrete or concrete blockworks.

Bedding: Thin bed cement-based adhesive. 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.

Joint width: 3mm. Movement joints: Location: All internal corners;

Width: 6mm

Accessories: all exposed edges and corners to have preformed rounded edges In toilets, no tiles behind low level ducts or full height ducts. Complete tiling should be done behind mirrors. In pantry, tiles are to be fixed behind base and wall units but not behind service duct panels.

Plaster only where no tiles.

2.4 FLOOR TILING

Background/Base: screed 1 in-situ concrete

Screed: 11.5:3 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: 2.5mm.

Movement joints: location: At all perimeters including door thresholds; Width: 6mm- 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.

2.5 NA

2.6 GROUTING MATERIALS

A. **Sand-Portland Cement Grout:** ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

B. **Chemical-Resistant Epoxy Grout:** ANSI A 118.3, color as indicated.

1. 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.

C. **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.

2.7 ELASTOMERIC SEALANTS

A. **General:** Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 7 Section "Joint Sealants."

B. **Colors:** Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.8 MISCELLANEOUS MATERIALS

A. **Trowelable Underlayments and Patching Compounds:** Latex-modified, Portland- cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. **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.

1. 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.

C. **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.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

1. 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.

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DIVISION 09 66 00

TERRAZZO TILE FLOORING / CAST IN SITU TERRZZO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes the following:

1. Terrazzo Tiles Flooring.
2. Cast in Situ Terrazzo.

1.3 DEFINITIONS

A. **Module Size:** Actual tile size (12” x 12” x 1”thick).

B. **Facial Dimension:** Actual tile size (minor facial dimension as measured per ASTM C 499).

C. **Facial Dimension:** Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. **Static Coefficient of Friction:** For tile installed on Flooring surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1 Level Surfaces: Minimum 0.6.

B. **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:

1. Heavy: Passes cycles 1 through 12. Use where indicated in Finishing Schedules.
2. Moderate: Passes cycles 1 through 10. Use for other applications indicated on Schedule where heavy duty is not indicated.

1.5 SUBMITTALS

A. **Product Data:** For each type of tile, mortar, grout, and other products specified.

B. **Shop Drawings:** For the following:

1. Tile patterns and locations.
2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
3. 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.

C. **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.

D. **Grout Samples for Initial Selection:** Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

E. **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.

1. Each type and composition of tile and for each color and texture required, at least 12" x 12" 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.
2. Full-size units of each type of trim and accessory for each color required.

F. **Master Grade Certificates:** For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

G. **Product Certificates:** Signed by manufacturers certifying that the products furnished comply with requirements.

H. **Installer Experience:** List of five projects (minimum) of a similar nature carried out successfully by the installer with the same product.

I. **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.

J. **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**.**

K. **Setting Material Test Reports:** Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements from site and install permanent works.

G. **Pre-installation Conference:** Conduct conference at Project site to comply with requirements of Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. 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.

1.8 EXTRA MATERIALS

A. 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.

1. 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.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
2. Retain below with appropriate definitions in referenced part 1 article.
3. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
4. Tiles are to be highest grade of production in manufacturer’s quality grading system.

B. **ANSI Standards for Tile Installation Materials:** Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. **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:

1. Provide Consultant's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.

D. **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.

E. **Mounting:** Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

F. **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.

2.2 **TILE PRODUCTS**

A. **General Characteristics:** Tiles are to comply with the following general requirements:

1. Floor Tiles:

a. Abrasive Hardness: Minimum Index 253 to ASTM C 501, unless otherwise specified.

b. Bending Strength: Minimum 35 Kg/cm^2 to ASTM C 648

c. Water Absorption: As specified.

d. Chemical Resistance: Unaffected with moderate acids.

e. Tile Rating: For heavy duty floor by a rating system acceptable to the Consultant.

f. Water Absorption: Maximum 6% to ASTM C 373.

3.1 TERRAZZO TILE

The ingredients of the terrazzo topping finish of the tiles shall confirm the Specification stipulated for in situ Terrazzo finish herein above. The tiles shall be made by mechanical compression process and shall be of first grads. The size shall be 12" x 12" x 1" thick for floor and ½" thick for skirting. The tile shall be composed of one part of cement and two parts of marble chips. The compositions given above applies to 10 mm thickness of the top surface of the tile remaining portion being composed of normal 1:2 cement and course sand mortar. The size and colour composition of the marble chips shall be according to Consultant's instruction. Tiles shall be well shaped perfectly square with straight edges perfectly flat and free from defect which may defect its appearance of serviceability. Tiles with chips or cricks when being installed will not be acceptable. The following samples should be submitted to the Consultant.

Terrazzo tile type	- - -	2 of each
Coloring type	- - -	0.25 kg of each
Cleaning Compound	- - -	1 can of each.

The plain concrete sub-floor surfaces to receive the setting bed for tiles shall be clean and free of dirt, dust, oil or other objectionable matter. Setting beds for terrazzo tile flooring shall be composed of 1 part cement and 2 parts sand by volume with minimum amount of water necessary to produce a workable mass and shall be laid to an average thickness of 25 mm. This shall be covered with neat cement grout of creamy consistency. As large as area of setting bed shall be spread at one time as can be covered with tiles before the mortar has set. Surplus mortar shall be removed. The thickness of setting bed in any space shall not be

less then mm. tiles shall be laid out from the center line of each space outward and in straight lines in a symmetrical pattern with a minimum of cut tiles. Joints between tiles shall be as uniform width. Tile shall be cut with a suitable tool and rough edges shall be rubbed smooth Tile shall be laid to the straight edges.

Floor should be kept wet for 3 days no one should be allowed to walk on tiles during that period.

After seven days of laying the tiles the terrazzo tile floors shall be machine ground to a true even surface using various grades of abrasive stones as required. After the first grinding the floor shall be thoroughly grouted with the same cement and colour composition as used for the manufacture of tiles top surface. The grout shall be of the consistency of thick cream and shall be brushed over the floor to eliminate all blemishes and to thoroughly fill the surface for final grinding. Not less than 72 hours after application, the grouting coat shall be removed by grinding. The final surface should have very smooth finish. Small areas, inaccessible portions and corners which cannot be reached by the grinding machine shall be ground and rubbed by hand. The final gloss should be given polishing the surface to the satisfaction of the consultant

3.2 TERRAZZO SKIRTING TILES

The terrazzo skirting tiles shall be the same as or terrazzo floor tiles except that the skirting tiles shall be 4” x 12” and shall be laid over ½” rough plaster and shall be manufactured and finished in the same manner as the floor tiles.

4.0 FLOOR TILE MEASUREMENT & PAYMENT

Measurement for terrazzo tile shall be made of the net Sq. Ft area on which the terrazzo tile are laid and only approved by the Consultant.

The laid prices tendered for this work shall include the cost of the tiles and all other materials, supplying, mixing and applying, setting bed and slurry, grinding and finishing and of all plant, operation, procedures and requirements necessary of finish this work in accordance with these specification.

4.1 Measurement of terrazzo tile skirting shall be made at the net Rft. Length on which the skirting is laid and duty approved by the Consultant. The Unit Prices tendered for this work shall include the cost of tiles and all other materials, supplying, mixing and applying, setting plaster and slurry curing, grinding and finishing and of all plants, operations, procedures and requirements necessary to finish this work in accordance with these Specifications.

5.0 CONSTRUCTION REQUIREMENTS IN SITU TERRAZZO FLOORING

The floor shall consist of a wearing surface of consistency and net thickness as specified in Bill of Quantities, laid over 1:2:4 concrete base of the specified thickness. The net thickness specified for wearing surface shall be that obtained after grinding and polishing, 1:2:4 concrete shall be mixed and laid in the manner specified for cement concrete floor, using a minimum quantity of water for workability.

The cement concrete shall be leveled with a trowel and straight edge, consolidated and finished with steel trowels to an even but rough surface. The top layer of cement marble chips mixed in the proportion of 1:2 (1 cement and 2 marble Chips) shall be laid over it within 24 hours. The cement and marble chips must be mixed dry in such quantities as are sufficient for a unit of one specified shade. Water shall be added to only such quantities as can be mixed thoroughly and consumed in less than 30 minutes, the quantity of water being the minimum for

workability. Mixing must be done on watertight platform and any mix not used within 30 minutes shall be discarded and removed from site. A layer of cement and marble chipping mixture should be well trowelled into the surface of the base concrete before filling to the top level of the screeds. The layer should be well compacted, and all voids shall be filled in. A layer of neat cement, of the specified colour shall then be well trowelled into the surface leaving a plain smooth surface.

Floors shall be laid in panels of about 4.0'x4'-Q (1.2 x 1.2 meter) or of size as shown on the drawings. Dividing strips of aluminum/brass/glass as specified shall be provided and fixed to exact levels making an allowance for grinding. Aluminum strips shall not be less than 3mm thick and of width equal to the total thickness of cement concrete base and Terrazzo Topping.

Three days after laying the top layer must be evenly and smoothly machine ground with carborandum blocks of coarse, medium and fine grades so as to ensure that all marble chippings are evenly exposed allover the surface. If marble chips are not evenly exposed the Contractor shall pull down the surface and relay it at his own cost. After the first grinding, the floor shall be thoroughly grouted with the same cement and colour composition as specified for the terrazzo mix. The grout shall be of the consistency of thick cream and shall be brushed over the floor to eliminate all impressions and thoroughly fill the surface for final grinding. The surface after grinding shall be left un-disturbed and cured for 2 or 3 weeks, after which it shall be cleaned of dirt and dust by rubbing gently with pumice stone or washing soda in sufficient water. Three days after the surface has been cleaned it shall be rubbed hard with 1:10 solution of oxalic acid using felt. The surface shall then be cleaned and washed with plenty of water. After the surface has dried a

final gloss shall be given by polishing the surface. The walls and all surfaces of the finished works of other trades shall be properly protected from damage and spoiling during the process of grinding and washing of the terrazzo. After the finish grinding has been completed and the surface treatment applied, the terrazzo work shall be covered and protected with approved material until completion of the work of all other trades.

TERRAZZO TILE FLOORING AND CAST IN SITU TERRAZZO

6.0 TERRAZZO DADO AND SKIRTING

The marble chips and cement shall conform to specification for floor. Mixing shall be done in the same manner and proportion. The plastered surface over which the dado/skirting is 'to be applied shall be well roughened and watered; cement mortar of specified ratio shall then be plastered over this well roughened surface to indicated thickness. Before the base course has set the layer of terrazzo mixture shall be well trowelled into the surface of the base to a thickness which after grinding shall result in the finished thickness as per Bill of Quantities. A layer of neat cement of the specified colour shall then be well trowelled into the surface leaving a plain smooth surface. After the period specified for floors above, the Contractor shall start finishing as for floors specified above. Terrazzo skirting shall be provided around all terrazzo floors unless shown otherwise. Skirting and dado shall be straight, level and in plumb. Intersections at floors shall be straight and flush.

7.0 TERRAZZO ON STAIRS

The stair risers and treads shall be finished according to exact sizes including the terrazzo topping making allowance for grinding of terrazzo. The nosing shall be flush with the terrazzo toppings, and shall be protected by aluminum angles as specified or shown on Drawings. The

angles shall be firmly secured, by means of counter-sunk brass screws and cast together with the step.

8.0 MEASUREMENT

Work for floor and dado shall be measured in Sq.Ft. /M of wall and floor area, skirting shall be measured in Lin.Ft./H.

8.1 RATE AND PAYMENT

The rate for all items of work under this section shall cover the cost of furnishing all materials, labour, scaffolding framework laying, curing, grinding, polishing, finishing and appliances at site and performing all operations at any height in accordance with drawings, Bill of Quantities and as specified. The rate shall include the cost of furnishing and installing metal fixings, dividing strips for floors, dados, nosing, angles aluminum U-channels and screws for stairs etc., and providing all assistance to other trades for built in items etc.

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DIVISION 09 91 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 DEFINITIONS

A. **General:** the following coating terms apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.3 SUBMITTALS

A. **Product Data:** For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer’s Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

B. **Samples for Initial Selection:** Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1. After color selection, the Consultant will furnish color chips for surfaces to be coated.

C. **Samples for Verification:** Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

3. Submit Samples on the following substrates for the Consultant's review of color and texture only:

a. Concrete: Provide two 100-mm- square samples for each color and finish.

b. Ferrous Metal: Provide two 100-mm- square samples of flat metal and two 200-mm- long samples of solid metal for each color and finish.

D. **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 and addresses of Consultants and owners, and other information specified.

E. **Benchmark Samples (Mockups):** Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project.

1. The Consultant will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.

a. Wall Surfaces: Provide samples on at least 9 sq. m of wall surface.

b. Small Areas and Items: The Consultant will designate an item or area as required.

2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, the Consultant will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from job-applied samples.

E. **Manufacturers Qualifications:** Paint materials shall be the products of paint and coating manufacturers whose qualifications are as follows:

1. Manufacturers shall be reputable of multi-national scale in production and distribution with capabilities to deliver paint materials quantities necessary for the project on due time.

2. Manufacturers shall have evidence from scientific bodies that demonstrate their participation and share in the development of paint industry generally and production of new painting materials kinds.

3. Manufacturers shall have their own proprietary brand names that are well known worldwide.

4. Manufacturers shall have minimum 25 years of successful experience in producing painting materials for use in prestigious projects worldwide of same standard of quality as that intended for the Project.

5. Manufacturers shall be registered in the associations, councils, boards, federations or other similar bodies of paint manufacturers in countries of origin and practice.

F. **Performance of Paints:** Paints shall be fit for purpose and manufactured specifically for the applications indicated and uses intended, taking into account the type, nature, location, and aesthetic and utility requirements of the Project.

1. Opacity: Paint shall cover or hide the substrate to the Consultant's satisfaction.
2. Cleanability: Paint shall not absorb dirt and shall be capable of being washed or scrubbed periodically, to the Consultant's satisfaction, without adverse effect on its attributes or appearance.
3. Scrub resistance wet and dry: paint shall resist abrasion caused by scrubbing in accordance with ASTM D 2486.
4. Adhesion: Paint shall adhere firmly to the substrate without peeling.
5. Exposure resistance: Paint shall resist yellowing and weathering caused by UV rays and ozone.

G. **Standards:** Paints shall be manufactured to relevant US standards, or any other international standard approved by Authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.

4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 7 deg C. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and, in the quantities, described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to the Employer.

1. Quantity: Furnish the Employer with an additional 5 percent, but not less than 3.8L or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT MATERIALS, GENERAL

A. **General:** Employed paints and painting materials shall be the highest grade and top quality in manufacturer's range of products for the generic kind of paint or paint material.

B. **General:** Materials for paint works shall comply with requirements of BS 6150, as applicable.

C. **Material Compatibility:** Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another, and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

D. **Material Quality:** Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

E. **Colors:** Provide color selections made by the Consultant or by reference to manufacturer's color designations.

2.2 ANTI-CARBONATION PAINT MATERIALS, GENERAL

A. Paint for application on internal and external is to be anti-carbonation paint that is easy to clean, applicable on new or existing concrete, Portland cement plaster or masonry, water-based and nontoxic, allows substrate to breath, Protects substrates form Carbonation, of elastic nature with crack bridging properties.

B. Anti-carbonation paint is to be self-cleaning by application of just sprayed water, highly durable, copolymer-based coating which cures to form a tightly adherent, decorative weatherproof membrane guaranteed for up to 15 years. The formed coating membrane shall tolerate thermal movement in the substrate without splitting or cracking and will retain its elastomeric properties even after prolonged exposure to ultra-violet light. Coating shall have the advantage of being reinforced using glass fiber matting or tapes and shall be capable of bridging cracks or joints between different substrates. The finished surface shall be chemical and pollution-resistant surface that has been specially manufactured to shed dirt, ensuring that it retains a bright, attractive appearance throughout its life. Coating shall be vapor permeable and

allows entrapped substrate moisture to escape without causing blistering or delamination and shall produce an effective barrier to carbon dioxide diffusion and provide reinforced concrete substrates with an excellent defense against the harmful effects of carbonation. Color and sheen shall be selected by the Consultant from manufacturer's full range of products.

