NED UNIVERSITY
of Engineering & Technology
PROCUREMENT CELL

University Road, Karachi-75270. Tel: 9926 1261-68 Ext 2471 & 2291
Fax: 9926-1255 Email: ddff@neduet.edu.pk Web: www.neduet.edu.pk

NOTICE INVITING TENDER

No. PC/COS-106571/2605 Say NO to Corruption

Sealed Bids are invited from Reputable and Well Experienced Firms/Companies, having Category C-06 (if applicable) registration with Pakistan Engineering Council, Income Tax and Sindh Revenue Board to carry out the following Work:

EXTENSION OF COWASJEE MATERIAL TESTING LABORATORY AT NED MAIN CAMPUS

Estimated Cost	Tender Fee	Bid Security	Time of Completion
11.196 Million	Rs. 2,000/-	2%	6 Months

Tender Documents Issuance, Submission & Opening Schedule

To be issued from	To be sold up to	Submission up to	Opening
15.05.2017 8:30 am-1:00 pm	30.05.2017 8:30 am-1:00 pm	31.05.2017 10:00 am	31.05.2017 10:30 am

Venue: 2nd Floor, CCEE, Administration Bldg., Main Campus, NEDUET

TERMS & CONDITIONS:

a) Under the following Conditions, Bid can be rejected:
i) Conditional & Telegraphic Tenders
ii) Bids not accompanied by Bid Security of 2% of the Bid Price
iii) Bids received after Specified Date and Time
iv) Bids must be signed, stamped and stamped by the authorized person of the Firm/Company along with Authorization Letter
v) Black-Listed Firms/Companies

b) Bid Validity Period: **90 Days**

c) The NEDUET reserves the right to reject all or any Bid subject to the relevant provisions of Sindh Public Procurement Rules 2010 amended up to date.

d) Responsive Bidder is required to submit the following Documents with their Bid:
i) List of Similar Assignments with Cost (Mention Number of Projects with their Cost) undertaken over the Past 03 Years
ii) Detail of Equipment, Machinery & Transport owned by the Firm/Contractor
iii) Financial Statement (Summary) and Income Tax Returns for the Last 03 Years
iv) Affidavit that the Firm has never been Blacklisted
v) Copies of CNIC / Establishment of Firm / Company etc.
vi) Proof of Registration with Income Tax (NTN), SRB and PEC
vii) Integrity Pact Documents

Tender Documents can be obtained on any Working Day from the Office of ADP-II, Procurement Cell, NEDUET as per above schedule against payment of prescribed Tender Fee (Non-Refundable) in favour of Director Finance. Tender Documents can also be downloaded from SPPRA website **www.pprasindh.gov.pk** and the University website **www.neduet.edu.pk**

Director Procurement

NED UNIVERSITY
of Engineering & Technology
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www.pprasindh.gov.pk
www.neduet.edu.pk

DAWN: 12.05.2017 **HILAL –E- PAK: 12.05.2017**

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of Engineering & Technology
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شرائط و ضوابط:

www.pprasindh.gov.pk
www.neduet.edu.pk

JANG: 12.05.2017

Department of Procurement Cell

NED University of Engineering & Technology, Karachi - 75270

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
PROCUREMENT CELL
Tele # 99261261- 68, (Ext. 2291) Fax # 99261255, E-mail: ddff@neduet.edu.pk

"Say NO to Corruption"

Director Procurement

No. PC/NED/ COS-106571/2605

Dated: 11/05/2017

Notice Inviting Tender

Sealed bids are invited from reputable and well experienced firms/companies having Category C-06 (if applicable) registered with Pakistan Engineering Council, Income Tax and Sindh Revenue Board to carry out following works:

S#	Name of Work	Estimated Cost (Rs. in Million)	Bid Security	Tender Fee	Time of Completion
1.	Extension of Cowasjee Material Testing Laboratory at NED Main Campus	11.196	2%	2,000/-	Six Months

Issuance Date	To be sold	Submission uo to Date & time	Opening date & time	Venue
15-05-2017 8:30 to 1:00 p.m	30-05-2017 8:30 to 1:00 p.m	31-05-2017 10:00 a.m	31-05-2017 10:30 A.M	2nd Floor CCEE (Academy) Administrati Building at Main Campus,NEDUET.

TERMS & CONDITIONS:

(a) Under following conditions bid can be rejected

(i) Conditional and telegraphic bids/tenders.
(ii) Bids not accompanied by bid security of 2% of the Bid price.
(iii) Bids received after specified date and time.
(iv) Bid must be signed, named & stamped by the authorized person of the firm/companies along with authorized letter.
(v) Blacklisted firms/companies

(b) Bid validity Period:- (90) days

(c) The NEDUET reserves the right to reject all or any bids subject to the relevant provisions of Sindh Public Procurement Rules 2010 amended up-to-date.

(d) Responsive Bidder is required to submit following documents with their bid:

(i) List of similar assignments with cost (mention number of projects with their cost) under-taken over the past 03 years.
(ii) Details of equipment, machineries and transport Owned by firms/contractor.
(iii) Financial Statement (summary) and income tax return for the last 03 years.
(iv) Affidavit that firm has never been blacklisted.
(v) Copy of CNIC / Establishment of Firm/ Company etc.
(vi) Proof of Registration of NTN, SRB & PEC.
(vii) Integrity Pact Documents

Tender documents can be obtained on any working day from the office of ADP-II, Procurement Cell, NEDUET as per above schedule with prescribed tender fee (not refundable) in favour of Director Finance. Tender documents can also be downloaded from SPPRA website www.pprasindh.gov.pk and this University website www.neduet.edu.pk

11/05/2017

Director Procurement

NED UNIVERSITY
OF ENGINEERING & TECHNOLOGY– KARACHI

TENDER DOCUMENTS FOR

Extension of Cowasjee Material Testing Laboratory
@
NED Main Campus

VOLUME – I

LEGAL PART

Department of Earthquake Engineering
NED University of Engineering and Technology, Karachi-75270

TABLE OF CONTENTS

INVITATION TO BID

1. The office of Director services, NED University of Engineering and Technology Karachi invites sealed bids from interested bidders for furnishing the necessary labour, materials, equipment and services for the Construction, completion and maintenance of the work stated here under:

   WORKS:

   Extension of Cowasjee Material Testing Laboratory @ NED Main Campus

2. Interested bidders may obtain further information from, and inspect the bidding documents at, the office of:

   THE DIRECTOR SERVICES, NED UNIVERSITY ENGINEERING & TECHNOLOGY, KARACHI

3. A complete set of bidding documents may be purchased by any interested bidder on the submission of a written application to the above and upon payment of non-refundable fee of Rs.1500/- inform to pay order in the name of Director Finance NED University, Karachi/or in cash. Additional sets of documents may be purchased each at the same price.

4. The Tender Guarantee shall, at the bidder's option be in the form of pay order in favour of Director Services, NED University, from a schedule bank located in Pakistan at its Karachi Branch of not less than 2% of the total bid price in Pak Rupees and must be delivered to the :

   Director Procurement NED University of Engineering and Technology Karachi, together with the Bid.

5. The Bids will be received upto 11:00 AM on _____ at the following address: **The Office of Director Procurement, NED University of Engineering & Technology**, Karachi. The Bids shall be opened in the presence of those bidders's representatives who choose to attend at Block on the same day at the above address of Director Planning and Projects.

6. The Employer reserves the right to reject any or all Bids without assigning any reason thereof.

INSTRUCTIONS TO TENDER

INSTRUCTIONS TO TENDERERS

1. INTRODUCTION

1.1 The purpose of these Instructions is to provide the Tenderers with the necessary information and instructions to enable them to prepare and submit their Tenders in a coordinated manner and to establish the procedure to be followed up to the time when the Contract is awarded.

1.2 Any Tender which does not conform with these Instructions to Tenderers may be rejected.

2. TENDER DOCUMENTS

2.1 The following documents have been prepared for tendering purposes and must be used by the Tenderer when submitting his Tender.

(i) Instructions to Tenderers
(ii) Form of Tender
(iii) Conditions of Contract
(iv) Technical Specification
(v) Bills of Quantities with Summary of Cost
(vi) Model Forms
(vii) Drawings

2.2 Tenderers are also deemed to be in possession of all Standards, Specifications, Codes of Practice and such like documents, published by national and international authorities, which are referred to in the tender documents and which are necessary to be examined in the preparation and submission of the Tender.

3. CONFIDENTIALLY

3.1 All Tenderers and others recipients of the Tender Documents (whether or not they submit a Tender) shall treat all details of the documents as Private and Confidential and shall not disclose nor release the information contained therein for any other use or purpose than that intended.

3.2 The Tender Documents shall remain the property of the Employer and all unused Tender Documents shall be returned to the Employer.

3.3 Tender Documents are not transferable.

4. RESPONSIBILITY OF TENDERERS

4.1 Each Tenderer shall inspect and examine the site surroundings and shall satisfy himself before submitting his Tender as to the nature of the ground, the hydrological and climatological conditions, the form and nature of the Site, the quantities and nature of the Work and materials T & P shuttering & type of skilled/unskilled labour necessary for the completion of the Works, and the means of access to the Site. It will be his responsibility of arranging water, material, electricity etc., and the space accommodation he may require, laws, byelaws and regulation, and in general, shall himself obtain all necessary information as to risks safety, contingencies and other circumstances which may influence or affect his Tender.

4.2 Any neglect or failure on the part of the Tenderer on this account to obtain all relevant information for uninterrupted execution of work shall not be considered a reason for extension of time escalation/compensation or for additional payments in accordance with the responsibility of completing and handing over the Works as required.

4.3 The Tenderer shall be entirely responsible for the cost of tendering. The Employer shall not be responsible for, nor shall pay for any loss damage, cost or expense which may be incurred by any Tenderer.

5. CLARIFICATIONS DURING THE TENDER PREPARATION PERIOD

5.1 Should there by any doubt or obscurity as to the meaning of the Tender Documents or as to anything to be done or not to be done under Contract, the Tenderer must describe in writing such doubts or obscurity and deliver the same to the Engineer.

5.2 A formal circular letter will be issued if necessary to all Tenderer amending or explaining the Tender Documents.

5.3 Such Circular Letter (s) shall have the status of documents provided for the purpose of tendering.

TENDER PREPARATION

6. COMPLETION OF THE FORMS PROVIDED

6.1 Tenderers shall fill in the blank spaces in the tender documents provided for the purpose of tendering as follows:

- Form of Tender

- The Bill of Quantities

- The Summary of Cost

6.2 Tenderers shall enter their quotations for undertaking the works under this contract in the Bill of Quantities. The Bill of Quantities shall be filled out completely with all rates and amounts to be expressed in Pakistan Rupees.

The payment to be made to the Contractor shall be for the actual quantities of each item executed. The tender should enter the rates in figure as well as in words against each item in BOQ.

6.3 The Tenderer shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the Works and of the rates and prices stated in the priced Bills of Quantities which Tender rates and prices shall, except in so far as it is otherwise provided in the Documents, cover all his obligations under the Contract and all matters and things necessary for the proper execution, completion and maintenance of the Works.

7. DOCUMENTS TO BE SUBMITTED WITH THE TENDER

7.1 Authority (Power of Attorney or a copy thereof) of the signatory authorized to sign the Tender and the Contract.

7.2 An organization chart of the minimum supervisory staff which the tenderer proposes to employ showing distribution of work for each member of staff.

7.3 A list with complete description of make, motive power and capacity of all major items of constructional plant and equipment suitable and sufficient to meet the requirements of this Contract.

7.4 A tentative construction programme from commencement of mobilization to completion, adequately showing the sequence of operations and the time estimated for the performance of each phase of work.

7.5 Tender Guarantee/Earnest Money

In order to be considered, Tenders must be accompanied by a Tender Guarantee in the form of a draft or Deposit at Call or pay order in the name of Project Director, NED University of Engineering & Technology, Karachi in the amount stated in the Tender at 2% of the amount put to Tender. The Tender Guarantee shall remain valid for not less than the period stated in Page T-1 following the date for opening of Tenders.

The Tender Guarantee of unsuccessful Tenderers will be returned by the Project Director upon award of the Contract. The Tender Guarantee of the successful Tenderer upon execution of the Contract Agreement covering this Work will be adjusted against the Security Deposit/Retention money payable by him from his monthly payments for the work done by him. Should the successful Tenderer refuse or fail for any reason to enter into the Contract his Tender Guarantee shall be forfeited and the amount retained by the Employer as compensation for such default. The amount of this Tender Guarantee shall not be less than 2% (two percent) of the amount put to tender.

7.6 Tenders which are not accompanied by the above said documents providing the information requested will not be considered.

7.7 Tenderers will endeavor to abide, as a possible, by the conditions of this Contract and avoid introducing new conditions on their part. However in case it is not possible for the tenderers to avoid new conditions then they must quote, in their tenders, the total evaluated price (in rupees) for each of their new condition and this total price shall be added (in the form of a separate appendix to be prepared by the tenderer) to and counted towards the total Tender price which total price shall form the basis of comparison and evaluation of tenders without prejudice to any of the condition of the Contract laid herein. Any New Condition for which the evaluated price is not given in the tender shall be deemed free of financial implications & the employer reserves the right to reject the conditional Tender.

8. LANGUAGE OF THE TENDER

8.1 All entries in the Tender are to be made in the English language.

9. CURRENCY OF THE TENDER

9.1 All prices, rates, cost information shall be given in Pakistani rupees.

10. UNAUTHORISED ALTERATION OF TENDER DOCUMENTS

10.1 No unauthorized alteration shall be made to the Tender Documents.

10.2 The only permitted changes, to the Tender Documents will be notified by circular letters issued in accordance with the procedure described in paragraph of these instructions.

SUBMISSION OF TENDER

11. DATE AND PLACE OF SUBMISSION

11.1 The Tender and supporting documents shall be delivered to the Engineer in the office of the Project Director not later than the time and day stated in the Notice of invitation to tender or as may have been amended by a circular letter to Tenderers.

11.2 Tender submissions may be made earlier than the stated date in which case they shall be kept safe and unopened by the Engineer.

12. COPIES OF DOCUMENTS

12.1 The Tenderer may make and retain copy of all the documents making up his Tender submission or additional copies of the Tender Documents may be had no payment.

13. SIGNATURE ON TENDER DOCUMENTS

13.1 The Form of Tender and the Bill of Quantities must be signed with date by the Principal duly authorized to represent and bind the Tenderer with date.

13.2 All drawings and documents submitted are to be endorsed by the Tenderer with his official seal or stamp on each page.

13.3 Tenderers shall also sign all corrections, interpolations and over-writings in the forms, Schedule of Quantities, and Specifications etc. in words & figures as the case may be before submitting the Tender.

13.4 Tenderers shall indicate in the space provided in the Tender their full name and proper address at which notices may be legally served on them and to which all correspondence in connection with this Tender and the Contract is to be sent.

14. WRAPPING AND LABELLING SUBMISSION

14.1 All the documentation shall be placed in plain sealed (s) bearing the names of the Work.

The interior of the sealed packet must not reveal the identity of the Tender.

14.2 If the Tender submission comprises more than one package, each package shall be marked with a package number and indicate the total number of packages, e.g. Package No.2 or 3.

POST TENDERING MATTERS

15. TENDER RECEIPT

15.1 The Engineer will accept Tenders up to the last date and time set for receiving tenders.

15.2 It is the Tenderer's responsibility to ensure that his Tender is received in time.

15.3 Any tender which has not been received by the due time and date shall not be considered.

16. TENDER OPENING

16.1 Tenders will be opened in the presence of the Tenderers or their representatives who may care to attend. The total Tender sum alongwith, the amount due to new conditions if any shall be announced.

17. TENDER APPRAISAL

17.1 Tenders will be checked to see that they are complete, in accordance with the Instructions to Tenderers.

17.2 Tenders will be checked for accuracy in computation. Any errors of whatever kind may be corrected by the Project Director or their appointed representative and the Tender price Sum amended accordingly. Errors in multiplying the exhibited total cost with the premium quoted by the Contractor shall be adjusted by regarding the premium as correct. Any adjustment made in a Tender shall be made known to the Tenderer before acceptance of the Tender.

17.3 Tenderers may be called to explain all or part of their Tender should the Project Director or their appointed representative requires it. These explanations may be called for in writing or by the Tenderer attending meetings with the Project Director or their appointed representative.

18. ACCEPTANCE OF TENDER

18.1 The successful Tenderer will be required to enter into and execute an Agreement in the form appended herewith together with any modifications, additions or deletions therein as may be required to suite the circumstances.