C. Anti carbonation paint shall also comply with following properties;

1. Carbon Dioxide Diffusion Resistance, Taywood Method

a. Equivalent Thickness of Air: More than 175 mm.

b. Equivalent Thickness of 30N Concrete: More than 500 mm;

2. Chloride Ion Diffusion Coefficient: No chloride ion diffusion after 60 days; Taywood Method

3. Static Crack Spanning Capability for 200-micron Dry Film Thickness at 23 ºC: Minimum 2.00 mm to ASTM C836.

4. Tear Resistance: 15 N/mm to ASTM D1004.

5. Tensile Strength: 5.00 N/mm2 to ASTM D412.

6. Reduction in Water absorption: Not less than 82% to ASTM C642.

7. Reduction in Chloride Ions Penetration: Not less than 92% to AASHTO M259.

8. Adhesion: Not less than 1.00 N/mm2, BS 1881.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. **Coordination of Work:** Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Consultant about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. **General:** Preparation of surfaces to receive paints is to be according with requirements of BS 6150 and recommendations of paints manufacturer.

B. **General:** Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

C. **Cleaning:** Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. **Surface Preparation:** Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreignsubstances. Use solvent or mechanical cleaning methods that comply with recommendations of referenced standards.

a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of referenced standards.

b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint

manufacturer, and touch up with the same primer as the shop coat.

4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. **Materials Preparation:** Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

F. **Tinting:** Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. **General:** Apply paint according to recommendations of BS 6150 and manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built- in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Sand lightly between each succeeding enamel or varnish coat.

B. **Scheduling Painting:** Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. **Application Procedures:** Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. **Minimum Coating Thickness:** Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. **Mechanical and Electrical Work:** Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. **Prime Coats:** Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

G. **Pigmented (Opaque) Finishes:** Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

H. **Transparent (Clear) Finishes:** Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

I. **Stipple Enamel Finish:** Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

J. **Completed Work:** Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Employer reserves the right to invoke the following test procedure at any time and as often as the Employer deems necessary during the period when paint is being applied:

1. The Employer will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. The testing agency will perform appropriate tests for the following characteristics as required by the Employer:

a. Quantitative material analysis.

b. Abrasion resistance.

c. Apparent reflectivity.

d. Flexibility.

e. Washability.

f. Absorption.

g. Accelerated weathering.

h. Dry opacity

i. Accelerated yellowness.

j. Recoating.

k. Skinning

l. Color retention.

m. Alkali and mildew resistance.

3. The Employer may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint,

the 2 coatings are incompatible.

3.5 CLEANING

A. **Cleanup:** At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Consultant.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

3.7 EXTERIOR PAINT SCHEDULE

A. Coordinate the following paint coats with surface preparation steps as specified.

B. Concrete and Cement Sand Portland Plaster: Provide the following finish system over exterior concrete and Portland Cement Plaster.

1. Light Textured Emulsion Paint

a. 100% pure acrylic-based paint specially formulated for external application. The paint is to dry by evaporation of water and will produce a durable, flexible, excellent water and alkali resistant and is to provide long lasting protection for coated surfaces. The paint is to be UV-resistant, of high bond strength to substrates and distinguished color retention, and is to provide anti-carbonation shield for the substrate while allowing moisture of substrate to escape to the outside.

b. Finished surface is to be of light texture.

C. **Ferrous Metal:** Provide the following finish system over exterior ferrous metal.

1. Full-Gloss, Epoxy-Based Enamel: Two finish coat over primer.

a. Primer: High-molecular-weight, epoxy-resin primer at spreading rate recommended by manufacturer.

b. Finish Coat: High-molecular-weight, epoxy-resin topcoat at spreading rate recommended by the manufacturer.

c. Protection Coating: Two Coats of clear polyurethane-based, UV resistant protection coating.

3.8 INTERIOR PAINT SCHEDULE

A. Coordinate the following paint coats with surface preparation steps as specified.

B. Concrete: Provide the following paint systems over interior concrete and masonry surfaces

1. Flat Acrylic Finish: 2 finish coats over a primer.

a. Primer: Alkali-resistant, acrylic-latex, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.025 mm.

2. First and Second Coats: Flat, acrylic latex-based, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.060 mm per coat.

C. **Plaster:** Provide the following finish systems over new, interior Portland cement plaster surfaces:

1. Flat Acrylic Finish: 2 finish coats over a primer.

a. Primer: Alkali-resistant, acrylic-latex, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.036 mm.

b. Undercoat: same material for finish coats specified hereafter diluted to the manufacturer's recommendations.

c. First and Second Finish Coats: Flat, acrylic-latex, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.064 mm per coat.

2. Semigloss, Alkyd-Enamel Finish: One finish coat over an undercoat and a primer.

a. Primer: Alkali-resistant, alkyd- or latex-based, interior primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

b. First and Second Coats: Semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.066 mm.

D. **Woodwork and Hardboard:** Provide the following paint finish systems over new, interior wood surfaces:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a wood undercoater.

a. Undercoat: Alkyd- or acrylic-latex-based, interior wood undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.031 mm.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.066 mm.

2. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over a wood undercoater.

a. Undercoat: Alkyd, interior enamel undercoater applied at spreading rate recommended by the manufacturer to achieve a total dry film

thickness of not less than 0.031 mm.

b. First and Second Coats: Full-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.061 mm.

E. **Stained Woodwork:** Provide the following stained finishes over new, interior woodwork:

1. Alkyd-Based, Satin-Varnish Finish: 2 finish coats of an alkyd-based, clear- satin varnish over a sealer coat and an alkyd-based, interior wood stain. Wipe wood filler before applying stain.

a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.

b. Stain Coat: Alkyd-based, interior wood stain applied at spreading rate recommended by the manufacturer.

c. Sealer Coat:Clear sanding sealer applied at spreading rate recommended by the manufacturer.

d. First and Second Finish Coats: Alkyd-based or polyurethane varnish, as recommended by the manufacturer, applied at spreading rate recommended by the manufacturer.

F. **Zinc-Coated Metal:** Provide the following finish systems over zinc-coated metal:

1. Full-Gloss, Alkyd-Enamel Finish: One finish coat over an enamel undercoat and a primer.

a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.031 mm.

b. Undercoat: Alkyd, interior enamel undercoat or semigloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the

manufacturer to achieve a total dry film thickness of not less than 0.031 mm.

c. Finish Coat: Full-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.031 mm.

G. **Ferrous Metal:** Provide the following finish systems over ferrous metal:

1. Full-Gloss, Alkyd-Enamel Finish: two finish coat over a primer.

a. Primer: Interior ferrous-metal primer at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.031 mm.

b. Finish Coat: Full-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.031 mm percoat.

H. **Ferrous Metal:** Provide the following finish systems over ferrous metal:

1. Full-Gloss, Epoxy-Based Enamel: Two finish coat over primer.

a. Primer: High-molcular-weight, epoxy-resin primer at spreading rate recommended by manufacturer.

b. Finish Coat: High-molcular-weight, epoxy-resin topcoat at spreading rate recommended by the manufacturer.

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DIVISION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Warm-air dryers..

1.3 SUBMITTALS

A. **Product Data:** Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. **Samples:** For each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. **Setting Drawings:** For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. **Product Schedule:** Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

E. **Maintenance Data:** For accessories to include in maintenance manuals specified in Division

1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. **Product Options:** Accessory requirements, including those for materials,

finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Consultant, may be provided.
2. Other manufacturers' products with equal characteristics may be considered. See Division 1 Section "Substitutions."
3. Do not modify aesthetic effects, as judged solely by Consultant, except with Consultant's approval. Where modifications are proposed, submit comprehensive explanatory data to Consultant for review.

1.5 WARRANTY

A. **General Warranty:** Special warranty specified in this Article shall not deprive Employer of other rights Employer may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Manufacturer's Mirror Warranty:** Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finishes (satin), in 0.8-mm minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16M, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.9-mm minimum nominal thickness; surface preparation and metal

pretreatment as required for applied finish.

D. **Galvanized Steel Sheet: ASTM A 653/A 653M, Z180.**

E. **Chromium Plating: ASTM B 456,** Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal**.**

F. **Baked-Enamel Finish:** Factory-applied, gloss-white, baked-acrylic-enamel coating.

G. **Mirror Glass:** as per requirements of Division 8, section "Mirrored Glass".

H. **Galvanized Steel Mounting Devices:** ASTM A 153/A 153M, hot-dip galvanized after fabrication.

I. **Fasteners:** Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed**.**

2.2 FABRICATION

A. **General:** Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. **Surface-Mounted Toilet Accessories:** Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. **Recessed Toilet Accessories:** Unless otherwise indicated, fabricate units of all- welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. **Mirror-Unit Hangers:** Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

E. **Keys:** Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Employer's representative.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

3.2 ADJUSTING AND CLEANING

A. Remove temporary labels and protective coatings.

B. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. **Toilet Tissue Dispenser (Toilet Paper Holder):** Provide toilet tissue dispenser complying with the following:

1. Type Single-roll dispenser.
2. Mounting: Surface mounted with concealed anchorage.
3. Material: Stainless steel
4. Operation: Non-control delivery with mfr's standard spindle.
5. Capacity: Designed for standard diameter-core tissue rolls up to 140

mm diameter (800 sheets)

B. **Soap Dish:** Stainless steel size and shape as selected by the Consultant from manufacturer's standard range.

C. **Soap Dispenser:** Provide soap dispensers complying with the following:

Liquid Soap Dispenser, Vertical-Tank Type: Wall mounted type, minimum 1182.9 ml capacity tank with stainless steel piston, springs, and internal parts designed to dispenses soap in measured quantity by pump action, and stainless-steel cover with unbreakable window-type refill indicator.

Mounting: Designed for wall mounting.

Soap Valve: Designed for dispensing soap in liquid form.

D. **Paper Towel Dispenser:** 800 multi-hold towels capacity, stainless steel, surface mounted.

E. **Robe Hook**

1. Stainless steel.
2. Double- prong with rectangular wall bracket and back plate for concealed mounting.

F. **Grab Bar**

1. Surface mounting, exposed.
2. Stainless steel.
3. 38 mm outside diameter and 1.20 mm minimum wall thickness and 38 mm distance from inside of bar and face of wall.
4. Furnish complete with two end flanges, 3 mm thick minimum and 76 mm diameter, each of three countersunk screw holes for attachment to walls.
5. Use of flanges with snap covers is acceptable.

G. **Warm-Air Dryer:** Provide warm-air dryer complying with the following:

1. Touch-Button-Activated Hand Dryer: Surface-mounted, warm-air hand dryer activated by touch button and with manufacturers' standard, white-painted metal cover and 30-second-timed power cut-off switch.

------x-x-x------

INSTITUTE OF BUSINESS ADMINSTRATION, KARACHI
UNIVERSITY ROAD MAIN CAMPUS, KARACHI

VOLUME - IIIA (CONSTRUCTION OF GIRLS HOSTEL BLOCK I & II)

1- BILL OF QUANTITIES
2 - LIST OF APPROVED SUPPLIERS

CLIENT:

IBA Institute of Business Administration Karachi
Leadership and Ideas for Tomorrow

PLANNING & DEVELOPMENT OF PROJECT

Institute of Business Administration Karachi
Leadership and Ideas for Tomorrow

I N D E X

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2.	BILL OF QUANTITIES	Page 01 - 30
3.	LIST OF APPROVED MANUFACTURERS-Civil	Page 01 – 01
4.	LIST OF APPROVED MANUFACTURERS – MEP	Page 01 -03

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SUMMARY TO BILL OF QUANTITIES FOR
IBA GIRLS HOSTEL PHASE - II STAFF TOWN KARACHI UNIVERSITY ENCLAVE

14/3/2022

S.#	SECTION	DESCRIPTION	UNIT	AMOUNT AS PER CSR 2012 INCL. ADDENDA 1&2 ISSUED ON 1ST DEC.2021	CONTRACTOR PREMIUM	TOTAL COST OF SCHEDULE BASED ITEMS	AMOUNT BASED ON NON - SCHEDULE ITEMS RATES	TOTAL AMOUNT (Rev. Sch. Based & Non Schedule based item)
1	**SECTION - A**	MAIN BUILDING GROUND FLOOR	Rs.	**26,570,628**	-	-	-	-
2	**SECTION - B**	MAIN BUILDING FIRST FLOOR	Rs.	**17,071,618**	-	-	-	-
3	**SECTION - C**	MAIN BUILDING SECOND FLOOR	Rs.	**15,725,074**	-	-	-	-
4	**SECTION - D**	MAIN BUILDING THIRD FLOOR	Rs.	**1,682,459**	-	-	-	-
		TOTAL AMOUNT OF BUILDING WORKS		**61,049,779**	-	-	-	-
5	**SECTION- E**	**UNDER GROUND WATER TANK 20000 GLS CAPACITY**		**1,885,065**	-	-	-	-
5	**SECTION - F**	TENNIS COURT, VOLLEY BALL & CENTRAL COURT	Rs.	**4,493,420**	-	-	-	-
11	**SECTION - G**	EXTERNAL DEVELOPMENT	Rs.	**2,732,180**	-	-	-	-
12	**SECTION-H**	COMPOUND WALL	Rs.	**2,150,045**	-	-	-	-
12	**SECTION -I**	HORICULTURE	Rs.	-	-	-	-	-
13	**SECTION - J**	SOIL, WASTE & VENT PIPING	Rs.	-	-	-	-	-
14	**SECTION - K**	FITTINGS & FIXTURES	Rs.	-	-	-	-	-
15	**SECTION - L**	SEWER PIPE NETWORK AND MANHOLES	Rs.	-	-	-	-	-
16	**SECTION - M**	WATER SUPPLY (HOT & COLD),GAS PIPING	Rs.	-	-	-	-	-
17	**SECTION - N**	VALVES , FITTINGS & FIXTURES	Rs.	-	-	-	-	-
18	**SECTION - O**	WIRING / WIRING ACCESSORIES ETC.	Rs.	-	-	-	-	-
19	**SECTION - P**	SWITCHES, SOCKETS, OUTLET & ACCESSORIES	Rs.	-	-	-	-	-
20	**SECTION - Q**	UN-INTERRUPTED POWER SUPPLY	Rs.	-	-	-	-	-
21	**SECTION - R**	LIGHT FIXTURES & FANS	Rs.	-	-	-	-	-
22	**SECTION - S**	MAIN. SUB-MAIN CABLES, CONDUIT & CABLE TRAY	Rs.	-	-	-	-	-
23	**SECTION - T**	SWITCHBOARDS / DISTRIBUTION BOARDS	Rs.	-	-	-	-	-
24	**SECTION - U**	EARTHING SYSTEM	Rs.	-	-	-	-	-
25	**SECTION - V**	FIRE ALARM SYSTEM	Rs.	-	-	-	-	-
26	**SECTION - W**	DATA SYSTEM	Rs.	-	-	-	-	-
27	**SECTION - X**	CEILING, EXHAUST AND VENTILATION FANS	Rs.	-	-	-	-	-
		T O T A L C O S T	Rs.	**72,310,490**	-	-		
		ADD SRB / SST AS PER ADMMISSIBLE - B	Rs.					
		TOTAL AMOUNT C = A + B	Rs.					

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
SECTION - A : **MAIN BUILDING GROUND FLOOR** **BASED ON COMPOSITE SCHEDULED RATES 2012 INCLUDED ADDENEDA I & II ISSUED DEC. 2021**					
1	**JUNGLE CLEARANCE**				
a	Jungle Clearance and removing within 100 ft (b) thick, Item No 4 (b) Page 95 Chapter 18	%0Cft	14,100	151.25	2,132.63
2	**EXCAVATION FOR FOUNDATION**				
a	Excavation in shingle or gravel formation and rock in dry not requiring blasting undressed lead upto 100ft. (Page No1 item No 4)	%0Cft	28,678	5,747.50	164,826.81
b	Cutting Hard Rock such as granite, ballast, hard lime stone or sand stone etc with chiesel and hammers for small foundations. Item No 19 Page -4	%0Cft	7,169	28,672.05	205,549.93
c	Extra for every 50'-0" lead or part thereof 500' lead Item no 8 a) Page No 2	%0Cft	14,339	1,007.80	14,450.84
d	Add for additional lift of every three feet (30.9 R.m) or part thereof in item Nos. 1 to 4. 10 to 13 and 19 to 22.	%0Cft	7,169	187.50	1,344.19
3	**DISPOSAL OF EARTH**				
	Cartage of 100Cft/ 5 Tons of all material like stones, aggregate, spawl,Coal,lime, surkhi etc by Truck------ lead 1 mile	% CFT	17,500	407.00	71,225.00
4	**BACK FILLING (USING EXCAVATED/SURPLUS EARTH PRESENT AT SITE)**				
i)	Filling, watering and ramming earth in floors with surplus earth from foundation lead upto one chain and lift upto 5'-0" (Item No 21 Page No 4)	%0 CFT	16,059	1,512.50	24,289.84
5	**LEAN CONCRETE**				
	Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering (Page No. 16, Item No. 5-i) 1:4:8 Concrete				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	Under Footing	% CFT	2737	14,605.67	399,757.19
b)	Under Floor	% CFT	2754	14,605.67	402,240.15
ii)	Concrete 1:3:6 under plinth Page No 16 Item No 5-(h)	% CFT	1590	16,907.00	268,821.30
6	**POLY ETHYLENE SHEET**				
	Providing and laying single per layer of polyethylene sheet 0.13 mm thick for water proofing as per specification and instruction of Engineer Incharge (Page No. 38, Item No. 38).	SFT	5509	10.7	58,946
7	**TERMITE PROOFING**				
	Providing anti-termite treatment by spraying / sprinkling / spreading Neptachler 0.5% Emulsion as an overall pre-construction treatment in slab type construction under the slab and attached perches or entrances etc. complete in all respect as per directions of the Engineer-in-Charge (Page No. 108, Item No. 92)	SFT	5508.59	9.74	53,654
8	**STONE SOLING**				
	Stone pitching including sub-base with hammer dressed stone on surface laid in courses including carriage of materials chains. (Page No. 32, Item No. 23) 6" THICK	%Cft	2754.3	5377.63	148,116

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
9	**REINFORCED CEMENT CONCRETE (GROUND FLOOR)**				
	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 curing rendering and finishing the exposed surface (including screening and washing of shingle) Page No. 17. Item No. 6(a)-ii				
	NOTE : ALL STRUCTURAL CONCRETE UPTO PLINTH LEVEL SHALL BE WITH SULPHATE RESISTING CEMENT .				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
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.				
a)	Ratio 1:2: 4 Conc. 90 lbs OPC cement,2 cft Sand 4 Cft stone aggregate				
(I)	Foundation	CFT	5045.75	398.6	2,011,236
(II)	Column up to P. Level.	CFT	406.45	398.6	162,011
(III)	Plinth beams with projected nibs etc	CFT	1950.51	398.6	777,473
IV)	Slab on Grade	CFT	2467.41	398.6	983,510
(iv)	Columns in super structure	CFT	711	398.6	283,405
(v)	Beams, lintel beams / with projected nibs etc	CFT	1969	398.6	784,843
(Vi)	Slabs / projection etc	CFT	4314	398.6	1,719,560
(vii)	Staircase steps, Landing waist etc	CFT	241	398.6	96,063
VIII)	RAMP	CFT	43	398.6	17,140
ix)	WALLS	CFT	350	398.6	139,510
10	**STEEL REINFORCEMENT**				-
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a	Fabrication of mild Steel Reinforcement for Cement Concrete including cutting, bending, laying in position, making joints and fastenings including the cost of binding wire, also include removal of) Item no 8 (b) page No 17 using TOR Bar	CWT	1171	9401.7	11,009,391

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
11	**BLOCK MASONARY**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	SOLID				
i)	**6 " OR BELOW THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 24)	% Cft	3508.65	20,083.01	704,643
ii)	**ABOVE 6 " THICKNESS**				
	NOTE : ALL THE EXTERNAL PERIPHERAL WALL ABOVE PLINTH LEVEL SHALL BE HOLLOW BLOCK MASONARY WALL 8" THICK USING 16"X8"X8" BLOCK				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and above in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 23)	% Cft	200	18933.44	37,867
iii)	**HOLLOW BLOCK MASONARY IN WALL 8" THICK**				
	Precast Cement Concrete Hollow Blocks 1:2:4 including cost of Templets and Constructing wall thereof. Item No 10 Page No17	CFT	2500	169.12	422,800
12	**RENDERING (PLASTER)**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Internal Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
	1/2" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-B	% SFT	6144.41	3,215.43	197,569
b)	**Cement Plaster 1:6 upto 12' height (Internal)**				
	1/2" thick Plaster (for ceiling and wall) Page No. 52, Item No. 13-c	% SFT	19974.5	3,103.83	619,975
ii)	**External Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
i)	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	15620	4,269.76	666,937
13	**DAMP PROOFING**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Horizontal DPC**				
	Damp proof course 2" thick with (cement sand and shingle concrete 1:2:4) including 2 coats of asphaltic mixture. (Page No. 18, Item No. 28-b)	%Sft	475.5	4,939.52	23,487

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
ii)	**Vertical DPC**				
	Vertical Damp Proof Course of 3/4' thick Cement Plaster 1:2 with Bitumen at 20 LBS per % Sft. Page N0 107 Item No 70	%Sft	1902	3,017.66	57,396
14	**FLOORING**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**FLOORING BASE CONC. 1:3 :6**				
a)	Cement Concrete plain including placing, compacting, finishing and curing complete including screening and washing at stone aggregate with out shuttering. (Ref. Item No 5 h, Page No16 1:3:6 Conc. Plain	% CFT	1536.1	16,907.00	259,708
b)	Providing & Laying 2"thick topping Cement Concrete 1:2:4 including surface finishing and dividing into panels. Item No 16 Page No42.	%Sft	508	4,302.17	21,855
II)	**TERRAZO FLOOR**				
a)	Flooring of Mosaic Marble Chips tiles of white cement laid flat in 1:2 grey cement mortar over 3/4" thick bed of grey cement mortar 1:2 Page No 48 Item No 64	% SFT	1967	13,896.37	273,342
b)	Mosaic Chequre Tiles of 8"x8"x1-1/4"of approved shade laid flat in 1/2" grey Cement mortar over a bed of 3/4" thick grey cement mortar 1:2 Ref Item No 56 Page No47	% SFT	412	16,559.14	68,224
C)	Laying floor of approved colour glazed tiles 1/4" thick in white cement and pigment on a bed of 3/4" thick Cement mortar 1:2 Item No 25 Page No 43	% SFT	720	28,945.06	208,404
15	**DADO & SKIRTING**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**TERRAZO TILES**				
	Mosaic Tile Skirting laid in 1:2 including Cement wash and filling joints Page No 44 Item No 35 (b) 4"high	% SFT	500.94	14,066.59	70,465
ii)	Glazed tiles dado 1/4" thick laid in pigment over csm 3/4" thick including finishing.Item 38Page 45	% SFT	1337.5	29,257.52	391,319
16	**CHEMICAL POLISH ON TERRAZO FLOOR**				
	Applying Chemical Polish on existing mosaic / Marble flooring / dado includding cleaning grinding with carborandum stone / sand paper and applying chemical polish as per requirement. Page 49 Item70.	P SFT	5969.44	36.6	218,482
17	**METAL WORK**				
A	Providing and fixing GI Frames /Choukhats of size 7"x2" or 4-1/2"x3" for door using 20 SWG GI sheet i/c welded hinges and fixing at site with necessary hold fasts. filling with cement sand slurry of ratio 1:6 and repaing the jambs. The cost includes all carriage, tools and plants used for making and fixing. Item No29 Page No93				
i)	Door Frame 7"x2"	Prft	949	228.9	217,226
18	**MS SECURITY GRILLS**				
	supplying and fixing in position iron /steel grill of 3/4"x1/4" size flat iron of approved design including painting 3 coats etc. (weight not to be less than 3.7 lbs /sft of finished grill)	Psft	492	180.5	88,806

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
19	**ALUMINUM WINDOWS /VENTILATORS**				
I	Supplying and fixing in position Aluminum Channels framing for sliding windows & ventilators of Alcop made with 5mm thick tinted glazing (Belgium) &Aluminum fly screen including handles, stoppers & locking arrangement etc. complete Deluxe Model (white) Ref. Item No 84(a) Page No 108	Psft	308	1592.69	490,549
20	**WOOD WORK**				
I)	Providing and Fixing with sunk iron screws wooden Archives approved design /shape having width not less than 2-1/2 inches as directed by Engineer Incharge.	RFT	1008	49.97	50,370
21	**PAINT**				
(i)	**CEILING DESTEMPER**				
	Distempering three coats page no 54 item no 24 c	% SFT	6144.41	1079.65	66,338
ii)	**INTERNAL WALL PAINTING**				
	Preparing the surface and painting with matt finish Enamel including rubbing the surface with bathy (silicon carbide rubbing brick) filling the voids with zink / chalk / plaster of paris mixture, applying first coat premix, making the surface smooth and then painting 3 coats with matt finish of approved make etc. complete (new surface). Page No. 55, Item No. 36A+36-b. (3 Coats)	% SFT	19974.5	3444.38	687,998
iii)	**EXTERNAL WALL PAINTING**				
	Preparing the Surface and painting with Weather Coat i/c Rubbing the surface with rubbing brick/sand paper, filling the voids with chalk /plaster of Paris and then paintining with weather coat of approved make (3 Coats) Page No 56 Item no 38-a & B	% SFT	15620	2567.95	401,114
iv)	**PAINT OVER IRON SURFACE**				
	Preparing surfaces & Painting Guard bars Gates, iron bars, gratins, railings including standard braces three coats Item No 5(d) Page No 70	% SFT	2008	1270.83	25,518
v)	**PAINT OVER WOODEN SURFACE**				
	Preparing surface and painting of doors and Windows any types (including edges) Priming coat & three coats of paints Ref. : Item no 5 © Page 79.	% SFT	5428.08	2743.14	148,900
22	**DISMENTALING OF DUMMY COLUMN**				
	Dismentaling cement concrete reinforced separating reinforcement from concrete cleaning and straightening the same Item No 20 Page 10	% CFT	30	5445	1,634
23	**CONC. PRECAST PLANKS 3" THICK**				
a	Precast RCC in Column , beams, lintols, stair case, shelves, etc Ration 1:1-1/2:3	Cft	250	321.77	80,443
b	Erecting & fixing in Position precast Conc. Slab in roof, litols etc lift upto 20'-0" including all charges	Cft	250	41.77	10,443
24	**PRECAST CC ORNAMENTAL JALI**				
	Providing and fixing CC ornamental jali 2" thick 1:2:4 with out reinforcement.(Item No 11 Page No 18)	PSFT	190	226.02	42,944

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
25	**WATER PROOFING**				
	Providing & Applying Hi Bond Sealer Water Proofing polymer Modified Cementious sulleries (WPMCS) to be used as Water Proofing, Anticorrosion, water resistance or curing member for fresh concrete having thickness 2mm in two coats upto 20'-0" height textured or trowel finish grey or coloured i/c preparing the surface for application as directed by Engineer.	Per % Sft	6500	2282.77	148,380
26	**EXTRA FOR USING SULPHATE RESISTING CEMENT**				
	ADD EXTRA FOR SULPHATE RESISTANT CEMENT (REF SOR MATERIALS VOL-III PART-III SIXTH EDITION-2011 PAGE 3&4	Bags	1700	40	68,000
	TOTAL COST IN PKR GROUND FLOOR BASED ON CSR				26,570,628
SECTION - B: **MAIN BUILDING FIRST FLOOR** **BASED ON SCHEDULED RATES**					
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
(a)	**STRUCTURAL WORKS**				
1	**REINFORCED CEMENT CONCRETE**				
	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 curing rendering and finishing the exposed surface (including screening and washing of shingle) Page No. 17. Item No. 6(a)-ii				
	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.				
a)	Ratio 1:2: 4 Conc. 90 lbs OPC cement,2 cft Sand 4 Cft stone aggregate				
(i)	Columns in super structure	CFT	711	398.6	**283,405**
(II)	Beams, lintel beams / with projected nibs etc	CFT	1969	398.6	**784,843**
(III)	Slabs / projection etc	CFT	4314	398.6	**1,719,560**
(Iv)	Staircase steps, Landing waist etc	CFT	241	398.6	**96,063**
v)	WALLS	CFT	550	398.6	**219,230**
2	**STEEL REINFORCEMENT**				
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
	Fabrication of mild Steel Reinforcement for Cement Concrete including cutting, bending, laying in position, making joints and fastenings including the cost of binding wire, also include removal of) Item no 8 (b) page No 17 using TOR Bar	CWT	780.7	9401.7	**7,339,907**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
3	**BLOCK MASONARY**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**6 " OR BELOW THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 24)	% Cft	2221.5	20,083.01	**446,144**
ii)	**ABOVE 6 " THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 23)	% Cft	50	18933.44	**9,467**
iii)	**HOLLOW BLOCK MASONARY IN WALL 8" THICK**				
	Precast Cement Concrete Hollow Blocks 1:2:4 including cost of Templets and Constructing wall thereof. Item No 10 Page No17	CFT	2500	169.12	422,800
4	**RENDERING (PLASTER)**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Internal Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
	1/2" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-B	% SFT	6144.41	3,215.43	**197,569**
b)	**Cement Plaster 1:6 upto 12' height (Internal)**				
	1/2" thick Plaster (for ceiling and wall) Page No. 52, Item No. 13-c	% SFT	20002.5	3,103.83	**620,844**
ii)	**External Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
i)	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	7810	4,269.76	**333,468**
5	**FLOORING**				
I)	**FLOORING SUBBASE CONC. 1:3 :6**				
a)	Cement Concrete plain including placing, compacting, finishing and curing complete including screening and washing at stone aggregate with out shuttering. (Ref. Item No 5 h, Page No16 1:3:6 Conc. Plain	%Cft	1536.1	16,907.00	**259,708**
B	Do 1:2:4 Concrete	% SFT	336.12	4,302.17	**14,460**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
ii)	**TERRAZO FLOOR TILES**				
	Flooring of Mosaic Marble Chips tiles of white cement laid flat in 1:2 grey cement mortar over 3/4" thick bed of grey cement mortar 1:2 Page No 48 Item No 64	% SFT	5092.5	13,896.37	**707,673**
III)	**TERRAZO CHEQURED TILES**				
	Mosaic Chequre Tiles of 11"x8"x1-1/4"of approved shade laid flat in 1/2" grey Cement mortar over a bed of 3/4" thick grey cement mortar 1:2	% SFT	412	16,559.14	**68,224**
IV)	**GLAZED FLOOR TILES**				
	Laying floor of approved colour glazed tiles 1/4" thick in white cement and pigment on a bed of 3/4" thick Cement mortar 1:2 Item No 25 Page No 43	% SFT	720	28,945.06	**208,404**
6	**DADO & SKIRTING**				
i)	**TERRAZO TILES**				
	Mosaic Tile Skirting laid in 1:2 including Cement wash and filling joints Page No 44 Item No 35 (b) 4"high	% SFT	545.16	14,066.59	**76,685**
ii)	**GLAZED TILES ON DADO & SKIRTING**				
	Glazed tiles dado 1/4" thick laid in pigment over cement sand mortar 3/4" thick including finishing. Item No 38 Page No 45	% SFT	1337.5	29,862	**399,405**
7	**CHEMICAL POLISH ON TERRAZO FLOOR**				
	Applying Chemical Polish on existing mosaic / Marble flooring / dado includding cleaning grinding with carborandum stone / sand paper and applying chemical polish as per requirement. Page 49 Item No 70.	P SFT	6049.66	36.6	**221,418**
8	**METAL WORK**				
A	Providing and fixing GI Frames /Choukhats of size 7"x2" or 4-1/2"x3" for door using 20 SWG GI sheet i/c welded hinges and fixing at site with necessary hold fasts. filling with cement sand slurry of ratio 1:6 and repaing the jambs. The cost includes all carriage, tools and plants used for making and fixing. Item No29 Page No93				
i)	Door Frame 7"x2"	Prft	943	240.5	**226,792**
9	**MS SECURITY GRILLS**				
	supplying and fixing in position iron /steel grill of 3/4"x1/4" size flat iron of approved design including painting 3 coats etc. (weight not to be less than 3.7 lbs /sft of finished grill)	Psft	1140.26	180.5	**205,817**
10	**ALUMINUM WINDOWS /VENTILATORS**				
I	Supplying and fixing in position Aluminum Channels framing for sliding windows & ventilators of Alcop made with 5mm thick tinted glazing (Belgium) &Aluminum fly screen including handles, stoppers & locking arrangement etc. complete Deluxe Model (white) Ref. Item No 84(a) Page No 108	Psft	488	1592.69	**777,233**
11	**WOOD WORK**				
I)	Providing and Fixing with sunk iron screws wooden Archives approved design /shape having width not less than 2-1/2 inches as directed by Engineer Incharge.	RFT	1008	49.97	**50,370**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
12	**PAINT**				
(i)	**CEILING DESTEMPER**				
	Distempering three coats page no 54 item no 24 c	% SFT	6144.41	1079.65	**66,338**
ii)	**INTERNAL WALL PAINTING**				
	Preparing the surface and painting with matt finish Enamel including rubbing the surface with bathy (silicon carbide rubbing brick) filling the voids with zink / chalk / plaster of paris mixture, applying first coat premix, making the surface smooth and then painting 3 coats with matt finish of approved make etc. complete (new surface). Page No. 55, Item No. 36A+36-b. (3 Coats)	% SFT	20002.5	3444.38	**688,962**
iii)	**EXTERNAL WALL PAINTING**				
	Preparing the Surface and painting with Weather Coat i/c Rubbing the surface with rubbing brick/sand paper, filling the voids with chalk /plaster of Paris and then paintining with weather coat of approved make (3 Coats) Page No 56 Item no 38-a & B	% SFT	7810	2567.95	**200,557**
iv)	**PAINT OVER IRON SURFACE**				
	Preparing surfaces & Painting Guard bars Gates, iron bars, gratins, railings including standard braces three coats Item No 5(d) Page No 70	% SFT	60	1270.83	**762**
v)	**PAINT OVER WOODEN SURFACE**				
	Preparing surface and painting of doors and Windows any types (including edges) Priming coat & three coats of paints Ref. : Item no 5 © Page 79.	% SFT	11179.26	2743.14	**306,663**
13	**CONC. PRECAST PLANKS 3" THICK**				
a	Precast RCC in Column , beams, lintols, stair case, shelves, etc Ration 1:1-1/2:3	Cft	250	321.77	**80,443**
b	Erecting & fixing in Position precast Conc. Slab in roof, litols etc lift upto 20'-0" including all charges	Cft	250	41.77	**10,443**
14	**EXTRA FOR BLOCK LIFT**				
	Add Extra lift for Block Masonry in First Floor	% SFT	8500	328.97	**27,962**
	TOTAL COST IN PKR FIRST FLOOR BASED ON CSR				**17,071,618**

SECTION - C:
MAIN BUILDING SECOND FLOOR
BASED ON SCHEDULED RATES

(a)	**Structural Works**				
	SECOND FLOOR				
1	**REINFORCED CEMENT CONCRETE**				
	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 curing rendering and finishing the exposed surface (including screening and washing of shingle) Page No. 17. Item No. 6(a)-iiR.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.				