18.2 Written acceptance of the Tender shall constitute a contractual relationship between the parties until such time as the formal agreement is signed.

TENDER AND APPENDICES

FORM OF TENDER

NAME OF WORK:

Note: Tenderers are required to fill up the blank spaces in this Tender Form and the Summary of Cost.

To: **THE DIRECTOR SERVICES NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI**

Dear Sir,
Having examined the Instructions to Tenderers, Drawings, Conditions, Quantities and Rates for the construction of the above named Works, we, the undersigned, offer to construct, complete and maintain the whole of the said Works in conformity with the said Drawings, Conditions of Contract, Specification and Bills of Quantities for the Tender Price of Rs._____ (Rupees _____) or such other sum as may be ascertained in accordance with the said Conditions.

2. We undertake if our Tender is accepted to commence the Work(s) within 14 days of receipt of the order to commence, and to complete and deliver the Works comprised in the Contract within the times specified in Appendix A to the Tender from the date of receipt of the order to commence.

3. We understand that in case we fail to commence the Works within 14 days of receipt of the order to commence, or should we refuse to sign the Agreement with the Employer the whole of the Tender Guarantee (Earnest Money) shall be forfeited.

4. We agree to abide by this Tender for a period of ninety (90) days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before expiration of that period, and agree to absolutely forfeit full value of the Tender Guarantee/Earnest Money to the Employer without prejudice to any other rights or remedies of the Employer should we withdraw or modify the Tender before the expiration of the said period of ninety (90) days.

5. Till a format Agreement is prepared and executed, this Tender together with written acceptance thereof shall constitute a binding Contract between us.

6. We understand that you are not bound to accept the lowest or any Tender you may receive and that you will not defray any expense incurred by us in Tendering.

7. We agree and accept that the full value of the Tender Guarantee/Earnest Money shall be retained by the Employer on account of Retention Money.

8. We shall pay liquidated damages as compensation for delay and agree to Retention Money/Security deposit, being adjusted.

9. As security for the due performance of the undertakings and obligations of this Tender we submit herewith Deposit-at-call/Bank Draft No._____ dated _____ obtained in your favour or made payable to from (Bank) _____ in the amount of Rs._____ (Rupees)

_____ being not less than 2% of the tendered cost of the whole of the works.

10. We understand that the Bills of Quantities with Summary of Cost attached hereto form part of the Tender.

11. We acknowledge receipt of the following circular letter/Addenda & Corrigenda, (if any).

Reference Number	Date
(1) _____	_____
(2) _____	_____
(3) _____	_____

and confirm we have taken account thereof in the Tender.

* **SIGNATURE OF TENDER** _____

In the Capacity of _____

Date _____

** Duly authorized to sign tenders
for and on behalf of _____

Registered address of
firm or Company _____

Date _____

Signature of Witness (1)_____ (2)_____

Address of Witness (1)_____ (2)_____

Occupation of Witness (1)_____ (2)_____

* To be completed by Tenderer.

** In the case of Limited Company, insert the name of the Company.

In the case of a Partnership or Un-incorporated body the names of all the Partners must be inserted.

_____

APPENDIX A TO TENDER

For ease of reference, certain information and special stipulations applicable to the Contract which is the subject of this Tender are set forth herein. Where the stipulation or information has not been given but rather a space has been provided therefore, required information shall be entered by the Tenderer.

Item		**Reference**	**Particular** **Contractual Requirement**
1.	Amount of Tender Guarantee in the form of Bank Draft or Bank's pay Order or Deposit at Call.	Clause 9 Page IT-02	Rs. (Minimum 2% of the Tender Price Sum)
2.	Performance Security	Clause 7 Page GC-04	Surety Bond for an amount equal to 05% of Contract Value in shape of Pay Order
3.	Period of Commencement from date of receipt of order to commence	Clause 2 Page IT-01	14 days
4.	Time for Completion from date of receipt of order to commence.	Clause 2 Page IT-01	06 Moths
5.	Amount of Compensation for Delay	Clause 43 Page GC-13	0.1% of Contract Value per day for every day that the works remain uncommenced or unfinished after the due dates subject to a maximum 10% of the said Value.
6.	Period of Maintenance	Clause 48(1) Page GC-014	12 Months (from the date of completion of work)
7.	Percentage of Security Deposit/Rotation money	Clause 58 Page GC-017	Five percent (5%)
8.	Validity of Tender	Clause 4 Page IT-01	90 (ninety) days
9.	Mobilization Advance	Clause 53 Page GC-016	10% (Ten percent) of the contract Value to be recovered fro each payment invoice at the rate of not less than 10% of the invoice with interest chargeable at rate of 10% per annum for the intervening period against the bank guarantee.

_____

Signature of Contractor

CONDITIONS OF CONTRACT

CONDITIONS OF CONTENTS

CONDITIONS OF CONTRACT

1. GENERAL

"The Conditions of Contract shall be the General Conditions of Contract", "Additional Conditions of Contract" as modified by the "Conditions of Particular Application" as are set out below.

2. GENERAL CONDITIONS OF CONTRACT

The "General Conditions of Contract" shall be as set out at pages GC-1 to GC-22.

3. ADDITIONAL CONDITIONS OF CONTRACT

The "Additional Conditions of Contract" shall be as set out at pages AD-01 to AD-03.

B – GENERAL CONDITIONS OF CONTRACT

(1) EFINITIONS AND INTERPRETATION

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

(a) "Employer" means NED University of Engineering & Technology, Karachi.

(b) "Project Director" The Project Director means the person appointed by the University to execute this contract.

(c) "Contractor" means the person or persons firm or company whose tender has been accepted by the Employer and includes the Contractor's personal representatives, successors and permitted assigns.

(d) "Consultants" means any Firm or person for the time being or from time to time duly appointed in writing by the Employer for the purpose of this Contract.

(e) "Engineer" means the Representative of Project Director the person for the time being or from time to time appointed by the Employer for the purpose of this Contract.

(f) "Agent" means the person for the time being or from time to time appointed by the Contractor to perform duties as set-forth in this Contract.

(g) "Works" or "Permanent Works" means the works to be executed in accordance with the Contract.

(h) "Contract" means the Conditions of Contract Specifications, Drawings priced bills of Quantities, Instructions to Tenderers. Tender with Appendix, Contract Agreement, Performance Bond and any other agreed correspondence.

(i) "Contract Value" means the sum named in the Letter of Acceptance of the Tender.

(j) The work "cost" shall be deemed to include overhead costs whether on or off the Site.

(k) "Contract price" means the Contract Value subject to such additions thereto or deductions there from as may be made under the provision hereinafter contained.

(l) "Constructional Plant" means all appliances or things of whatsoever nature required in or about the execution completion of maintenance of the Works or Temporary Works (as herein defined) but does not include materials or other things intended to form or forming part of the permanent works.

(m) "Temporary Works" means all temporary works of every kind required in or about the execution completion or maintenance of the Works.

(n) "Drawings" means the drawings referred to in the Specification and any modification of such drawings approved in writing by the Engineer/Consultant and such drawings

as may from time to time be furnished or approved in writing by the Engineer/Consultant.

(p) "Specification" means the specification referred to in the Tender and any modification thereof as may from time to time be furnished or approved in writing by the Engineer/Consultant.

(q) "Letter of Acceptance" means a letter from the Employer/Project Director accepting the final offer of the Contractor.

(r) "Site" means the land and other places on, under, in or through which the Permanent Works or Temporary Works are to be executed and any other lands and places provided by the Employer for working space or any other purpose as may be specifically designated in the Contract as forming part of the Site.

(s) "Tender Date" means the date by which Tenders are required to be delivered.

(t) "Nominated sub-Contractor" means any person, Firm or Company nominated by the Employer to carry out specific section of the work under the direction, supervision and control of the Contractor.

(u) "Sub-contractor" means the person or persons firm or company to whom the part of the works is sub-let with the prior consent of the Engineer. Provision of labour on piece work basis shall not be deemed to be sub-letting.

(v) "Suspension Order" has the meaning assigned in Clause 39 hereof.

(w) "Certificate of Completion" means a certificate given pursuant to the provisions of Clause 45 hereof.

(x) "Period of Maintenance" has the meaning assigned in Clause 49 hereof.

(y) "Orders for Variation" means an order made pursuant to the provisions of Clause 50 hereof.

(z) "Month" means calendar month according to the Gregorian Calendar.

(aa) "Person" includes a corporation.