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	Ratio 1:2: 4 Conc. 90 lbs OPC cement,2 cft Sand 4 Cft stone aggregate				
(i)	Columns in super structure	CFT	711	398.6	**283,405**
(II)	Beams, lintel beams / with projected nibs etc	CFT	1,969	398.6	**784,843**
(III)	Slabs / projection etc	CFT	4,314	398.6	**1,719,560**
(Iv)	Staircase steps, Landing waist etc	CFT	241	398.6	**96,063**
(v)	WALLS	CFT	550	398.6	**219,230**
2	**STEEL REINFORCEMENT**				
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
	Fabrication of mild Steel Reinforcement for Cement Concrete including cutting, bending, laying in position, making joints and fastenings including the cost of binding wire, also include removal of) Item no 8 (b) page No 17 using TOR Bar	CWT	703	9401.7	**6,606,010**
3	**BLOCK MASONARY**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**6 " OR BELOW THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 24)	% Cft	2221.5	20,083.01	**446,144**
ii)	ABOVE 6 " THICKNESS				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 23)	% Cft	50	18933.44	**9,467**
iii)	**HOLLOW BLOCK MASONARY IN WALL 8" THICK**				
	Precast Cement Concrete Hollow Blocks 1:2:4 including cost of Templets and Constructing wall thereof. Item No 10 Page No17	CFT	2500	169.12	422,800
4	**RENDERING (PLASTER)**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Internal Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	1/2" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-B	% SFT	6144.41	3,215.43	**197,569**
b)	**Cement Plaster 1:6 upto 12' height (Internal)**				
	1/2" thick Plaster (for ceiling and wall) Page No. 52, Item No. 13-c	% SFT	20002.5	3,103.83	**620,844**
ii)	**External Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
i)	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	7810	4,269.76	**333,468**
5	**FLOORING**				
I)	**FLOORING SUBBASE CONC. 1:3 :6**				
a)	Cement Concrete plain including placing, compacting, finishing and curing complete including screening and washing at stone aggregate with out shuttering. (Ref. Item No 5 h, Page No16 1:3:6 Conc. Plain	%Cft	1536.1	16,907.00	**259,708**
B	Do 1:2:4 Concrete	% SFT	336.12	4,302.17	**14,460**
ii)	**TERRAZO FLOOR TILES**				
	Flooring of Mosaic Marble Chips tiles of white cement laid flat in 1:2 grey cement mortar over 3/4" thick bed of grey cement mortar 1:2 Page No 48 Item No 64	% SFT	5092.5	13,896.37	**707,673**
III)	**TERRAZO CHEQURED TILES**				
	Mosaic Chequre Tiles of 11"x8"x1-1/4"of approved shade laid flat in 1/2" grey Cement mortar over a bed of 3/4" thick grey cement mortar 1:2	% SFT	412	16,559.14	**68,224**
IV)	**GLAZED FLOOR TILES**				
	Laying floor of approved colour glazed tiles 1/4" thick in white cement and pigment on a bed of 3/4" thick Cement mortar 1:2 Item No 25 Page No 43	% SFT	720	28,945.06	**208,404**
6	**DADO & SKIRTING**				
i)	**TERRAZO TILES**				
	Mosaic Tile Skirting laid in 1:2 including Cement wash and filling joints Page No 44 Item No 35 (b) 4"high	% SFT	545.16	14,066.59	**76,685**
ii)	**GLAZED TILES ON DADO & SKIRTING**				
	Glazed tiles dado 1/4" thick laid in pigment over cement sand mortar 3/4" thick including finishing. Item No 38 Page No 45	% SFT	668.75	29,862	**199,702**
7	**CHEMICAL POLISH ON TERRAZO FLOOR**				
	Applying Chemical Polish on existing mosaic / Marble flooring / dado includding cleaning grinding with carborandum stone / sand paper and applying chemical polish as per requirement. Page 49 Item No 70.	P SFT	6049	37	**221,393**
8	**METAL WORK**				
i)	Door Frame 7"x2"	Prft	911	241	**219,096**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
9	**MS SECURITY GRILLS**				
	supplying and fixing in position iron /steel grill of 3/4"x1/4" size flat iron of approved design including painting 3 coats etc. (weight not to be less than 3.7 lbs /sft of finished grill)	Psft	492	181	**88,806**
10	**ALUMINUM WINDOWS /VENTILATORS**				
I	Supplying and fixing in position Aluminum Channels framing for sliding windows & ventilators of Alcop made with 5mm thick tinted glazing (Belgium) &Aluminum fly screen including handles, stoppers & locking arrangement etc. complete Deluxe Model (white) Ref. Item No 84(a) Page No 108	Psft	308	1,593	**490,549**
11	**WOOD WORK**				
I)	Providing and Fixing with sunk iron screws wooden Archives approved design /shape having width not less than 2-1/2 inches as directed by Engineer Incharge.	RFT	1008	49.97	**50,370**
12	**PAINT**				
(i)	**CEILING DESTEMPER**				
	Distempering three coats page no 54 item no 24 c	% SFT	6144.41	1079.65	**66,338**
ii)	**INTERNAL WALL PAINTING**				
	Preparing the surface and painting with matt finish Enamel including rubbing the surface with bathy (silicon carbide rubbing brick) filling the voids with zink / chalk / plaster of paris mixture, applying first coat premix, making the surface smooth and then painting 3 coats with matt finish of approved make etc. complete (new surface). Page No. 55, Item No. 36A+36-b. (3 Coats)	% SFT	20002.5	3,444.38	**688,962**
iii)	**EXTERNAL WALL PAINTING**				
	Preparing the Surface and painting with Weather Coat i/c Rubbing the surface with rubbing brick/sand paper, filling the voids with chalk /plaster of Paris and then paintining with weather coat of approved make (3 Coats) Page No 56 Item no 38-a & B	% SFT	7810	2567.95	**200,557**
iv)	**PAINT OVER IRON SURFACE**				
	Preparing surfaces & Painting Guard bars Gates, iron bars, gratins, railings including standard braces three coats Item No 5(d) Page No 70	% SFT	2140	1270.83	**27,196**
v)	**PAINT OVER WOODEN SURFACE**				
	Preparing surface and painting of doors and Windows any types (including edges) Priming coat & three coats of paints Ref. : Item no 5 © Page 79.	% SFT	11179.26	2743.14	**306,663**
13	**CONC. PRECAST PLANKS 3" THICK**				
a	Precast RCC in Column , beams, lintols, stair case, shelves, etc Ration 1:1-1/2:3	Cft	250	321.77	**80,443**
b	Erecting & fixing in Position precast Conc. Slab in roof, litols etc lift upto 20'-0" including all charges	Cft	250	41.77	**10,443**
	TOTAL COST IN PKR SECOND FLOOR BASED ON CSR				**15,725,074**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
SECTION - D: **MAIN BUILDING THIRD FLOOR** **BASED ON SCHEDULED RATES**					
(a)	**Structural Works**				
	THIRD FLOOR				
1	**REINFORCED CEMENT CONCRETE**				
	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 curing rendering and finishing the exposed surface (including screening and washing of shingle) Page No. 17. Item No. 6(a)-ii				
	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.				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	Ratio 1:2: 4 Conc. 90 lbs OPC cement,2 cft Sand 4 Cft stone aggregate				
(i)	Columns in super structure	CFT	372	398.6	**148,279**
(II)	Beams, lintel beams / with projected nibs etc	CFT	122	398.6	**48,629**
(III)	Slabs / projection etc	CFT	362	398.6	**144,293**
IV)	WALLS	CFT	250	398.6	**99,650**
2	**STEEL REINFORCEMENT**				
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
	Fabrication of mild Steel Reinforcement for Cement Concrete including cutting, bending, laying in position, making joints and fastenings including the cost of binding wire, also include removal of) Item no 8 (b) page No 17 using deform Bar.	CWT	54	9401.7	**507,692**
3	**BLOCK MASONARY**				
i)	**6 " OR BELOW THICKNESS**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 24)	% Cft	656.58	20,083.01	**131,861**
ii)	**ABOVE 6 " THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and below in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 23)	% Cft	20	18933.44	**3,787**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
iii)	**HOLLOW BLOCK MASONARY IN WALL 8" THICK**				
	Precast Cement Concrete Hollow Blocks 1:2:4 including cost of Templets and Constructing wall thereof. Item No 10 Page No17	CFT	30	169.12	5,074
4	**RENDERING (PLASTER)**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Internal Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
	1/2" thick Plaster (for ceiling and wall)Page52, Item11-B	% SFT	540	3,215.43	**17,363**
b)	**Cement Plaster 1:6 upto 12' height (Internal)**				
	1/2" thick Plaster (for ceiling and wall) Page 52,Item13-c	% SFT	1107	3,103.83	**34,359**
ii)	**External Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
i)	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	3550	4,269.76	**151,576**
5	**FLOORING**				
iv)	**TERRAZO FLOOR CHEQURED**				
v	Mosaic Chequre Tiles of 11"x8"x1-1/4"of approved shade laid flat in 1/2" grey Cement mortar over a bed of 3/4" thick grey cement mortar 1:2	% SFT	96	16,559.14	**15,897**
vi)	**CHEMICAL POLISH ON TERRAZO FLOOR**				
	Applying Chemical Polish on existing mosaic / Marble flooring / dado includding cleaning grinding with carborandum stone / sand paper and applying chemical polish as per requirement. Page 49 Item No 70.	P SFT	96	36.60	**3,514**
6	**DADO & SKIRTING**				
i)	**TERRAZO TILES**				
	Mosaic Tile Skirting laid in 1:2 including Cement wash and filling joints Page No 44 Item No 35 (b) 4"high	% SFT	7.92	14,066.59	**1,114**
7	**PAINT**				
(i)	**CEILING DESTEMPER**				
	Distempering three coats page no 54 item no 24 c	% SFT	540	1079.65	**5,830**
ii)	**INTERNAL WALL PAINTING**				
	Preparing the surface and painting with matt finish Enamel including rubbing the surface with bathy (silicon carbide rubbing brick) filling the voids with zink / chalk / plaster of paris mixture, applying first coat premix, making the surface smooth and then painting 3 coats with matt finish of approved make etc. complete (new surface). Page No. 55, Item No. 36-b. (3 Coats)	% SFT	1107	3444.38	**38,129**

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
iii)	**EXTERNAL WALL PAINTING**				
	Preparing the Surface and painting with Weather Coat i/c Rubbing the surface with rubbing brick/sand paper, filling the voids with chalk /plaster of Paris and then paintining with weather	% SFT	8581	2567.95	**220,356**
8	**MS SECURITY GRILLS**				
	supplying and fixing in position iron /steel grill of 3/4"x1/4" size flat iron of approved design including painting 3 coats etc. (weight not to be less than 3.7 lbs /sft of finished grill)	Psft	168	180.50	**30,324**
9	**PRECAST RAIN WATER SPOUT**				
	Reinforced Cement Concrete RCC spout including fioxing in position with top & Bottom Khuras Item 27 Page 19	Each	13	524.98	**6,825**
10	**EXTRA LABOUR FOR R.C.C IN 3RD FLOOR**				
	Add Extra Labour for RCC in Third Floor	CFT	855	24.20	**20,691**
11	**EXTRA LABOUR FOR BLOCK IN 3RD FLOOR**				
	Add Extra Labour for block in Third Floor	%Sft	1500	1191.00	**17,865**
12	**EXTRA LABOUR FOR STEEL IN 2ND FLOOR**				
	Add Extra Labour for STEEL in Second Floor	Cwt	54	301.00	**16,254**
13	**EXTRA LABOUR FOR PLASTER IN 2ND FLOOR**				
	Add Extra Labour 32% of Labour for PLASTER in Third Floor	%SFT	5200	251.86	**13,097**
	TOTAL COST OF THIRD FLOOR BASED ON SCHEDULE OF RATES 2012				**1,682,459**

SECTION - A:
MAIN BUILDING WORK - GROUND FLOOR
BASED ON NON-SCHEDULE RATES

1	**IMPORTED EARTH FILLING**				
	Supply, place and compact in layers of 6" thick compacted thickness to 95% Modified Proctor's Relative Dry Density, approved selected earth brought from outside to soil groups GM, SW, and ML as per ASTM D2487-85 (as amended) (classification of soil for engineering purpose) including cost of laboratory and field tests, spreading , leveling, watering and compaction etc; complete in all respect as per drawing and specifications and as instructed by the ENGINEER INCHARGE.	CFT	5500		
	ARCHITECTRUAL				
2	**PRECAST SPIRAL STAIR CASE**				
	Providing, making and fixing Pre Cast Spiral staircase using 1:2:4 concrete with nominal steel complete in all respects confirming to the details given in drawing, specification and as per direction of Engineer.	Each	2		
3	**WALL HAND RAIL**				
	Providing, fabricating and fixing wall hand rail, using MS tube rail bracket fix to the wall as per detail CW-04 including 3" thick Circular wooden hand rail at top screwed with pipe rail including cost of polish on wooden rail. Complete in all respects confirming to the requirements of drawings, specifications and as per direction by the Engineer.	RFT	20		