(bb) "Programme of Works" means the programme of works submitted by the Contractor and approved by the Engineer/Consultant pursuant to clause 14 hereof including any amendments thereto from time to time approved by the Engineer/Consultant.

(cc) "Security Deposit" means the sums retained pursuant to Clause 58 hereof

(dd) "Approved" means approved in writing including subsequent written confirmation of previous oral approval and "approval" means approval in writing including such written confirmation.

(ee) The masculine includes the feminine and vice versa.

1.2 "Singular and Plural" Words importing the singular only also include the plural and vice versa where the context requires.

1.3 "Marginal Headings or Notes" The marginal headings or notes in these Conditions shall not be deemed to be part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.

(2) PROJECT DIRECTOR AND ENGINEER

2.1 "Duties and Powers of Engineer" The Engineer is responsible to the Project Director and his duties are to watch and input the works under top supervision by the Consultant and to test and examine at the expense of Contractor any material to be used or workmanship employed in connection with the works. He shall have full Technical and financial control over the Contract/Contractor and shall have authority to relieve the Contractor of any of his duties, liabilities or obligations under the Contract.

2.2 "The Project Director, NED University of Engineering & Technology, Karachi shall carry out such duties in issuing decisions, certificates and order as are specified in the contract.

2.3 "Delegation of Powers to Engineer" The Project Director may, from time to time, in writing, delegate to the Engineer any additional powers out of the Powers and authorities vested in the Project Director and shall furnish to the Contractor a copy of all such written delegations of powers and authorities. Any written instructions or approval given by the Engineer to the Contractor within the terms of such delegation (but not otherwise) shall be binding on the Contractor and the Project Director to the same extent as if it had been given by the Project Director.

Provided always as follows:

(a) Failure of the Engineer to disapprove any work or materials shall not prejudice the power of the Project Director thereafter to disapprove such work or materials and to order the pulling down, removal or breaking up thereof at the cost of the Contractor.

(b) If the Contractor is not satisfied by reason of any decision of the Engineer he shall be entitled to refer the matter to the Project Director who shall thereupon confirm reverse or vary such decision.

EXTENT OF CONTRACT

3. "Extent of Contract" The Contract comprises the construction, completion and maintenance of the works, and except insofar as the contract otherwise provides, the provision of all labour, materials, constructional plant, temporary works and every thing whether of temporary or permanent nature required in and for such construction, completion and maintenance so far as the necessity for providing the same is specified in or can reasonably be inferred from the Contract.

CONTRACT DOCUMENT

4. "Documents Mutually Explanatory" The several documents forming the Contract are to be taken as mutually explanatory of one another and in case ambiguities or discrepancies the same shall be explained and adjusted by the Project Director whose decision in this respect shall be final and binding on the Contractor.

5. (1) "Custody of Drawings" The Drawings shall remain in the sole custody of the Engineer but two copies thereof shall be furnished to the Contractor free of

cost. The Contractor shall provide and make at his own expense any further copies required by him.

(2) The Contractor shall give adequate notice in writing to the Engineer/Consultant of any further Drawing or specifications that may be required for the execution of the works or otherwise under the Contract.

(3) "One copy of Drawings to be kept on Site" One copy of the drawings furnished to the Contractor as aforesaid shall be kept by the Contractor on the Site and the same shall at all reasonable times be available for inspection and use by the Engineer and Consultant of works and by any person authorized by the Engineer in writing.

6. "Further Drawings and Instruction" The Engineer/Consultant shall have full power and authority to supply to the Contractor from time to time during the progress of the Works such further drawings and instructions as shall be necessary for the purpose of the proper and adequate execution and maintenance of the Works and the Contractor shall carry out and be bound by the same.

GENERAL OBLIGATIONS

7. "Performance Security" The Contractor shall deposit with the Employer a Performance Bond, in a shape of Pay Order, at the time of signing of Agreement for an amount equal to 05% (five percent) of the accepted tender price, as per accompanying Model Form together with any modifications, additions or deletions as the Employer may consider necessary. The Performance Security must be made by way of an unconditional undertaking from the Contractor to deposit the said sum upon demand in writing by the Employer which shall be unconditionally guaranteed by the Surety to the Bond. No interest will be paid in respect thereof by the Employer and any cost in obtaining such a Bond shall be at the expense of the Contractor in all respects. In case the contractor does not deposit the said performance security, the Commissioner shall be entitled to deduct and retain an equal amount from the money due to the Contractor.

The Performance Bond shall always be maintained at the amount stipulated and will be held by the Employer on the conditions and subject to the stipulations hereinafter contained as a pecuniary guarantee for the due execution and proper performance of the Contract and the recovery "Protanto" of any penalties or damages or other sums for which the Contractor may become liable to the Employer may at any time recover from the amount of the Performance Bond any sums (for which the Contractor shall become liable to Employer) which are not promptly paid by him, without any previous notice to the contractor or observance of any legal or other formality. The Employer shall be entitled to the immediate payment by the Surety of the whole of the amount guaranteed without being bound to give any evidence whatsoever to the Surety that the same or any part thereof is due. The Performance Bond shall be maintained by the Contractor at the full stipulated amount uptill the successful completion of the Works.

8. "Removal of Employees, workmen & foreman" The Engineer/Consultant shall have full powers at all times to object to the employment of any workmen, foreman or other employee on the works by the Contractor, and if the Contractor shall receive notice in writing from the Engineer requesting the removal of any such man or men from the works, the Contractor shall comply with the request forthwith.

No such workman, foreman or other employee after his removal from the works by request of the Engineer shall be re-employed or re-instated on the works by the Contractor at any time, except with the previous approval in writing of the Engineer.

The Contractor shall not be entitled to demand the reason from the Engineer for requiring the removal of any such workman, foreman or other employee.

9. "Contractor liable for damage done and imperfections for 12 months after certificate" If the Contractor or his work-people or servants shall break, deface, injure or destroy any part of a building in which they may be working or any building, road, fence, enclosure, or grass land, or cultivated ground contiguous to the premises on which the work or any part of it is being executed, or if any damage shall happen to the work while in progress, from any cause whatever, or any imperfections become apparent in it within twelve months after a certificate final or other of its completion shall have been given by the Engineer as aforesaid, the Contractor shall make good the same at his own expense; or in default, the Engineer may cause the same to be made good by other workmen and deduct the expense (of which the Certificate of the Engineer shall be final) from any sums that may be then or at any one time thereafter may become due to the Contractor or from his security deposit.

10. (1) "Care of Works" From the commencement to the completion of the Works the Contractor shall take full responsibility for the care thereof and of all Temporary Works and in case any damage loss or injury shall happen to the Works or to any Temporary Works from any cause whatsoever (save and except the excepted risks as defined in sub-clause (2) of this clause) shall at his own cost repair and make good the same so that at completion, the Works shall be in good order and condition and in conformity in every respect with the requirements of the Contract and the Engineer's instructions. In the event of any such damage loss or injury happening from any of the excepted risks the Contractor shall if and only to the extent require by the Employer make good the same as aforesaid at the cost of the Employer. The Contractor shall also be liable for any damage the Works occasioned by him in the course of any operations carried out by him for the purpose of complying with his obligations under Clause 47 hereof.

(2) The "excepted risks" are war hostilities (whether war be declared or not) invasion act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war or (otherwise than among the Contractor's own employees) riot, commotion or disorder or any such operation of the forces of nature as reasonable foresight and ability on the part of the Contractor could not foresee or reasonably be provided against or use or occupation by the Employer of any portion of the works in respect of which a Certificate of Completion has been issued or a cause solely due to the Consultant's design of the Works all of which are herein collectively referred to as the Excepted Risks.

11. (1) "Damages to Persons and Property" The Contractor shall indemnify and keep indemnified the Employer against all losses and claims for injuries or damage to any person or any property whatsoever (other than surface or other damage to land being or crops being on the site suffered by tenants of occupiers) which may arise out of or in consequence of the construction and maintenance of the Works and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto. Provided always that nothing herein contained shall be deemed to render the Contractor liable for or in respect of or to indemnify the Employer against any compensation or damages for or with respect to:

(a) The permanent use or occupation of land by the Works or any part thereof or (save as hereinafter provided) surface or other damage as aforesaid.

(b) The right the Employer to construct the Works or any part thereof on, over, under, in or through any land.

(c) Interference whether temporary or permanent with any right of light, air way or water or other casement or quasi-easement which is the unavoidable result of the construction of the Works in accordance with the Contract.