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			A	B	C = B X A
4	**ROUGH CAST MACHINE PLASTER**				
	Providing and applying 1/8" thick rough cast plaster over external grooved plastered surface using 1:3 CSM includding scaffolding, levelling, finishing, curing etc at any height as per drawing,specification as per direction.	SFT	1000		
5	**GLASS FOR WINDOW SKY LIGHT**				
	Providing and fixing 6mm thick clear glass for sky light . Fix into MS frame of door including cost of wooden beading etc complete in all respects confirming of drawing and specification and to the entire satisfaction of the Engineer.	SFT	140		
6	**STAIR HAND RAIL**				
	Providing, fabricating & fixing 3'-0" high staircase railing, using 5/8" MS Square bar with 1-1/2" wide and 1/4" thick strip stiffner horizontal for support all welded properly and anchored/grouted to RCC structures including 3" circular wooden hand rail at top screwed with flat iron strip welded to Balusters including cost of 3 coat of red oxide paint and polish on wooden rail as per detail AW-71.2 (w) complete in all respects confirming to the requirement of drawings, specification and as direction by the Engineer.	RFT	40		
7	**ALUMINUM PROFILE ON EXPANSION JOINT WALL**				
	Providing and fixing aluminum profile 4"x3/4" in vertical expansion joint , fixed one side with screws at 12" C/C, including cutting of strip fixing tightly so as as to make the points weather tight , as per detail No CW 01.1 complete as per drawing and as per direction.	Rft	80		
8	**ALUMINUM METAL SADDLE IN FLOOR EXPANSION JOINT**				
	Providing and Fixing 4" wide metal saddle fastened to expansion joint in floor fixed one side with screw @9" C/C , including cutting of strip, fixing tightly so as to make the joints weather tight, as per detail CW 011 complete as per drawing and direction.	Rft	65		
9	**FALSE CEILING**				
	Providing and installing 2'-0"x2'-0" Gypsum Board Moisture Resistant Ceiling Tiles including GI suspension system, attachment devices, hanger edge moulding, trim clip and trimming, including making provision for light fixture, A/C diffusers, smoke detectors etc. Complete in the respect and confirming to the requirements of drawings, specification.	SFT	580		
10	**THERMOPORE IN EXPANSION JOINT**				
	Providing and fixing thermopore in expansion joint(density 35Kg/Cum) of Column, beam, roof and removing after concrete pouring complete as per drawing & specification.	Sft	510		
11	**GROOVE PLASTER**				
	Providing and laying 1-1/2" thick external groove plaster (1:5) CSM to external block masonary and concrete wall surface, 3/4" thick base plaster and 3/4" thick and 5" wide strip making 3/4"x1" groove between strip including scaffolding, levelling, finishing and curing as per detail CW No 8 etc at any height including making vertical and horizontal control joints as per drawing and specification and as per direction.	SFT	1000		
12	**MS RAFTER**				
	Providing and installing MS Rafter size 10'-0" x 3' comprising of 2"x1/2" 16SWG MS box 4Nos each welded and supported by 2x1/2" MS 16SWG box 4 Nos at eqidistant painting with approved make and shade enamel paint three coats with anticorrosive primer complete as per direction.	SFT	720		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
13	**EXPANSION JOINT**				
	Providing and making expansion joint including cost of 1"x1"Sealing Compound filling by gun or as specified by the manufacturer's recommendation (PU-300 of Pagel or its equivalent) with Backer Rod as per drawing ST-05), specifications and as directed by the Engineer.	RFT	105		
14	**WINDOW BLIND**				
	Provide and install window blinds of approved sample (thermec or approved equivalent) including lifting and fixing etc, complete as per drawings, specification instructions of the architect.	SFT	336		
15	**MIRROR IN LAVATORY BLOCK**				
	Provide and install in position, mirror in toilet consisting of 6mm thick Belgium mirror, double polished front and rear of approved quality with 12mm thick commercial ply backing fixed with 30x6 mm thick imported (European) SS clip, fix on wall including wastage, fixing and accessories etc. complete in all respect as per drawing, specifications and as instructed by the ENGINEER.	SFT	50		
16	SEMI SOLID FLUSH DOOR SHUTTER				
	Providing,fabricating & fixing in position in given sizes, semi solid block board door shutter 1-1/2" thick including 1/8" thick commercial ply on both sides, including 1/2' thick deodar wood lipping all around, hardware of approved quality/make such as hinges, bolts,latches, Al-drops, handle etc including stainless steel kick & push plates on both sides. All door hardwares are as per schedule including cost of termite proofing, rubbing, making surface smooth as per drawing & specification and as directed by the Engineer Incharge. (Door Frame and Paint is to be paid as seprate BOQ item)				
a)	Type D-4 3'-3"x7'-0"	Nos	26		
b)	Type D-4 3'-3"x7'-0" with 4mm thick clear glass vp	Nos	2		
c)	Type D-7 2'-6"x7'-0" with kick plate & hardware as per schedule	Nos	12		
d)	Type D-8 2'-0"x7'-0" with kick plate & hardware as per schedule	Nos	2		
17	**WARD ROBE**				
	Providing and install wardrobe comprising of deodar wood frame, 1/2" wood lipping, 3/4" laminated M.D.F (Alnoor or equivalent) of approved quality including wastage, cutting of openings, fixtures / hardware, polishing on lipping, termite proofing, including the cost of 4" thick 1:3:6 C.C Bed etc. complete in all respect as per drawing and specifications and as instructed by the Engineer.	Sft	936		
	TOTAL AMOUNT FOR NON SCHEDULE ITEMS GROUND FLOOR				

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	SECTION - B: **MAIN BUILDING - FIRST FLOOR** **BASED ON NON-SCHEDULE RATES**				
1	**WALL HAND RAIL**				
	Providing, fabricating and fixing wall hand rail, using MS tube rail bracket fix to the wall as per detail CW-04 including 3" thick Circular wooden hand rail at top screwed with pipe rail including cost of polish on wooden rail. Complete in all respects confirming to the requirements of drawings, specifications and as per direction by the Engineer.	RFT	20		
2	**STAIR HAND RAIL**				
	Providing, fabricating & fixing 3'-0" high staircase railing, using 5/8" MS Square bar with 1-1/2" wide and 1/4" thick strip stiffner horizontal for support all welded properly and anchored/grouted to RCC structures including 3" circular wooden hand rail at top screwed with flat iron strip welded to Balusters including cost of 3 coat of red oxide paint and polish on wooden rail as per detail AW-71.2 (w) complete in all respects confirming to the requirement of drawings, specification and as direction by the Engineer	RFT	40		
3	**ALUMINUM PROFILE ON EXPANSION JOINT WALL**				
	Providing and fixing aluminum profile 4"x3/4" in vertical expansion joint , fixed one side with screws at 12" C/C, including cutting of strip fixing tightly so as as to make the points weather tight , as per detail No CW 01.1 complete as per drawing and as per direction.	Rft	80		
4	**ALUMINUM METAL SADDLE IN FLOOR EXPANSION JOINT**				
	Providing and Fixing 4" wide metal saddle fastened to expansion joint in floor fixed one side with screw @9" C/C , including cutting of strip, fixing tightly so as to make the joints weather tight, as per detail CW 011 complete as per drawing and direction.	Rft	65		
5	**FALSE CEILING**				
	Providing and installing 2'-0"x2'-0" Gypsum Board Moisture Resistant Ceiling Tiles including GI suspension system, attachment devices, hanger edge moulding, trim clip and trimming, including making provision for light fixture, A/C diffusers, smoke detectors etc. Complete in the respect and confirming to the requirements of drawings, specification.	SFT	580		
6	**GROOVE PLASTER**				
	Providing and laying 1-1/2" thick external groove plaster (1:5) CSM to external block masonary and concrete wall surface, 3/4" thick base plaster and 3/4" thick and 5" wide strip making 3/4"x1" groove between strip including scaffolding, levelling, finishing and curing as per detail CW No 8 etc at any height including making vertical and horizontal control joints as per drawing and specification and as per direction.	SFT	1,000		
7	**ROUGH CAST MACHINE PLASTER**				
	Providing and applying 1/8" thick rough cast plaster over external grooved plastered surface using 1:3 CSM includding scaffolding, levelling, finishing, curing etc at any height as per drawing,specification as per direction.	SFT	1,000		
8	**GLASS FOR WINDOW SKY LIGHT**				
	Providing and fixing 6mm thick clear glass for sky light . Fix into MS frame of door including cost of wooden beading etc complete in all respects confirming of drawing and specification and to the entire satisfaction of the Engineer.	SFT	140		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
9	**MS RAFTER**				
	Providing and installing MS Rafter size 10'-0" x 3' comprising of 2"x1/2" 16SWG MS box 4Nos each welded and supported by 2x1/2" MS 16SWG box 4 Nos at eqidistant painting with approved make and shade enamel paint three coats with anticorrosive primer complete as per direction.	SFT	720		
10	**THERMOPORE IN EXPANSION JOINT**				
	Providing and fixing thermopore in expansion joint(density 35Kg/Cum) of Column, beam, roof and removing after concrete pouring complete as per drawing & specification.	Sft	510		
11	**EXPANSION JOINT**				
	Providing and making expansion joint including cost of 1"x1"Sealing Compound filling by gun or as specified by the manufacturer's recommendation (PU-300 of Pagel or its equivalent) with Backer Rod as per drawing ST-05), specifications and as directed by the Engineer.	RFT	105		
12	**WINDOW BLIND**				
	Provide and install window blinds of approved sample (thermec or approved equivalent) including lifting and fixing etc, complete as per drawings, specification instructions of the architect.	SFT	336		
13	**MIRROR IN LAVATORY BLOCK**				
	Provide and install in position, mirror in toilet consisting of 6mm thick Belgium mirror, double polished front and rear of approved quality with 12mm thick commercial ply backing fixed with 30x6 mm thick imported (European) SS clip, fix on wall including wastage, fixing and accessories etc. complete in all respect as per draing, specifications and as instructed by the ENGINEER.	SFT	50		
14	**WOODEN DOOR SHUTTER**				
	Providing,fabricating & fixing in position in given sizes, semi solid block board door shutter 1-1/2" thick including 1/8" thick commercial ply on both sides, including 1/2' thick deodar wood lipping all around, hardware of approved quality/make such as hinges, bolts,latches, Al-drops, handle etc including stainless steel kick & push plates on both sides. All door hardwares are as per schedule including cost of termite proofing, rubbing, making surface smooth as per drawing & specification and as directed by the Engineer Incharge. (Door Frame and Paint is to be paid as seprate BOQ item)				
a)	Type D-4 3'-3"x7'-0"	Nos	26		
b)	Type D-4 3'-3"x7'-0" with 4mm thick clear glass vp	Nos	2		
c)	Type D-7 2'-6"x7'-0" with kick plate & hardware	Nos	12		
d)	Type D-8 2'-0"x7'-0" with kick plate & hardware	Nos	2		
15	**WARD ROBE**				
	Providing and install wardrobe comprising of deodar wood frame, 1/2" wood lipping, 3/4" laminated M.D.F (Alnoor or equivalent) of approved quality including wastage, cutting of openings, fixtures / hardware, polishing on lipping, termite proofing, including the cost of 4" thick 1:3:6 C.C Bed etc. complete in all respect as per drawing and specifications and as instructed by the Engineer.	Sft	936		
	TOTAL AMOUNT FOR NON SCHEDULE ITEMS FIRST FLOOR				

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	SECTION - A: **MAIN BUILDING WORK - SECOND FLOOR** **BASED ON NON-SCHEDULE RATES**				
1	**WALL HAND RAIL**				
	Providing, fabricating and fixing wall hand rail, using MS tube rail bracket fix to the wall as per detail CW-04 including 3" thick Circular wooden hand rail at top screwed with pipe rail including cost of polish on wooden rail. Complete in all respects confirming to the requirements of drawings, specifications and as per direction by the Engineer.	RFT	10		
2	**STAIR HAND RAIL**				
	Providing, fabricating & fixing 3'-0" high staircase railing, using 5/8" MS Square bar with 1-1/2" wide and 1/4" thick strip stiffner horizontal for support all welded properly and anchored/grouted to RCC structures including 3" circular wooden hand rail at top screwed with flat iron strip welded to Balusters including cost of 3 coat of red oxide paint and polish on wooden rail as per detail AW-71.2 (w) complete in all respects confirming to the requirement of drawings, specification and as direction by the Engineer.	RFT	40		
3	**ALUMINUM PROFILE ON EXPANSION JOINT WALL**				
	Providing and fixing aluminum profile 4"x3/4" in vertical expansion joint , fixed one side with screws at 12" C/C, including cutting of strip fixing tightly so as as to make the points weather tight , as per detail No CW 01.1 complete as per drawing and as per direction.	Rft	80		
4	**ALUMINUM METAL SADDLE IN FLOOR EXPANSION JOINT**				
	Providing and Fixing 4" wide metal saddle fastened to expansion joint in floor fixed one side with screw @9" C/C , including cutting of strip, fixing tightly so as to make the joints weather	Rft	65		
5	**FALSE CEILING**				
	Providing and installing 2'-0"x2'-0" Gypsum Board Moisture Resistant Ceiling Tiles including GI suspension system, attachment devices, hanger edge moulding, trim clip and trimming, including making provision for light fixture, A/C diffusers, smoke detectors etc. Complete in the respect and confirming to the requirements of drawings, specification.	SFT	580		
6	**GROOVE PLASTER**				
	Providing and laying 1-1/2" thick external groove plaster (1:5) CSM to external block masonary and concrete wall surface, 3/4" thick base plaster and 3/4" thick and 5" wide strip making 3/4"x1" groove between strip including scaffolding, levelling, finishing and curing as per detail CW No 8 etc at any height including making vertical and horizontal control joints as per drawing and specification and as per direction.	SFT	1,000		
7	**ROUGH CAST MACHINE PLASTER**				
	Providing and applying 1/8" thick rough cast plaster over external grooved plastered surface using 1:3 CSM includding scaffolding, levelling, finishing, curing etc at any height as per drawing,specification as per direction.	SFT	1,000		
8	**GLASS FOR SKY LIGHT**				
	Providing and fixing 6mm thick clear glass for sky light . Fix into MS frame of door including cost of wooden beading etc complete in all respects confirming of drawing and specification and to the entire satisfaction of the Engineer.	SFT	140		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
9	**MS RAFTER**				
	Providing and installing MS Rafter size 10'-0" x 3' comprising of 2"x1/2" 16SWG MS box 4Nos each welded and supported by 2x1/2" MS 16SWG box 4 Nos at eqidistant painting with approved make and shade enamel paint three coats with anticorrosive primer complete as per direction.	SFT	720		
10	**THERMOPORE IN EXPANSION JOINT**				
	Providing and fixing thermopore in expansion joint(density 35Kg/Cum) of Column, beam, roof and removing after concrete pouring complete as per drawing & specification.	Sft	510		
11	**EXPANSION JOINT**				
	Providing and making expansion joint including cost of 1"x1"Sealing Compound filling by gun or as specified by the manufacturer's recommendation (PU-300 of Pagel or its equivalent) with Backer Rod as per drawing ST-05), specifications and as directed by the Engineer.	RFT	105		
12	**WINDOW BLIND**				
	Provide and install window blinds of approved sample (thermec or approved equivalent) including lifting and fixing etc, complete as per drawings, specification instructions of the architect.	SFT	336		
13	**MIRROR IN LAVATORY BLOCK**				
	Provide and install in position, mirror in toilet consisting of 6mm thick Belgium mirror, double polished front and rear of approved quality with 12mm thick commercial ply backing fixed with 30x6 mm thick imported (European) SS clip, fix on wall including wastage, fixing and accessories etc. complete in all respect as per drawing, specifications and as instructed by the ENGINEER.	SFT	50		
14	**WOODEN DOOR SHUTTER**				
	Providing,fabricating & fixing in position in given sizes, semi solid block board door shutter 1-1/2" thick including 1/8" thick commercial ply on both sides, including 1/2' thick deodar wood lipping all around, hardware of approved quality/make such as hinges, bolts,latches, Al-drops, handle etc including stainless steel kick & push plates on both sides. All door hardwares are as per schedule including cost of termite proofing, rubbing, making surface smooth as per drawing & specification and as directed by the Engineer Incharge. (Door Frame and Paint is to be paid as seprate BOQ item)				
a)	Type D-4 3'-3"x7'-0"	Nos	26		
b)	Type D-4 3'-3"x7'-0" with 4mm thick clear glass vp	Nos	2		
c)	Type D-7 2'-6"x7'-0" with kick plate & hardware	Nos	12		
d)	Type D-8 2'-0"x7'-0" with kick plate & hardware	Nos	2		
15	**WARD ROBE**				
	Providing and install wardrobe comprising of deodar wood frame, 1/2" wood lipping, 3/4" laminated M.D.F (Alnoor or equivalent) of approved quality including wastage, cutting of openings, fixtures / hardware, polishing on lipping, termite proofing, including the cost of 4" thick 1:3:6 C.C Bed etc. complete in all respect as per drawing and specifications and as instructed by the Engineer.	Sft	936		
	TOTAL AMOUNT FOR NON SCHEDULE ITEMS SECOND FLOOR				