(d) Injuries or damage to persons or property resulting from any act or neglect done or committed during the currency of the Contract of the Employer his agents, servants or other contractors (not being employed by the Contractor) or for or in respect of any claims, demands, proceedings, damages, costs, charges and expenses, in respect thereof or in relation thereto. Provided further that for the purposes of this clause expression "the Site" shall be deemed to be limited to the area defined in the specification or shown on the drawings in which land and crops will be disturbed or damaged as an inevitable consequence of the carrying out of the Works.

12. "Accident or Injury to Workmen". The Employeer shall not be liable for or in respect of any damages or compensation payable at law in respect or person in the employment of the Contractor or any sub-contractor save and except an accident or injury resulting from any act or default of the Employer his agents or servants and the Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation (save and except as aforesaid) and against all claims, demands, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

13. "Contractor liable for payment of compensation to injured workmen or, in case of death, to his relative". In every case in which by virtue of the provision of Section 12, sub-section (1) of the Workmen's compensation Act, 1923 or any other law for the time being in force the Employer is obliged to pay compensation to an employee of the Contractor in execution of the Works, the Employer will recover from the Contractor the amount of the compensation so paid and without prejudice to the rights of the Employer under Section 12, sub-section (2) of the said Act, the Employer shall be at liberty to recover such amount or any part thereof by deducing it from the security deposit or from any sum due by the Employer to the Contractor whether under this contract or otherwise.

The Employer shall not be bound to contest any claim made against him under Section 12, sub-section (1) of the said Act or any other law for the time being in force except on the written request of the Contractor and upon his giving to Employer full

security for all costs for which the Employer might become liable in consequence of contesting such claim.

14. "Report Accidents". The Contractor shall, within 24 (twenty four) hours of the occurrence of any accident at or about the site or in connection with the execution of the works, report such accidents to the Employer. The reporting of any accident by the Contractor will not absolve him of any of his responsibilities as provided in the Contract. The Contractor shall also report such accidents to all the concerned authorities wherever such report is required by law for the time being in force.

15. "Giving of Notices and Payment of Fees". The Contractor shall give all notices and at his own costs pay all fees required to be given or paid by any National or State Statute Ordinance or other Law or any Regulation or By-Law of any local or other duly constituted authority in relation to the execution of the public bodies and companies whose property or rights are affected or may be affected in anyway by the Works or any temporary Works.

16. "Patent Rights and Royalties". The Contractor shall save harmless and indemnify the Employer form and against all claims and proceedings for or on account of infringement of any patent rights, design, trade mark or name or other protected rights in respect or any constructional plant, machine, work or material used for or in connection with the works, temporary works, or any of them and against all claims, demands, proceedings, damages costs, charges and expenses whatsoever in respect thereof or in relation thereto. Except where otherwise specified, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation if any, for getting from outside the Employer's land/area stone, sand, gravel, clay or other materials

17. "Surveying Instruments". The Contractor shall maintain at his own cost in his office at site all necessary surveying instruments in perfect working condition to enable the Engineer/Consultant to check levels and lines of works. The Contractor shall also construct and preserve accurate setting out stations and bench marks so that the lines and levels may easily be checked. In case of failure of the Contractor to supply surveying instruments, the Engineer may supply the same and deduct charges (of the amount of which Engineer's decision shall be final) from any payments due to the Contractor.

18. "Setting Out". The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the position, levels, dimensions and alignments of all parts of the works and for the provision of all necessary labour in connection therewith. If at any time during the progress of the works any error shall appear or arise in the position, levels, dimensions or alignment of 4^{th} part of the works, the Contractor on being required, to at his own expenses, rectify such error to the satisfaction of the Engineer/Consultant.

    The checking of any setting out at line or level by the Engineer/Consultant shall not in any way relieve the Contractor of his responsibility for the correction thereof and the Contractor shall erect and carefully protect and preserve all bench-marks, the rails, pegs and other things used in setting out of works.

19. "Contractor not entitled to extra Payment." Except as otherwise specifically provided in the Contract, the Contractor shall not be entitled to any extra or additional payment for any reason whatsoever and in particular and without prejudice to the generality of foregoing provision the Contractor shall not be entitled to any extra or additional

payment nor to resile from the Contractor nor to be relieved from any of his obligations/liabilities thereunder for any or all of the following reasons, namely:

i) That there has been any misunderstanding or misapprehension by the Contractor in respect of any matter, or

ii) That any incorrect information was given to the Contractor by any person whether in the employment of or representing the Employer or not; or

iii) That the Contractor failed or was unable to obtain or was prevented from obtaining correct information, or

iv) That the Contractor did not or could not foresee any matter which may in fact affect or has affected the execution or maintenance of the works.

20. "Sums payable by way of compensation to be considered as reasonable compensation without reference to actual loss". All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the use of the Employer without reference to the actual loss or damage sustained and whether or not any damage shall have sustained.

21. "Deduction of Amounts due to Employer or any amount" whatsoever to be permissible from sum payable to Contractor". Any excess payment made to the Contractor inadvertently or otherwise under this contract or on any account whatever and any other sum found to be due to the Employer by the Contractor in respect of this contract or any other contract or work-order or on any account whatever may be deducted from any sum whatsoever payable by the Employer to the Contractor either in respect of this contract, any work order or contract or on any other account.

22. "Change in Constitution". In the case of a tender by partners any chance in the constitution of the firm shall be forthwith notified by the Contractor to the Employer for his information.

23. "Work to be done under direction of the Project Director". All works to be executed under the Contractor shall be executed under the direction and subject to the approval in all respect of the Project Director/Engineer who shall be entitled to direct at what point or points and in what manner they are to be commenced and from time to time carried on.

24. "Action where no Specification". In the case of any class of work for which there is no Specification in the Contract, such work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer/Consultant.

25. "Depositing of Material not to cause inconvenience". The Contractor shall not deposit any material on any site which will be inconvenient to the Employer or Public. The Engineer/Consultant may require the Contractor to remove any material which is considered by him to be a source of danger or inconvenience to the Employer or Public, or cause them to be removed at the Contractor's cost.

26. "Description of work-item is brief". The nature of work as to be carried out is given in brief in the nomenclature/description of the items in the Bill of Quantities. But for all purposes the drawings and Specifications together with any instructions of the Engineer/Consultant fully describe the work to be carried out.

27. "Inspection of Site by Contractors". The Contractor should inspect the site of work and acquaint themselves with the nature and requirements of the work, facilities of access for materials, removal of rubbish, cost of carriage, nature of strata and obtain all other necessary information etc., before submitting their tenders.

28. "Approach Roads etc." The Contractors may have to make temporary approach roads etc. at their own cost to facilitate carriage of materials, such approach roads shall be aligned in a manner approved by the Project Director/Consultant.

29. "Rates inclusive of all Taxes etc." All rates unless otherwise specified include the cost of the following and any fluctuation thereof Royalty, Malkana, Octroi, terminal tax, sales tax, super tax, customs and excise duty, emergency tax, water tax and any other tolls, taxes and levies imposed by Central or Provincial Governments and Local Authorities.

30. "Detailed programme to be submitted". The Contractor shall within ten days of the acceptance of his tender submit to the Engineer a confirmed detailed programme of construction incorporating the priority of completion of different parts of works, showing the order of procedure and methods in which he proposes to carry out the works and period of time estimated for performing each phase of the work. The Contractor shall furnish in writing such further information concerning his arrangements for carrying out the works and of the constructional plant or temporary works he intends to supply or use for construction work the Engineer/Consultant may from time to time require. The submission to or approval by the Engineer of such programme or such particulars or information shall not relieve the Contractor of any of his duties, responsibilities or obligation under the Contract. The Contractor shall modify his programme as desired by the Engineer and resubmit the programme after modifications for approval. If at any time it should appear to the engineer that the actual progress of the Works does not conform to the approved programme, the Contractor shall produce, at the request of the Engineer, a revised programme showing the modifications to the approved programme necessary to ensure completion of the Works within the time for completion stipulated in the Tender.

31. "Site Clearance on Completion". On completion of the work or earlier as directed by the Engineer/Consultant, the Contractor shall remove all temporary structure (Godown, Site Office, etc) erected by him at the site of work. He shall fill all tanks dug out by him at site, removal all debris and other materials like surplus sand, stone ballast, rubbish etc. and in short, shall leave the site in a neat and tidy condition.

32. **LAOBUR**

32.1 No female labour and 'Cad' labour shall be employed for the construction, completion and maintenance of the Works.

32.2 No below the permissible age as per the relevant laws shall be employed on the work.

32.3 The Contractor shall pay his laborers not less than the wages paid for similar/compareable work in the neighborhood or the relevant minimum wages fixed by the Government for such purpose.

32.4 Contractor shall also comply with the rules and regulations framed by the Government or instructions issued from time to time for the protection of health and maintenance of necessary sanitary arrangements for his labour, periodical medical check up as required by law shall also be arranged by the Contractor in respect of his employees.

32.5 The Employer shall have the right to have the relevant labour laws and regulations framed by the Government implemented by the Contractor including making well any loss suffered by a worker or workers on account of non-observance of such labour regulations on the part of the Contractor.

32.6 Workers, employees and staff engaged by the Contractor for the performance of his duties under the contract shall remain the servants of the Contractor and the Contractor shall alone be the defacto and dejure employer of such all persons for all intents and purposes. They shall be treated as employees employed by the Contractor but not through the Contractor. They shall not take the relationship of master and servant with the Employer.

32.7 Provisions of clause 32 together with its sub-clauses 32(1) to 32(6) shall apply to all labour/employees whether in the direct employment of the Contractor or his sub-contractor and to all classes of labour engaged for the executions of work under the Contract.

33. "Labour Returns". The Contractor shall, if so required by the Engineer/ Consultant deliver to his office a return in detail in such form and at such intervals as the Engineer/Consultant may prescribe showing the number of all the classes of labour from time to time employed by the Contractor on the site and such information respecting constructional plant and equipment as the Engineer/Consultant may require.

34. **WORK MATERIALS AND PLANT**

34.1 "Quality of Materials and Workmanship and Tests". All materials and workmanship shall be of the respective kinds described in the Contract and in accordance wit the Engineer/Consultant and shall subject from time to time to such test as the Engineer/Consultant may direct the place of manufacture or fabrication or on the Site or at all or any of such places. The Contractor shall provide such assistance instruments machines labours and materials as are normally required for examining measuring and testing any work and the quality weight or quantity of any material used and shall supply samples of materials before incorporation in the Works for testing as may be selected and required by the Engineer/Consultant.

34.2 "(1) Cost of Samples". Al samples shall be supplied by the Contractor at his own cost.

34.3 "Cost of Test". The cost of making any test or tests upon samples or materials supplied or items manufactured by the Contractor shall be borne by the Contractor.

34.4 "Cost of Tests etc. not provided for". The cost of samples and tests for the materials supplied by the Employer shall be borne by the Employer.

35. "Works to be executed in accordance with Specifications, drawings, orders etc. The Contractor shall execute the whole and every part of the work in the most substantial and workman-like manner, and both as regards materials and otherwise in every respect in strict accordance with the Specification. The Contractor shall also conform exactly fully and faithfully to the designs, drawings and instruction in writing to the work signed by the Engineer/Consultant.

36. "Action and Compensation payable in case of bad work". If shall appear to the Engineer/Consultant or his subordinate incharge of the work that any work has been executed with unsound imperfect or unskillful workmanship or with materials of any

inferior description or that any materials or articles provided by him for the execution of the work are unsound or of a quality inferior to that contracted for or otherwise not in accordance with the contract the Contractor shall on demand in writing from the Engineer/Consultant specifying the work, materials or articles complained of, notwithstanding that the same may have been inadvertently passed certified and paid for, forthwith rectify or remove and reconstruct the work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own proper charge and cost and in the event of his failing to do so within a period to be specified by the Engineer/Consultant in his demand aforesaid, then the Contractor shall be liable to pay compensation at the rate of one percent on the amount of the tendered cost of such work materials or articles for every day not exceeding ten days while his failure to do so shall continue and in the case of any such failure the Engineer/Consultant may rectify or remove and re-execute the work or remove and replace with other the materials or articles complained of, as the case may be, at the risk expense in all respects of the Contractor.

37. "Works to be Open to Inspection". All work under or in course of execution in pursuance of the Contract shall at all times be upon to the inspection and supervision of the Engineer and Consultant and the Contractor shall, all time during the usual working hours and at all other times at which reasonable notice of the intention of the Employer or Consultant to visit the works shall have been given to the Contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing present for that purpose. Orders given to the Contractor's agent shall be considered to have the same forces as if they had been given to the contractor himself.

38. "Notice to be given before work is covered up". The Contractor shall give not less than five days notice in writing to the Engineer or Consultant of the work before covering up or otherwise placing beyond the reach of measurement any work in order that the same may be measured and control dimensions thereof be taken before the same is so covered up or placed beyond the reach of measurement and shall not cover up or place beyond the reach of measurement any work without the consent in writing of the Engineer or Consultant of the work; and if any work shall be covered up or placed beyond the reach of measurement without such notice having been given or consent obtained the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the material with which the same was executed.

39. (1) "Suspension of Works". The Contractor shall on the written order of the Engineer suspend the progress of the works or any part thereof for such time or times and in such manner as the Engineer may consider necessary and shall during such suspension properly protect and secure the work at his own cost so far as is necessary in the opinion of the aforesaid authority.

(2) "Extension of Time". The Contractor will be allowed by the Employer an extension of time for completion which shall not be less than the period of suspension for the item or portion of work so affected but no other claim in this respect for compensation or otherwise howsoever/whatsoever will be admitted. The contractor will also be entitled to a reasonable time of extension in a manner as mentioned heretofore if the work is delayed by force majeure or Excepted Risks as defined in Clause 10(2) of these conditions.

40. "Contractor to Supply tools, plant, ladder etc." The Contractor shall supply at his own cost all material (except such special materials, if any, as may in accordance with the

Contract be supplied b the Employer), scaffolding and temporary works requisite or proper for the proper execution of the work, whether original, altered or substituted and whether included in the Specification or other documents forming part of the Contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer/Consultant as to any matter as to which under these Conditions he is entitled to be satisfied or which he is entitled to require together with carriage therefore to and from the work.
"And be liable for damages arising from non provision of light, fencing etc." The Contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works and counting, weighing and assisting in the measurements or examination at any time and from time to time of the work or materials. Failing his so doing the same may be provided by the Engineer/Consultant at the expense of the Contractor and the expenses may be deducted from any money due to the Contractor under the Contract or from his security deposit. The Contractor shall also provide all necessary fencing and lights required to protect the public from accident, and shall be bond to bear the expenses of defence of every suit action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions, and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

41. PROPERTY IN MATERIALS AND PLANT

41.1 "Plant etc. the Property of the Employer". All constructional plant, temporary works and materials provided by the Contractor shall, when brought on the site, immediately be deemed to become the property of the Employer and the Contractor shall not remove the same or any part thereof without the consent in writing of the Engineer. But the Engineer will permit the Contractor the exclusive use of all such constructional plant, temporary works and materials in and for the construction and completion of the works until the happening of an event which gives right to the Employer to exclude or reject the Contractor from the site and proceed with the completion of the works.

41.2 "Employer not Responsible". The Employer shall not at any time be responsible for or involved in any way as to the ownership, origin or manufacture of any such tools, plants, and equipment etc. brought to the site by the Contractor which may under the Contract come under the possession of the Employer and the Contractor shall be solely responsible for the same.

41.3 "Revesting of Plant etc." Upon the removal of any such constructional plant temporary works or materials with consent of the Engineer the same shall be deemed to revest in and become the property of the Contractor and, upon completion of the works, the remainder of the said constructional plant and temporary works & any un-used material provided by the Contrctor shall be deemed to revert in and become the property of the Contractor, who shall remove the same at his own cost. If the Contractor fails to remove any of the said constructional plant, temporary works or unused materials with such reasonable times, after the completion of work, as may be allowed by the Engineer then such constructional plant, temporary works and un-used materials shall become the absolute property of the Employer and the Employer may sell or otherwise dispose of the same in the manner the deems appropriate without payment of any compensation to the Contractor.

41.4 "Employer not liable for the damages to Plant etc." The Employer shall not at any time be liable for the loss or damage to any of the said construction plant, temporary works or materials etc.

41.5 "No approval by vesting". The operation of this clause shall not be deemed to imply any approval by the Engineer of the materials or other things referred to therein nor shall it prevent the rejection of any such materials and other things at any time by the Engineer.