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			A	B	C = B X A
SECTION - A: **MAIN BUILDING WORK - SECOND FLOOR** **BASED ON NON-SCHEDULE RATES**					
	ARCHITECTURAL				
1	**ROOF TREATMENT**				
	Provide and laying roof treatment of following items (For payment screed area will be measured)				
a	Providing & Laying elastomeric cementitious waterproofing and protective coating of Expancote Rubber- ***flex two-component acrylic polymer modified cementitious coating manufactured by M/S FOS PAK or equivalent confirming to ASTM D412 & ASTM D4541: 1989 in two coats to achieve a total dry film thickness of 1.25 – 2.00 mm*** **as per manufacturer's recommendation with experienced applicator.**	SFT	5,800		
b	1:2:4 screed in required slope minimum 2-1/2" thick (Average) laid in Panel using 5mm thick glass strip , including curing, making ridges, valleys, chamfered edges, hacking of existing surface for bond where necessary etc.	SFT	5,800		
c	**DURACRETE**				
	Providing & mixing Duracrete Polypropylene fibre by Matrixx mixing at the rate as per recommendation by manufacturer @100gms per bag of Cement as per direction of the Engineer Incharge.	Kg	5		
d	**ROOF INSULATION**				
	Providing & fixing Hollow block 390mmx190mmx90mm high density in natural colour manufacture by M/S Envicrete, Izhar ltd or equivalent minimum compressive strength 1000 +/- 5% based on Net Area, laid in 90mm thick on roof as insulation tile jointed with 1:4 CSM min. 1/2" thick 1:6 base mortar including levelling, curing etc complete as per direction.	SFT	5,800		
	TOTAL AMOUNT FOR NON SCHEDULE ITEMS THIRD FLOOR				
SECTION - E : **UNDER GROUND WATER TANK 2000 GLS CAPACITY INSIDE SIZE 30'-0" X15'-0"X8'-0"** **BASED ON COMPOSITE SCHEDULED RATES 2012 INCLUDED ADDENEDA I & II ISSUED DEC. 2021**					
1	**EXCAVATION FOR UNDER GROUND TANK**				
a	Excavation for tanks & reservoirs in all kind of soils morum hard average or soft i/c trimming and dressing sides to true alignment /design sections/profiles and shape levelling of beds of trenches to correct level and grade i/c laying of earth in 6" layer for construction of banks and dressing and disposal of surplus earth. Excavated earth within one chain as directed by Engineer Incharge i/c providing fence guards, lights, flags and temporary crossings for non vehicular traffic where ever required lift upto 5 ft and lead upto one chain 100ft. Item No5 Page 69 CSR volume iv part vi 2012	%0Cft	7,560	4,050.00	30,618.00
b)	Extra for additional lead of 300 ft. item 17 page 75	%0Cft	7,560	1,650.00	12,474.00
c	Add for additional lift of every three feet (30.9 R.m) or part thereof in item Nos. 16 page 74.	%0Cft	3,780	550.00	2,079.00

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			A	B	C = B X A
2	**DISPOSAL OF EARTH**				
	Cartage of 100Cft/ 5 Tons of all material like stones, aggregate, spawl,Coal,lime, surkhi etc by Truck------ lead 1 mile	% CFT	250	407.00	1,017.50
3	**BACK FILLING (USING EXCAVATED/SURPLUS EARTH PRESENT AT SITE)**				
i)	Filling, watering and ramming earth in floors with surplus earth from foundation lead upto one chain and lift upto 5'-0" (Item No 21 Page No 4)	%0 CFT	1,060	1,512.50	1,603.25
4	**LEAN CONCRETE**				
	Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering (Page No. 16, Item No. 5-i) 1:4:8 Concrete				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	Under Footing	% CFT	378	14,605.67	55,209.43
5	**POLY ETHYLENE SHEET**				
	Providing and laying single per layer of polyethylene sheet 0.13 mm thick for water proofing as per specification and instruction of Engineer Incharge (Page No. 38, Item No. 38).	SFT	756	10.7	8,089
6	**TERMITE PROOFING**				
	Providing anti-termite treatment by spraying / sprinkling / spreading Neptachler 0.5% Emulsion as an overall pre-construction treatment in slab type construction under the slab and attached perches or entrances etc. complete in all respect as per directions of the Engineer-in-Charge (Page No. 108, Item No. 92)	SFT	756	9.74	7,363
7	**STONE SOLING**				
	Stone pitching including sub-base with hammer dressed stone on surface laid in courses including carriage of materials chains. (Page No. 32, Item No. 23) 6" THICK	%Cft	378	5377.63	20,327
8	**REINFORCED CEMENT CONCRETE**				
	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 curing rendering and finishing the exposed surface (including screening and washing of shingle) Page No. 17. Item No. 6(a)-ii				
	NOTE : ALL STRUCTURAL CONCRETE UPTO PLINTH LEVEL SHALL BE WITH SULPHATE RESISTING CEMENT .				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
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.				
a)	Ratio 1:1-1/2: 3 Conc. 50Kg OPC cement,1-1/2 cft Sand 3 Cft stone aggregate				

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			A	B	C = B X A
(I)	Foundation Slab 9" thick	CFT	408	427.4	174,379
(ii)	Walls	CFT	665	427.4	284,221
IiV)	Roof Slab 6"th	CFT	325	427.4	138,905
(v)	Beams,	CFT	30	427.4	12,822
	Total	CFT	**1428**		
10	**STEEL REINFORCEMENT**				-
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a	Fabrication of mild Steel Reinforcement for Cement Concrete including cutting, bending, laying in position, making joints and fastenings including the cost of binding wire, also include removal of) Item no 8 (b) page No 17 using TOR Bar	CWT	92	9401.7	864,956
11	**BLOCK MASONARY**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	**SOLID BLOCK MASONRY**				
i)	**ABOVE 6 " THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and above in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 23)	% Cft	268	18933.44	50,742
12	**RENDERING (PLASTER)**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Internal Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	1650	4,269.76	70,451
ii)	**External Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
i)	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	900	4,269.76	38,428

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			A	B	C = B X A
13	**DAMP PROOFING**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
ii)	**Vertical DPC**				
	Vertical Damp Proof Course of 3/4' thick Cement Plaster 1:2 with Bitumen at 20 LBS per % Sft. Page N0 107 Item No 70	%Sft	900	3,017.66	27,159
14	**FLOORING**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**FLOORING BASE 1;2:4**				
a)	Providing & Laying 2"thick topping Cement Concrete 1:2:4 including surface finishing and dividing into panels. Item No 16 Page No42.	%Sft	450	4,302.17	19,360
b)	Providing & Laying 2"thick topping Cement Concrete 1:2:4 including surface finishing and dividing into panels. Item No 16 Page No42. (Roof Screed)	%Sft	520	4,302.17	22,371
15	**EXTRA FOR SULPHATE RESISTING CEMENT**				
	Adding Extra for Sulphate Resisting Cement in Lieu of OPC Item No 45 Schedule of Rates 2011	Bags	350	40.00	14,000
16	**EXTRA FOR USING WATER PROOFING AGENT**				
	Adding extra for pudlo @5% or as per manufacture's recommendation	Kg	150	125.00	18,750
17	**CI VENTILATOR**				
	P/F CI Ventilator (Weight not less than 80 lbs each) in tank roof of approved design with water tight joint i/c painting etc complete.	Each	2	4,870.00	9,740
	TOTAL AMOUNT OF THIS SUB HEAD BASED ON CSR 2012 ADDING ADDENDA 1&II ISSUED Dec 2021				1,885,065

SECTION - E:
UNDER GROUND WATER TANK 20000 GLS CAPACITY
BASED ON NON-SCHEDULE RATES

1	Providing and laying GI Steps as per details and directions.	Each	10		
2	Providing & fixing heavy duty CI Man Hole Cover 2'-0" x2'-0" with Cover minimum weight 65 Kg as per details & specifications	Each	2		
	TOTAL AMOUNT OF THIS SUB HEAD FOR NON SCHEDULE ITEMS				

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			A	B	C = B X A
SECTION - F: **TENNIS COURT, VOLLEY BALL & CENTRAL COURT** **BASED ON SCHEDULED RATES 2012 & ADDENDA I &II ISSUED ON 1ST Dec. 2021**					
	TENNIS COURT & VOLLEY BALL COURT				
1	**Jungle Clearance**				
	Jungle Clearance and removing within 100 ft (b) thick Item No 4 (b) Page 95 Chapter 18	%0Cft	10,720	151.25	1,621
2	**EXCAVATION FOR FOUNDATION**				
a	Excavation in shingle or gravel formation and rock in dry not requiring blasting undressed lead upto 100ft. (Page No1 item No 4)	%0Cft	21,440	5,747.50	123,226
b	Extra for every 50'-0" lead or part thereof 500'lead Item no 8 a) Page No 2 lead 200 ft	%0Cft	10,720	403.12	4,321
3	**DISPOSAL OF EARTH**				
	Cartage of 100Cft/ 5 Tons of all material like stones, aggregate, spawl,Coal,lime, surkhi etc by Truck------ lead 1 mile	% CFT	21,440	407.00	87,261
4	**TERMITE PROOFING**				
	Providing anti-termite treatment by spraying / sprinkling / spreading Neptachler 0.5% Emulsion as an overall pre-construction treatment in slab type construction under the slab and attached perches or entrances etc. complete in all respect as per directions of the Engineer-in-Charge (Page No. 108, Item No. 92)	SFT	10,720	9.74	104,413
5	**STONE SOLING**				
	Stone pitching including sub-base with hammer dressed stone on surface laid in courses including carriage of materials chains. (Page No. 32, Item No. 23) 6" THICK	%Cft	5,304	5,377.63	285,229
6	**PLAIN CEMENT CONCRETE**				
i)	Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering (Page No. 16, Item No. 5-i) 1:4:8 Concrete				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
A)	Under Floor	% CFT	5,304	14,605.67	774,685
7	**POLY ETHYLENE SHEET**				
	Providing and laying single per layer of polyethylene sheet 0.13 mm thick for water proofing as per specification and instruction of Engineer Incharge (Page No. 38, Item No. 38).	SFT	10,720	10.70	114,704
8	**GLASS PATTI**				
	Providing & fixing glass strips 4mm for flooring upto 1" depth including fixing in flooring with cement inspecified pattern & design. Item No75 Page /50	PSFT	10,720	11.16	119,635

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
9	**RCC SLAB ON GRADE**				
	NOTE : ALL STRUCTURAL CONCRETE UPTO PLINTH LEVEL SHALL BE WITH SULPHATE RESISTING CEMENT .HOWEVER THE DIFFERENCE OF COST SHALL BE PAID AS PER MENTIONED IN NON-SCHEDULE ITEM.				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
	Providing & laying 4" thick RCC slab on Grade Using Concrete 1:1-1/2:3. Item No 6b (II) Page 17	PCFT	3,303	427.4	1,411,702
10	**REINFORCEMENT BAR**				
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
	Fabrication of Mild Steel Reinforcementr for Cement Concrete i/C cutting,bending, laying in position,making joints and fastenings including cost of binding wire(also includes removal of (b) Using Tor bars. Item no 8(b) Page 17	Per CWT	60	9401.7	564,102
11	**CONCRETE FLOOR TOPPING ON SLAB ON GRADE**				
	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 form moulds, lifting shuttering, curing, rendering and finishing the exposed surface (including screening & washing of shingle Ratio 1:1-1/2 :3 Concrete.	CFT	2,000	427.4	854,800
12	**EXTRA FOR SULPHATE RESISTING CEMENT**				
	Adding Extra for Sulphate Resisting Cement in Lieu of OPC Item No 45 Schedule of Rates 2011	Bags	1193	40.00	47,720
	TOTAL AMOUNT OF SCHEDULED BASED ITEM				**4,493,420**

SECTION - F:
TENNIS COURT, VOLLEY BALL & CENTRAL COURT
BASED ON NON - SCHEDULED RATES

1	**EARTH FILLING**				
	Suppling, placing and compacting in layers of 6"thick of compacted thickness to 95% Modified Proctor's Relative density, approved selected earth brought from out side to soil groups GM, SW and ML as per ASTM D2487-85 (as amended) Classification of soils for Engineering Purposes) including Cost of spreading ,levelling, dressing, watering and mechanical compaction as per drawing & specification and instruction.	CFT	10,720		
2	**FLOOR COATING**				
	Providing & painting with water based acrylic reinforced floor coat Berger or equivalent in two coats each coat dry minimum 25 micro meter in approved shade by using roller or as per manufacturer's recommendation.	SFT	4,608		
3	**LINE MARKINGS**				
	Providing & Marking lines with floor marking 2" WIDE OR AS DIRECTED USING MARKING PAINT BY , Jotun, Berger or equivalent as approved MAKE & SHADE.	RFT	684		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
4	**PROTECTIVE FENCE**				
	Providing , Making & fixing enamel painted protective fence comprising of 75mm dia 6.0 m MS corner post 4mm thick, 50mm dia 4mm thick 6.00 meter long intermediate post , 25mmdia 3mm thick top and intermediate horizontal bracing,12 Gauge Galvanised chain mesh of 50x50mm pitch size welded/fixed to steel supports (m.s) 6m high red oxide and and enameled painted supplied with MS plate, provision of doors, including cost of making RCC foundation and Pedestal Column, steel reinforcement, all necessary hardware to complete the work as per drawings, manufacturer's specifications and as per instruction.	SFT	5,100		
5	**WOODEN BENCHES**				
	Providing ,making & fixing in position seasoned wood, termite treated golden teak wooden benches including all necessary hardware to complete as per drawing	RFT	36		
6	**TENNIS COURT NET**				
	Providing & fixing Tennis Court Net WILSON, BABOLAT or equivalent including enamel painted 4-1/2 " dia pole with Americal style Nobe, RCC Concrete foundation and steel reinforcement, all fixing arrangement to complete work in all respect as per drawing, specifications and as instructed by the Engineer Incharge.	Job	1		
7	**VOLLEY BALL NET**				
	Providing & fixing Volley Ball Net including Enamel Painted 3"dia Pole with American style Knob, RCC Concrete Foundation and all fixing Arrangement, Steel reinforcement to complete work complete in all respect as per drawing, specifications and as per direction.	each	1		
	TOTAL AMOUNT OF SCHEDULED BASED ITEM				

SECTION - G:
EXTERNAL DEVELOPMENT
BASED ON SCHEDULED RATES

	EXTERNAL DEVELOPMENT				
1	**EXCAVATION FOR FOUNDATION**				
a	Excavation in shingle or gravel formation and rock in dry not requiring blasting undressed lead upto 100ft. (Page No1 item No 4)	%0Cft	39,380	5,747.50	226,337
2	**DISPOSAL OF EARTH**				
	Cartage of 100Cft/ 5 Tons of all material like stones, aggregate, spawl,Coal,lime, surkhi etc by Truck------ lead 1 mile	% CFT	39,380	407.00	160,277
3	**TERMITE PROOFING**				
	Providing anti-termite treatment by spraying / sprinkling / spreading Neptachler 0.5% Emulsion as an overall pre-construction treatment in slab type construction under the slab and attached perches or entrances etc. complete in all respect as per directions of the Engineer-in-Charge (Page No. 108, Item No. 92)	SFT	19,690	9.74	191,781
4	**Back Filling**				
a)	**USING EXCAVATED/SURPLUS EARTH PRESENT AT SITE**				
i)	Filling, watering and ramming earth in floors with surplus earth from foundation lead upto one chain and lift upto 5'-0" (Item No 21 Page No 4)	%0 CFT	39,380	1,512.50	59,562
5	**KERB STONE**				
	Providing & fixing Precast Edge Block 3750 PSI Industrial made size 6"x12"x12" high including the cost of cartage, excavation, form work for haunching, 1450PSI lean concrete 2250 PSI Concrete for haunching 1:4 CSM mortar.	PRft	1,352	297.01	401,558