COMMENCEMENT TIME AND DELAYS

42. "Rate of Progress". The whole of the materials plant and labour to be provided by the Contractor under the Contract and the manner and speed of execution and maintenance of the works are to be of a kind and conducted in a manner approved by the Engineer. Should the rate of progress of the works or any part thereof be at any time, in the opinion of the Engineer, too slow to ensure the completion of the works by the prescribed time or extended time for completion, the Engineer shall so notify to the Contractor in writing and the Contractor shall thereupon take such steps which he may think necessary and the Engineer may approve to expedite progress so as to complete the works by the prescribed time or extended time for completion. The absence of any such notice by the Engineer, however, shall in no manner absolve the Contractor from his responsibility of competing the works by the prescribed period or the extended time for completion.

43. "Compensation for Delay". The time allowed for carrying out the work as entered in the tender shall strictly observed by the Contractor and shall be recknoned from the date on which the order to commence work is received by the Contractor. The Work shall throughout the stipulated period of the Contract be proceeded with all due diligence (time being deemed to be of the essence of the Contract on the part of the Contractor) and the Contractor shall pay as compensation an amount equal to 0.1 percent, or such smaller amount as the Employer (whose decision in writing shall be final) may decide, on the amount of the tendered cost of the whole work (Contract Value) for every day that the work remains uncommenced or unfinished after the proper dates. And further to ensure good progress during the execution of the work, the Contractor shall be bound to coplete one-fourth of the whole of the work before one-fourth of the whole time allowed under the contract has elapsed, one half of the work before one-half on such time has elapsed, and three-fourths of the work before three-fourths of such time has elapsed; in the event of the Contractor failing to comply with this condition he shall be liable to pay as compensation an amount to 0.1 percent or such smaller amount as the Employer (whose decision in writing shall be final) may decide on the said tendered cost of the whole work for every day that the due quantity of work remains incomplete. Provided always that the entire amount of compensation to be paid under the provisions of this clause shall not exceed 5 percent of Contract Value. Compensation shall be paid by Contractor in case the additional or altered works are also delayed beyond the extended date of completion as per clause 50 hereof.

44. "Extension of Time for Completion". If the Contractor shall desire an extension of the time for completion of the work on the grounds of his having been unavoidably hindered in its execution or any other ground he shall apply in writing to the Engineer within 30 days of the date of the hindrance on account of which he desires such extension as aforesaid, and the Employer shall, if in his opinion (which shall be final) reasonable grounds be shown therefore, authorize such extension of time, if any, as may in his opinion be necessary or proper. Provided that any extension given under this clause or any other provision of the agreement or any delay on whatsoever reason

occurring in the completion of the works within the stipulated time or the extended period shall not entitle the Contractor to claim any compensation and no claim from the Contractor on this account shall be entertained.

45. "Certificate for Completion of Works". As soon as in the opinion of the Engineer the Works shall have been substantially completed and shall have satisfactorily passed any final test that may be prescribed by the Contract the Engineer shall, on receiving a written undertaking by the Contractor to finish any outstanding work during the period of Maintenance and with the approval of the Employer, issue a Certificate of Completion in respect of the works and the period of Maintenance of the Works shall commence from the date given in such certificate.

Provided that the Engineer may, with the prior approval of the Employer, give such a certificate with respect to any part of the works before the completion of the whole of the works and shall, upon the written application of the Contractor and with the prior approval of the Employer, give such certificate with respect to any substantial part of the works which has been both completed to the satisfaction of the Engineer and occupied or used by the Employer and when any such certificate is given in respect of a part of the works such part shall be considered as completed and the period of Maintenance of such part shall commence from the date given in such certificate.

Provided also that a certificate of completion given in accordance with the foregoing provisions of any part of the works occupied and used as aforesaid shall not be deemed to certify completion of any ground or surfaces requiring reinstatement unless such certificate shall expressly so state.

46. "Work on Sunday or Holidays". No work shall be done on Sunday and official holidays or at nights without the sanction in writing of the Engineer.

47. "Suspension of Works". The Employer may require the suspension of works in forenoon on any specific day of work and the contractor may have to start work in afternoon. Similarly the Employer may require the progress of work on some Sundays and Holidays.

MAINTENANCE AND DEFECTS

48. (1) "Maintenance of Works". To the intent that the works shall, at or as soon as practicable after the expiration of the Period of Maintenance of 12 months, be delivered to the Employer in as good and perfect a condition (fair wear and tear excepted) to the satisfaction of the Engineer as that in which they were at the commencement of the period of Maintenance the Contractor shall execute all such work of repair, additions and alterations, re-construction, rectifications and making good of defects, imperfection, shrinkages or other faults as may be required of the Contractor in writing by the Engineer during the period of Maintenance or within 30 (thirty) days after its expiration as a result of an inspection made by or on behalf of the Employer before its expiration.

(2) "Remove Defects". All such works as are specified in sub-clause(1) above shall be carried out by the Contractor at his own expense if the necessity thereof shall in the opinion of the Engineer be due to the use of materials or workmanship not in accordance with the contract or due to neglect or failure on the part of the Contractor to comply with any obligation expressed or implied on the Contractor's part under the contract. If in the opinion of the Engineer necessity shall be due to any other cause or requirement of the

Employer not involving negligence on the part of the Contractor the value of such work be ascertained and, subject to approval of the Employer, be paid for as if it was additional work.

(3) "Remedy on Contractor's failure to carry out work required". If the Contractor shall fail to do any such work as aforesaid required by the Engineer the Employer shall be entitled to carry out such work by its own workmen or by any other contractor at the Contractor's own risk and cost.

The Employer shall be entitled to re-cover from the Contractor the cost thereof including all other charges in this respect or the same may be deducted from any monies due or that become due to the Contractor.

49. "Approval by Maintenance Certificate". No certificate other than the Maintenance certificate described hereunder shall be deemed to constitute approval of any work or other matter in respect of which it is issued nor shall be taken as an admission of the due performance of the Contractor or any part thereof or varied work having been ordered by the Employer nor shall any other certificate conclude or prejudice any powers of the Employer.

50. "Maintenance Certificate". The Contract shall be considered as completed until a Maintenance Certificate shall have been, with the prior approval of the Employer, signed by the Engineer and delivered to the Contractor, stating that the works have been completed and maintained for a period of 12 (twelve) months to his satisfaction. The Maintenance Certificate shall be given by the Engineer within 30 (thirty) days after the expiration of the Period of Maintenance or, if different periods of Maintenance shall become applicable to different parts of the works, on the expiration of the such latest period and full effect shall be given to this clause notwithstanding any previous entry on the works or the taking possession, working or using therefore or any part thereof by the Employer.

ALTERATIONS ADDITIONS AND OMISSIONS

51. "Alteration in Specification and Designs". The Engineer/Consultant shall have power to make any alterations in, omissions from, additions to or substitutions for the original Specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work and the Contractor shall be bound to carry out the work in accordance with any instructions which may be given to him in writing signed by the Engineer and such alterations, omissions, additions or substitutions shall not invalidate the Contract, and any altered, additional or substituted work which the Contractor may be directed to do in the manner above specified as part of the work shall be carried out by the Contractor on the same conditions in all respects on which he agreed to do the main work and the same rates as are specified in the contract for the main work.

"Do not invalidate Contract". The time for the completion of the work shall be extended in the proportion that the altered, additional or substituted work bears to the original contract work and the certificate of the Engineer shall be conclusive as to such proportion. And if the altered, additional or substituted work includes any class of work for which no rate is mentioned in this Contract, then such class of the work shall be carried out by the Contractor at suitable rate to be mutually worked out by the Contractor and the Consultant and approved by the Engineer.

"Extension of time in consequence of Alterations". In the event of disagreement between the Consultant and the Contractor, the Engineer shall fix such rate as may in

his opinion be reasonable and proper having regard to the circumstances and this will be final & binding for the contractor with no claim.

No deviations from specifications stipulated in the Contract or any additional items of work shall be carried out by the Contractor unless rates of the substituted altered or additional items have been approved in writing by the Engineer, failing which the Employer shall not be bound to entertain any claim on this account.

52. "Claims for payment of an extra ordinary nature to be referred to the Employer for decision". No claims for payment of an extra-ordinary nature, such as claims for a bonus, labour employed incompleting the work before the expiry of the contractual period at the request of Engineer or claims for compensation where work has been temporarily brought labour employed in-completing the work before the expiry of the contractual period at the request of Engineer or claims for compensation where work has been temporarily brought to a standstill though no fault of the Contractor shall be allowed unless and to the extent that the same shall have been expressly sanctioned by the Employer.