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
6	**PLAIN CEMENT CONCRETE**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering (Page No. 16, Item No. 5-i) 1:4:8 Concrete				
A)	Under Floor	% CFT	1,690	14,605.67	246,836
7	**POLY ETHYLENE SHEET**				
	Providing and laying single per layer of polyethylene sheet 0.13 mm thick for water proofing as per specification and instruction of Engineer Incharge (Page No. 38, Item No. 38).	SFT	19,690	10.70	210,683
8	**CC PAVER**				
i	Providing and fixingCement Paving Blocks flooring having size of 197x97x80mm of city /quddra/cobble shape with natura colour having struength b/w 5000 psi to 8500 psi i/c filling the joints with hill sand and laying in specified manner /pattern and design complete Item No 71 Page No 49	PSFT	3,380	199.77	675,223
ii	do but pigmented	PSFT	2,500	223.97	559,925
9	**EXTRA FOR USING SR CEMENT**				
	ADD EXTRA FOR SULPHATE RESISTANT CEMENT (REF SOR MATERIALS VOL-III PART-III SIXTH EDITION-2011 PAGE 3&4	Bags	1,650	40	66,000
	TOTAL AMOUNT OF SCHEDULED BASED ITEM FOR THIS SUB HEAD				**2,732,180**
SECTION - H: **COMOUND WALL** **BASED ON SCHEDULED RATES**					
	EXTERNAL DEVELOPMENT				
1	**EXCAVATION FOR FOUNDATION**				
a	Excavation in shingle or gravel formation and rock in dry not requiring blasting undressed lead upto 100ft. (Page No1 item No 4)	%0Cft	4,500	5,747.50	25,864
2	**Back Filling**				
a)	**USING EXCAVATED/SURPLUS EARTH PRESENT AT SITE**				
i)	Filling, watering and ramming earth in floors with surplus earth from foundation lead upto one chain and lift upto 5'-0" (Item No 21 Page No 4)	%0 CFT	3,200	1,512.50	4,840
3	**PLAIN CEMENT CONCRETE**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	Cement concrete plain including placing compacting, finishing and curing complete (including screining and washing at stone aggregate without shuttering (Page No. 16, Item No. 5-i) 1:4:8 Concrete				
A)	Under FOOTING	% CFT	150	14,605.67	21,909
4	**REINFORCED CEMENT CONCRETE**				
	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 curing rendering and finishing the exposed surface (including screening and washing of shingle) Page No. 17. Item No. 6(a)-ii				

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			A	B	C = B X A
	NOTE : ALL STRUCTURAL CONCRETE UPTO PLINTH LEVEL SHALL BE WITH SULPHATE RESISTING CEMENT .				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
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.				
a)	Ratio 1:1-1/2: 3 Conc. 50Kg OPC cement,1-1/2 cft Sand 3 Cft stone aggregate				
(I)	Foundation	CFT	350	427.4	149,590
(ii)	Plinth Beam	CFT	450	427.4	192,330
IiV)	Column Upto Plinth	CFT	105	427.4	44,877
(v)	Column in Super Structure	CFT	210	427.4	89,754
	Total	CFT	**1115**		
5	**STEEL REINFORCEMENT**				-
	ADD FOR DIFFERENCE OF COST OF DEFORMED STEEL PKR 88000 PER M TON AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a	Fabrication of mild Steel Reinforcement for Cement Concrete including cutting, bending, laying in position, making joints and fastenings including the cost of binding wire, also include removal of) Item no 8 (b) page No 17 using TOR Bar	CWT	85	9401.7	799,145
6	**BLOCK MASONARY**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
a)	**SOLID BLOCK MASONRY**				
i)	**ABOVE 6 " THICKNESS**				
	Providing and laying 1:3:6 cement concrete solid block masonry wall 6" and above in thickness set in 1:6 cement mortar in ground floor Super Structure including raking out joints and curing etc. complete. (Page No. 19, Item No. 23)	% Cft	1608	18933.44	304,450
7	**RENDERING (PLASTER)**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
i)	**Internal Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	2400	4,269.76	102,474
ii)	**External Plaster**				
a)	**Cement Plaster 1:4 upto 12' height**				
i)	3/4" thick Plaster (for ceiling and wall) Page No. 52, Item No. 11-d	% SFT	2600	4,269.76	111,014

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
8	**DAMP PROOFING**				
	ADD FOR DIFFERENCE OF COST OF CEMENT PKR 350 PER BAG AS PER ADDENDA ISSUED ON 1ST DECEMBER 2021				
ii)	**Vertical DPC**				
	Vertical Damp Proof Course of 3/4' thick Cement Plaster 1:2 with Bitumen at 20 LBS per % Sft. Page N0 107 Item No 70	%Sft	1200	3,017.66	36,212
9	**EXTERNAL WALL PAINTING**				
	Preparing the Surface and painting with Weather Coat i/c Rubbing the surface with rubbing brick/sand paper, filling the voids with chalk /plaster of Paris and then paintining with weather coat of approved make (3 Coats) Page No 56 Item no 38-a & B	% SFT	5500	2567.95	**141,237**
10	**MS SECURITY GRILLS**				
	supplying and fixing in position iron /steel grill of 3/4"x1/4" size flat iron of approved design including painting 3 coats etc. (weight not to be less than 3.7 lbs /sft of finished grill)	Psft	700	180.50	**126,350**
9	**EXTRA FOR USING SR CEMENT**				
	ADD EXTRA FOR SULPHATE RESISTANT CEMENT (REF SOR MATERIALS VOL-III PART-III SIXTH EDITION-2011 PAGE 3&4	Bags	1,650	40	66,000
	TOTAL AMOUNT OF SCHEDULED BASED ITEM FOR THIS SUB HEAD				**2,150,045**
SECTION - I: **HORICULTURE**					
	HORTICULTURE				
1	**Rough dressing the area**				
	grass roots and other injurious matters and breaking of clods complete including disposal of rubbish within 3 chains (92 m).	**Sft**	**6500**		
2	**SWEET EARTH**				
	Supplying stacking & Spreading approved garden soil (sweet earth) free from salts, pebbles and grass roots etc. including all leads and lifts.	CFT	6,500		
3	**MANURE**				
	Supplying , stacking & spreading well decayed sewage manure from approved sources including all leads and lifts .	CFT	1,200		
3	**GRASS**				
a	Supply &Grassing fine by dribbling grass roots 3" apart including watering, weeding till such time the grass is set and becomes green and is fit for mowing DHAKA GRASS	SFT	8,500		
4	**Trees**				
	Preparing Tree Pit (size 4' X 4'.X 4') wherever required by excavating into any strata.				
	Application of antitermite treatment @ 20 ml of Chloropyriphos per plant on the walls & base of the pit.				
	Filling the pit with compost. (ratio 1 animal manure : 3 sweet earth).				
	Flooding with water at least 20 ltr. Per tree, dressing including removal of rubbish & surplus earth if any with all leads & lifts, planting and staking (with a bamboo dipped in charcoal) in full and final location including all locations specified. Maintenance of trees for a period of 3 months from the date of plantation, replacement of any dead & unhealthy tree in this period,				

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	Supply & spraying of insecticides as required.				
	Supply & planting of the following trees as per botanical name & specification mentioned below:				
	Complete in all respect as per drawings, specifications and as per the instruction by the architect.				
a	**T-01** Champa Tree (2" dia trunk size, 8'-10' high, Multiple branching).	each	15		
b	**T-02** Termenalia (1.5"-2"dia trunk size, 8-10' high multiple branching)	each	25		
c	**T-03** Bamboo Tree (2" dia trunk size, 8'-10' high, Multiple branching)	each	10		
d	**T-05** Erika Palm 5' high	each	10		
e	T-06 Cornocorpus Hedge 8' high	each	25		
f	**T-07** Triangular Palm 10" high	each	20		
g	T-08 Gulmuhar Tree (2" dia trunk size, 8'-10' high, Multiple branching).	each	25		
4	**HORTICULTURE**				
5	**GROUND COVER**				
	Providing and planting the following ground covers as per drawings, specifications, and as instructed by architect.				
a	Wadhlia (yellow flowering)	each	20		
b	Pebbles	cft	2,000		
c	Crush (1" thick Avg. grey color)	cft	1,500		
	TOTAL AMOUNT OF NON SCHEDULED BASED ITEM				

SECTION - J :
SUPPLY, INSTALLATION, TESTING & COMMISSIONING
SOIL, WASTE AND VENT PIPING
Make - Ref. List of approved Manufacturers

Supply, install and commission Soil & Waste piping uPVC Non Pressure pipes & fittings confirming to BSS 3505/BSS 3506 PSI 3051-91 ASTM D 1785-94 DIN 8061-8062 standards, including all special accessories, and hangers as per drawings & specifications for drainage systems.

1	75mm dia I.D	Rm	110		
2	100mm dia I.D	Rm	55		
3	32mm Dia VENT PIPE	Rm	34		
4	50mm Dia Vent Pipe	Rm	79		
5	75mm Dia Vent Pipe	Rm	21		
	Supply & Installation of UPVC floor drain with SS Cover of the following size with all consumable of approved make .				
6	75mm	Nos.	36		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	Supply & Installation of floor clean out of following sizes including all consumable as per approved make.				
7	100mm Diameter	Nos	12		
	Supply installation of Cowel Vent of the following sizes as per specification and approved make.				
8	75mm dia	Nos	2		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

SECTION - K :
SUPPLY, INSTALLATION, TESTING AND COMMISSIONING
SANITARY FIXTURES AND FITTINGS WITH ALL CONSUMABLE AND ACCESSORIES WITH COMPETE IN ALL RESPECTS
Make - Ref. List of approved Manufacturers

1	Water Closet Western Floor Mounted with Flush tank operated.	Nos	12		
2	Water Closet Eastern Cistern Operated.	Nos	6		
3	Wash Hand Basin of Half Pedestal	Nos	18		
4	Single Lever Wash Hand Basin Mixer	Nos	18		
5	Single lever Shower Mixer & shower hose,.	Nos	12		
6	WC Bib Cock	Nos	18		
7	Janitorial Bib Cock	Nos	6		
8	Liquid Soap Dispenser	Nos	6		
9	WC Hand Shower	Nos	18		
10	toilet paper holder	Nos	18		
11	Towel Rail including accessories	Nos	18		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

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			A	B	C = B X A
SECTION - L: **SUPPLY, INSTALLATION, TESTING AND COMMISSIONING** **SEWER PIPE NETWORK AND MANHOLES** **Make - Ref. List of approved Manufacturers**					
	Soil & Waste piping UPVC Non Pressure pipes & fittings confirming to BSS 3505/BSS 3506 PSI 3051-91 ASTM D 1785-94 DIN 8061-8062 standards, including all special accessories,EXCAVATION IN ANY SOIL, LAYING & JOINTING PIPE, BACK FILLING, COMPACTION as per drawings & specifications for drainage systems.				
1	150mm I.D Diameter	Rm	137		
2	Making of Manhole 900mm x 900mm internal size with block masony 200mm thick wall water proof plaster from both sides, including, excavation, back filling, RCC ring and Cover 600mm dia with benching complete. Maximum depth upto invert level 1800mm. complete as per drawing & design.	Nos	12		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
SECTION - M : **SUPPLY, INSTALLATION, TESTING AND COMMISSIONING** **WATER, GAS AND FIRE SUPPRESSION PIPING** **Make - Ref. List of approved Manufacturers**					
	Poly Propylene Random PPR (PN 20) piping for Cold Water Supply system complete in all respects with all fittings & accessories as per drawings and specifications confirming to DIN 8077-78 and fitting DIN 16962.				
1	20mm Diameter (20mm ID)	Rm	256		
2	25mm Diameter (25mm ID)	Rm	24		
3	32mm Diameter (32mm ID)	Rm	76		
4	38mm Diameter (40mm ID)	Rm	82		
5	50mm Diameter (50mm ID)	Rm	12		
6	63mm Diameter (63mm ID)	Rm	12		
	Poly Propylene Random PPR (PN 20) piping for Hot Water Supply system complete in all respects with all fittings & accessories as per drawings and specifications confirming to DIN 8077-78 and fitting DIN 16962. including pressure testing, AS PER MAKE, MODEL, BRAND AS PER APPROVED MANUFACTURER'S LIST				
7	20mm Diameter	Rm	134		
8	25mm Diameter	Rm	23		
9	32mm Diameter	Rm	46		
10	38mm Diameter	Rm	31		
11	50mm Diameter	Rm	6		
	Closed Cell Foam (Fire Retardant) Insulation (IPI) with venture Cladding on PPR pipes of the following sizes having thermal conductivity of 0.26 BTU/Ht ft square @67 Degree F complete in all respect as per specification .				
12	20mm Diameter	Rm	134		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
13	25mm Diameter	Rm	23		
14	32mm Diameter	Rm	46		
15	38mm Diameter	Rm	31		
16	50mm Diameter	Rm	6		
	Galvanized Steel (GI) piping with anticorrosive Tape, Medium quality confirmining to BS 1387 for Gas supply complete in all respects with all fittings & accessories as per drawings and specifications.				
17	20mm Diameter	Rm	38		
18	25mm Diameter	Rm	49		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

SECTION - N :
SUPPLY, INSTALLATION, TESTING AND COMMISSIONING
WATER, GAS AND FIRE SUPPRESSION FITTINGS AND FIXTURES
Make - Ref. List of approved Manufacturers

1	Landing Valve hydrant with quick coupling of the size 75mm diameter incl. all consumable and accessories as per specification.	**Each**	8		
2	Gate Valves confirming with ASTM A216 - WCB with all consumable and accessories as per drawings & specifications.				
a	25mm Diameter	**Nos**	12		
b	32mm Diameter	**Nos**	6		
c	38mm Diameter	**Nos**	10		
3	CHECK Valves confirming with ASTM A216 - WCB with all consumable and accessories as per drawings & specifications. 38mm dia	**Nos**	4		
4	FLOAT Valves confirming with ASTM A216 - WCB with all consumable and accessories as per drawings & specifications. 38mm dia	**Nos**	4		
5	VALVE CHAMBER 36" X 24" DEPTH AS PER REQUIRED WITH 6" THICH BLOCK MASONARY 1:6 csm and 1/2" thick internal & external water proof plaster complete as per drawings & specifications including PVC frame and cover as per drawing & direction.	**Nos**	4		
6	Cold & Hot Water Dispenser Plastic body 36"Hx 11"W and 12"D as per approved make and model.	**Nos**	6		
7	Gas water Gyser 55 Gallons Capacity 10 ~12 SWG Galvanized Water Tank, Heavy duty Thermostat with pressure relieving valve complete as per specification.	**Nos**	6		
8	Over Head Fibre Glass Water Tank 500 US Gallons (1892 litres) horizontal type complete with all fittings as per drawings & specifications.	**Nos**	2		
9	32mm dia x100 RFT Hose Reels (C/01-04) with Cabinet Door for two Compartment, complete with supports including with all Consumables and Assoceries of all as per specification.	**Nos**	6		

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IBA Institute of Business Administration Karachi
Leadership and Ideas for Tomorrow

14/3/2022

S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
10	6 Kg Dry Powder portable fire extiguisher, complete with supports including with all Consumables and Assoceries of all as per specification and approved make.	**Nos**	6		
11	2 Kg Carbon DiOxide portable fire extiguisher, complete with supports including with all Consumables and Assoceries of all as per specification and approved make.	**Nos**	6		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

SECTION - O:
SUPPLY, INSTALLATION, TESTING & COMMISSIONING
WIRING / WIRING ACCESSORIES ETC.
Make - Ref. List of approved Manufacturers

1	Wiring of light circuit from DB to switch, between switches or first light point / directly controlled from DB with single core PVC insulated 2 x 1C - 2.5 sq.mm + 1 x 2.5 sq.mm wires in 25 mm dia PVC conduit complete in all respect.	Nos.	48		
2	Wiring from switch to first light point with 2 x 1C - 1.5 sq.mm + 1 x 1.5 sq.mm wires in 25 mm dia PVC conduit complete in all respect.	Nos.	490		
3	Same as above but from point to point.	Nos.	122		
4	Wiring of power circuit from DB to first power socket with 2 x 1C-2.5 sq.mm + 1x 2.5 Sq.mm PVC wires in 25 mm dia PVC conduit complete in all respect. **Normal & Emergency.**	Nos.	78		
5	same as above but outlet to outlet	Nos.	93		
6	Wiring of Light circuit from DB to first light point with 2 x 1C-2.5 sq.mm + 1x 2.5 Sq.mm PVC wires in 25 mm dia PVC conduit complete in all respect.	Nos.	6		
7	same as above but point to point.	Nos.	25		
8	Wiring of power circuit from DB to AC - Isolator point and outdoor with 2 x 1C-4 sq.mm + 1x 4 Sq.mm PVC wires in 25 mm dia PVC conduit complete in all respect.	Nos.	70		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

SECTION - P:
SUPPLY, INSTALLATION, TESTING & COMMISSIONING
SWITCHES, SOCKETS, OUTLET & ACCESSORIES
Make - Ref. List of approved Manufacturers

1 (a)	**Following Switches etc. with M.S back box complete in all respect.**				
	1 - Gang. (1-way)	Nos.	19		
	2 - Gang. (1-way)	Nos.	180		
	3 - Gang . (1-way)	Nos.	4		
	4 - Gang . (1-way)	Nos.	9		
	Fan dimmers	Nos.	90		
1 (b)	**Following Sockets with all accessories complete in all respects**				
	13A Duplex Type - Flat pin	Nos.	6		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
	13 A Simplex type - Flat Pin	Nos.	180		
	13 A International Switch socket outlet	Nos.	360		
	13A Isolator switch for A.C	Nos.	90		
2	**Weather proof 10A switches with M.S back box complete in all respect.**				
	1 - Gang .(1-way)	Nos.	3		
	2 - Gang .(1-way)	Nos.	3		
3	**Weather proof socket outlet (IP-54) including sheet steel Back box or plastic box.**				
	13 Amp - International Switch Socket.	Nos.	6		
4	**Pull box as per drawing/requirement with M.S powder coated paint (With Cover)**				
	4"x4"	Nos.	3		
	18"x18"	Nos.	3		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
SECTION- Q : **INSTALLATION, TESTING & COMMISSIONING** **UN-INTERRUPTED POWER SUPPLY** **Make - Ref. List of approved Manufacturers**					
1	**Following size of UPS (10 Minutes backup) for emergency as per drawing/specs with dry battery complete in all respect.**				
a	10 KVA. (3-Phase in 1-Phase out).	Nos.	2		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
SECTION- R : **SUPPLY, INSTALLATION, TESTING & COMMISSIONING** **LIGHT FIXTURES & FANS** **Make - Ref. List of approved Manufacturers**					
1	**Following LED light fixtures complete in all repsect.**				
a	LED Downlight - 10 W	Nos.	143		
b	LED Tubelight with fixture - 4ft - 14W	Nos.	188		
c	LED Tubelight with fixture - 2ft - 12W	Nos.	23		
d	LED wall Light	Nos.	180		
e	LED Exit Lights -Battery maintained with 2 hours battery backup.	Nos.	11		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
2	**Following Fans with complete accessories and hanging arrangements etc. complete in all respect.**				
a	Exhaust Fan 18"	Nos.	8		
b	Ceiling Fan 56" - max. 60 Watt	Nos.	90		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
SECTION- S : **SUPPLY, INSTALLATION, TESTING & COMMISSIONING** **MAIN. SUB-MAIN CABLES, CONDUIT & CABLE TRAY** **Make - Ref. List of approved Manufacturers**					
1	**Following size multicore Cu/PVC/PVC/XLPE, including lugs, glands, termination kits, etc. complete in all respect as shown on drawing. Cables if layed in cable tray trafoil arrangements shall be made**				
a	3.5C-120 Sqm Cu./XLPE + 1C-70Sq.mm Cu./PVC as ECC from Existing MLTP to MDB in 100 mm dia Class-D conduit.	Rm	12		
b	3.5C-50 Sqm Cu./XLPE + 1C-25Sq.mm Cu.PVC as ECC from MDB to SMDB - Ground floor -01 in 100mm dia Class-D conduit.	Rm	38		
c	3.5C-95 Sqm Cu./XLPE + 1C-25Sq.mm Cu.PVC as ECC from MDB to SMDB - Ground floor -01 in 100mm dia Class-D conduit.	Rm	77		
d	4C-10 Sqm Cu./PVC/PVC + 1C-10Sq.mm Cu.PVC as ECC from SMDB Block - 01 to DB - Ground floor -01 in already laid cable tray	Rm	12		
e	4C-10 Sqm Cu./PVC/PVC + 1C-10Sq.mm Cu.PVC as ECC from SMDB Block - 01 to DB - First floor -01 in already laid cable tray	Rm	20		
f	4C-16 Sqm Cu./PVC/PVC + 1C-16Sq.mm Cu.PVC as ECC from SMDB Block - 01 to DB - Second Floor -01 in already laid cable tray.	Rm	30		
g	4C-16 Sqm Cu./PVC/PVC + 1C-16Sq.mm Cu.PVC as ECC from SMDB Block - 02 to DB - Ground floor -02 in already laid cable tray	Rm	10		
h	4C-16 Sqm Cu./PVC/PVC + 1C-16Sq.mm Cu.PVC as ECC from SMDB Block - 02 to DB - First floor -02 in already laid cable tray	Rm	20		
i	3.5C-25 Sqm Cu./PVC/PVC + 1C-16Sq.mm Cu.PVC as ECC from SMDB Block - 02 to DB - First floor -02 in already laid cable tray	Rm	30		
j	3C-6 Sqm Cu./PVC/PVC from SMDB Block - 01 to DB - UPS -01 in already laid cable tray.	Rm	15		
k	3C-6 Sqm Cu./PVC/PVC from SMDB Block - 01 to DB - UPS -01 in already laid cable tray .	Rm	15		
2	**Following sizes of PVC conduits complete in all respect**				
a	50 mm dia.	Rm	5		
b	38 mm dia.	Rm	5		
c	32 mm dia.	Rm	5		
d	25 mm dia.	Rm	5		
e	20 mm dia.	Rm	5		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
3	**Following sizes of Class- D PVC conduits complete in all respect**				
a	75 mm dia.	Rm	8		
b	50 mm dia.	Rm	8		
c	38 mm dia.	Rm	8		
d	32 mm dia.	Rm	8		
4	**Following sizes of Core Cutting complete in all respect.**				
a	Core Cutting 4'' Dia	Nos.	5		
b	Core Cutting 6'' Dia	Nos.	5		
c	Core Cutting 8'' Dia	Nos.	5		
d	Core Cutting 10'' Dia	Nos.	5		
5	**Galvanized Cable Tray including Cover of 16 SWG M.S. sheet steel (perforated) having 02 coats of Zinc Chromate paint with cover and hanging arrangement from ceiling / wall as per drawing / site conditions, complete in all respect to the entire satisfaction to Client / Consultant.**				
	CABLE TRAY				
a	100mm x 75mm 16 SWG	Rm	11		
b	150mm x 100mm 16 SWG	Rm	20		
c	300mm x 100mm 16 SWG	Rm	12		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

SECTION - T:
SUPPLY, INSTALLATION, TESTING & COMMISSIONING
SWITCHBOARDS / DISTRIBUTION BOARDS
Make - Ref. List of approved Manufacturers

1	**Supply & Installation of the following distribution boards as per detail shown on drawing complete in all respect.**				
a	Main Distribution Board	Nos.	1		
b	SMDB BLOCK - 01	Nos.	1		
c	SMDB BLOCK - 02	Nos.	1		
d	DB - Ground Floor - 01	Nos.	1		
e	DB - First Floor - 01	Nos.	1		
f	DB - Second Floor - 01	Nos.	1		
g	DB - Ground Floor - 02	Nos.	1		

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S.#	DESCRIPTION	UNIT	TOTAL QTY.	RATE IN PKR	AMOUNT
			A	B	C = B X A
h	DB - First Floor - 02	Nos.	1		
i	DB - Second Floor - 02	Nos.	1		
j	DB - UPS - 01	Nos.	1		
k	DB - UPS -02	Nos.	1		
l	DB - EXTERNAL	Nos.	1		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
SECTION - U: **SUPPLY, INSTALLATION, TESTING & COMMISSIONING** **EARTHING SYSTEM** **Make - Ref. List of approved Manufacturers**					
1	**Following size single core PVC insulated cable in 38mm Class-D PVC Conduit from earth electrode to ECP complete in all respects. Earth Test Report to be submitted by contractor to client.**				
	50 sq. mm	Rm.	30		
	35 sq. mm	Rm.	30		
2	3 Meter long 20mm dia steel rod copper claded, including inspection pit, test bar, chemical, etc. Earth resistance should be less than 1 ohm.	Nos.	4		
3	Bare copper strip of following size earth connecting point (ECP) with proper mounting arrangements including cover as per drawing complete in all respects.				
	200 mm x 50 mm x 10 mm	Nos.	2		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
SECTION - V: **SUPPLY, INSTALLATION, TESTING & COMMISSIONING** **WIRING & ACCESSORIES FOR FIRE ALARM SYSTEM** **Make - Ref. List of approved Manufacturers**					
	Supply, installation, Testing and Commissioning of following including flexible conduits from points to device complete in all respects as per drawings / specs.				
1	Fire alarm control panel (Addressable - 02 loop)	Nos.	2		
2	Smoke Detector.	Nos.	102		
3	Heat Detector.	Nos.	2		
4	Manual call point (Break glass).	Nos.	12		
5	Fire alarm sounder & Flasher.	Nos.	12		
6	Wiring of complete Fire Alarm System with 2C-1.5 Sq.mm PVC/XLPE (Fire Resistance Cable- 2 hours fire rating) in 25 mm dia PVC Conduit.	Rm	480		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

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			A	B	C = B X A
	SECTION - W: **SUPPLY, INSTALLATION, TESTING & COMMISSIONING** **WIRING & ACCESSORIES FOR DATA SYSTEM** **Make - Ref. List of approved Manufacturers**				
	Supply, installation, Testing and Commissioning of following including flexible conduits from points to device complete in all respects as per drawings / specs.				
1	RJ-45 including I/O with face plate, back box & accessories complete in all respect.	Nos.	141		
2	Cat-6 UTP cable in 25mm dia pvc conduit from each outlet to Data rack in Ground Floor.	Nos.	141		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				
	SECTION - X: **SUPPLY, INSTALLATION, TESTING & COMMISSIONING** **EXHAUST AND VENTILATION FANS** **Make - Ref. List of approved Manufacturers**				
1	Centrifugal fan (FN-05) of Capacity and specification as mentioned in Specification sheet complete with Foundation and supports and commissioning, testing, cleaning ,Adjusting, Balancing, including with all consumable and accessories.	Nos	1		
2	Centrifugal fan (FN-05) ofCapacity and specification as mentioned in Specification sheet complete with Foundation and supports and commissioning, testing, cleaning,Adjusting,Balancing, including with all consumable and accessories.	Nos	1		
3	6" dia Disc Valve Similar to Model Tyrox Type LV complete with all supports and consumables and aceessories of any of brand as mentioned in approved list and as per specifications.	Nos	48		
4	Machine made duct work for Air Exhaust , complete with GI Duct sleeve & supports including with all d consumables and aceessories of any of brand as mentioned in approved list and as per specifications.	Sq.ft	1000		
5	Quadrant volume dampers (Clear Type) complete with all accessories of any of the brand as mentioned in approved manufacturer's list as per specification.	Sq.ft	20		
6	Butterfly dampers 6" (150mm) dia complete with all accessories of any of the brand as mentioned in approved manufacturer's list as per specification.	Nos	48		
7	Flexible duct 6" (150mm) dia complete with all accessories of any of the brand as mentioned in approved manufacturer's list as per specification.	RFT	29		
8	Flexible duct Connector complete with all accessories of any of the brand as mentioned in approved manufacturer's list as per specification.	LOT	2		
9	**Supply, Installation, testing and Commissioning of DC Inverter based Split units (Wall mounted) Air Conditioning Units, including unloading, Lifting, Placing and Supply , installation , testing and comissioning of the supporting arrangements for outdoor units in the external area with proper coating of paints to prevent rusting due enviroment conditions fixing as per site including Gas charging (if required) complete in all respect**				

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			A	B	C = B X A
a	1.0 TR - WALL MOUNTED UNIT	Nos	4		
10	**Supply and Installation of Gas & Liquid Copper Piping & Fittings, L type on site tested at 250 PSI, Complete with Closed Cell Foam insulation, and wrapping with fiber glass 16kg/m3 with jacketing control wiring in pvc conduit (Size and no. of cables as per vendor recomendation) between Indoor Units & Outdoor Unit, including supporting arragements as per site and all other related material for installation purpose complete in all respect as specified as per site requirement.**				
a	Ø 1/4" & Ø 1/2"	Rm	25		
11	**Supply, installation, Testing and commissioning of uPVC including all accessories as per site condition.**				
a	25mm dia uPVC conduit.	Rm	50		
	TOTAL AMOUNT OF NON - SCHEDULED BASED ITEM				

1. **Cement** _____

- Lucky Cement
- Falcon Cement
- DG Cement

or Equivalent

2. **STEEL** _____

- AMEERLI STEEL
- Agha Steel

Or Equivalent

3. **Paints** _____

- ICI
- BERGER

Or Equivalent

4. **TILES** _____

- Porcelain tile
- Ceramic tile

Or Equivalent

5. **WINDOW GLASS** _____

- Ghani Glass

Or Equivalent

6. **Aluminum Doors and windows** _____

- Pakistan cables

Or Equivalent

7. **Wooden Doors** _____

- Partal
- Deodar
- Timber

Or Equivalent

8. **IRON MONGERY OF DOORS / WINDOWS** _____

- Khas

Or Equivalent

9. **Water Proofing** _____

- Fospak
- BASF.

Or Equivalent

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1. **PVC CONDUITS & ACCESSORIES** _____

- Dadex.
- Civic
- jeddah

or Equivalent

2. **POWER AND GENERAL WIRING CABLES** _____

- Pakistan Cables.
- Pioneer Cables
- Fast Cables

Or Equivalent

3. **SWITCH, SOCKET & DIMMERS** _____

- Clipsal
- Orange Electric

Or Equivalent

4. **EARTHING MATERIAL** _____

- FURSE – UK
- ERICO – USA
- DEHN

Or Equivalent

5. **CABLE TRAYS / LADDER & ACCESSORIES** _____

- Ezzi Engineering.
- Electroline.

Or Equivalent

6. **INTERNAL & EXTERNAL LIGHTING FIXTURE / LAMPS & ACCESSORIES** _____

- Philips
- Pierlite
- EAE

Or Equivalent

7. **FIRE ALARM SYSTSEM** _____

- HoneyWell
- Schneider
- Zeta

Or Equivalent

8. **LV CIRCUIT BREAKERS** _____

- Schneider Electric – Europe
- Terasaki - Japan
- ABB – Germany

Or Equivalent

9. **SWITCHGEAR MANUFACTURER** _____

- HRA Switchgear
- Hussain & Co.
- A to Zee Engineering

Or Equivalent

10. **LV CABLE JOINTING / TERMINATION KITS** _____

- 3M Pakistan (Pvt.) Ltd.
- Raychem.

Or Equivalent

11. **DATA SYSTEM** _____

- 3M Pakistan
- Schneider

Or Equivalent

12. **MS BACK BOXES** _____

- Hussain & Co.
- Libra Engineering

Or Equivalent

13. **UN-INTERRUPTED POWER SUPPLY** _____

- Eaton
- APC Symmetra
- ABB

Or Equivalent

14. **PAINT** _____

- Berger
- ICI

Or Equivalent

15. **GATE VALVE, GLOBE VALVE, STRAINER, CHECK VALVE** _____

- Oven trop. KITZ (GERMANY, ITALY, JAPAN)
- Hattersley, KITZ (UK, ITALY, JAPAN)

16. **THERMOMETERS PRESSURE GAGES** _____

- Trerice
- Weksler
- Weiss

17. **CONCRETE FASTERNERS, SUPPORTS, ANCHORS ETC** _____

- Hilti

- Fischer

18. **MOTORS** _____

- Siemens
- Imported European

19. **FANS** _____

- Pak Fans
- GFC
- Royal Fan

20. **PIPING POLYPROPYLENE RANDOM** _____

- Dadex
- Pak – Arab

21. **G.I PIPE and Steel conduits** _____

- IIL
- Steelex

22. **Upvc PIPE** _____

- Dadex
- Pak – Arab

23. **FIBRE GLASS PIPE INSULATION** _____

- Ductmate – USA
  Or Equivalent

24. **CLOSED CELL FOAM INSULATION** _____

- Armaflex – USA
- Aeroflex – Thailand

25. **AIR DEVICES** _____

- Thermec
- Shan Industries
- Mehran
- Steel Craft

26. **PUMP CONTROLLER AND LEVEL INDICATOR** _____

- Johnson – USA / EUROPE
- Honeywell – USA / EUROPE
- Schneider – USA / EUROPE

27. **PUMPS** _____

- KSB - GERMANY
- Grundfos – GERMAY / DENMARK
- Lowara - ITALY

28. **HOT WATER STORAGE HEATER** _____

- Grand Impex

29. **FIXTURES** _____

- Toto – Japan

30. **FITTINGS** _____

- Zilver – Germany

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