CERTIFICATES AND PAYMENTS

53. "Mobilization Advance". After signing the Contract and commencement of work and in exchange for the Performance Security and a separate bank guarantee for the amount of the Mobilization Advance the Contractor shall receive from the Engineer and Advance Payment Certificate for an amount equal to ten (10) percent of the Contract Value less any sum for the Contingencies if included in the Contract Value.

The bank guarantee for the full amount of the Mobilization Advance shall be from a Scheduled Bank of Pakistan and in the form appended herewith together with any modifications, additions or deletions that the Employer may consider necessary. The conditions of the bank guarantee shall bind the Guarantor to pay to the Employer in full or any part of the Advance Payment which remains not repaid by the Contractor to the Employer and which the Contractor has failed to repay in accordance with this clause.

The Advance payment made by the Employer shall be recovered from the Contractor at the rate of not less than 10% of each payment invoice of the contractor alongwith interest at the rate of 10% per annum for the intervening periods.

This bank guarantee shall be valid for the period to be modified in the Guarantee or until the full recovery of the Advance Payment whichever is the later.

If, however, the Advance Payment is recovered in full prior to the end of the said period, the Contractor may make application to the Employer for the release of the guarantee which will not be unreasonably with-held.

In the event of the Contract being determined under Clause 65 or 66 of these Conditions the Employer may deduct the balance of the Advance Payment outstanding from any monies due or which may become due to the Contractor or the Contractor shall upon demand pay to the Employer the amount of such balance and it shall be deemed a debt due from the Contractor to the Employer and shall be recoverable accordingly from the Contractor or from the Guarantee.

Advance Payment shall not be subject to retention of Security Deposit.

54. "Payment on Intermediate Certificates to be regarded as Advance". The Contractor shall on submitting the bill be entitled to receive a monthly payment proportionate to the part of the work then approved by the Consultant and passed by the Engineer whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the Contractor. But all such intermediate payments shall be regarded as payments by way of advance against the final payment only and not as payments for work actually done completed, this shall not preclude the requiring of bad, unsound and imperfect or unskillful work to be remove and taken away and reconstructed or re-erected, or be considered as an admission of the due performance of the contract or any part thereof in any respect or the accruing of any claim, nor shall it conclude determine or affect in any way the powers of the Engineer under these conditions or any of them as to the final settlement and adjustment of the accounts or otherwise, or in any other way vary or affect the contract.

"Final Bill to be submitted within one month". The Final Bill shall be submitted by the Contractor within one month of the date fixed by the Engineer, otherwise the Engineer's Certificate of the measurement and of the total amount payable for the work accordingly shall be final and binding on all parties.

55. "Bills to be submitted monthly". A bill shall be submitted by the Contractor each month on or before the date fixed by the Engineer for all work executed in the previous months, and the Engineer shall take or cause to be taken the requisite measurement for the purpose of having the same verified and the claim, as far as admissible, adjusted, if possible, before the expiry of ten days from the presentation of the bill. If the Contractor does not submit the bill within the time fixed as aforesaid, the Engineer may depute consultant to measure up the said work in the presence of the Contractor whose counter signature to the measurement list will be sufficient warrant; and the Consultant shall prepare a bill from such list which shall be binding on the Contractor in all respects. The Employer shall have the right to have such Bills properly checked and verified through its Audit/Accounts Departments before making the payment. Payment against such bills will be made within 30 days of verification by Consultant.

56. "Bills to be on printed forms". The Contractor shall submit all bills on the printed forms to be had on application at the office of the Consultant, and the charges in the bills shall always be entered at the rates specified in the tender or in the case of any extra work ordered in pursuance of these conditions and not mentioned or provided for in the tender at the rates provided for in the tender at the rates provided for such work in these conditions.

57. "Lump Sum in Bills of Quantities". When the Bills of Quantities includes lump sum in respect of a certain item, the Contractor shall be entitled to payment in respect of such item the lump sum amount entered in the Bills of Quantities and the price quoted by the Contractor shall be deemed to include all work and costs related to such lump sum item.

58. "Security Deposit". The Contractor shall permit the Employer at the time of making any payment to him for work done under the Contract to deduct such sum as will (with the earnest money deposited by him) amount to 10 percent of all monies so payable, such deduction to be held by the Employer by way of security deposit. All compensation or other sums of money payable by the Contractor to the Employer under the terms of this Contract may be deducted from his security deposit or from any sums which may be due or may become due to the Contractor by the Employer on any account whatsoever and in the event of his security deposit being reduced by reason of any such deduction as aforesaid the Contractor shall within ten days

thereafter make good in cash any sum or sums which may have been deducted from the Security Deposit or the balance if any, as the case may be, shall be released after successful completion of the period of Maintenance.

59. "Secured Advance against Materials". Secured Advance may be included in intermediate payments against quantities of non-perishable materials meant for use in works actually brought at site & placed in safe custody. It would be entirely at the discretion of the Engineer to make such payments and will only be paid in exceptional cases where the Engineer is convinced that such payments will be in the interest of work and is likely to accelerate the progress. The value assessed by the Engineer for such advances shall not be more than 75% of the cost of material taken out from the composite rates set out in the BOQ of the contract & such an advance shall be recovered from running bills in proportion to their consumption.

60. "Payment on completion". When the Engineer has granted a certificate of completion for the whole of the work under the Contract and when the Employer has ascertained the estimated final sum due to the Contractor, the Employer shall after allowing for the amount of all previous account bills and certificates and after allowing for all other payments due from the Contractor to the Employer pay to the Contractor such a sum out of the balance so calculated as the sum remaining due to the Contractor such a sum out of the balance so calculated as the sum remaining due to the Contractor will leave to be retained by the Employer a sum Equal to 5% (five percent) of the cost of total work executed.

61. "Payment of Contractor's Bill". Payment due to the Contractor will be made either by credit to his account with his bank or direct to him.

62. "All Payments subject to Audit/Accounts Rules". Any/all payments to be made to the Contractor shall be subject to their satisfactory compliance with the relevant Audit/Accounts rules and procedures adopted by the Employer.

63. "Cessation of Employer's Liability". The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or the execution of the works unless the Contractor shall have made a claim in writing in respect thereof before the giving of the Maintenance Certificate under clause 51 hereof.

64. **INCREASE OR DECREASE OF COSTS**

Adjustments of the Contract Price on account of fluctuation in costs of material shall be made in accordance with the provisions specified herein:

(1) (a) Material

The Clause will be operative in case of the fluctuations costs of the following materials only:

i) Cement
ii) Reinforcement steel

The increase or decrease of costs will be subject to statutory requirement or notifications of the Provincial and / or Federal Government issued after the date of signing the Contract, Adjustment of Contract Prices in respect of cement and reinforcement steel pursuant to this Clause shall be made on the

basis of the quantity actually consumed in the work and the difference in price as specified in sub-clause 'b' of this Clause. Unit rates quoted by the Contractor in the Bill of Quantities shall be deemed to include fluctuations in basic prices of all other materials during the contract period including any extension thereof. No escalation in the basic prices of materials other than those specified herein above shall be considered for payment to the Contractor.

(b) In determining the amount of any increase or decrease of the Contract price pursuant to this clause, no account shall be taken of the overheads and profits. The Contractor shall forthwith, upon happening of any event which may or may be likely to give rise to adjustment of the contract price pursuant to this Clause, give notice in writing

(c) base their calculations of item rates on the these basic rates which shall be taken into account for the adjustment of the Contract price.

(1)	Cement (Exfactory)			
(a)	Portland Grey	Rs.	per tons	To be fixed by
(b)	White Cement	Rs.	per tons	the Consultant
(2)	Steel (Exfactory)	Rs.	per tons	"
(a)	deformed bars with guaranteed yield strength of 60,000 Psi.	Rs.	per tons	"
(b)	Mild Steel	Rs.	per tons	"

65. REMEIES AND POWERS

65.1 (1) "Forfeiture" If the Contractor shall become bankrupt or have a receiving order made against him or shall present his petition in bankruptcy or shall make an arrangement with or assignment in favour of his Creditors or shall agree to carry out the Contract under a Committee of inspection of his creditors or (being a Corporation) shall go into liquidation other than a voluntary liquidation for the purpose of amalgamation or reconstruction or if the Contractor shall assign the Contract without the consent in writing of the Employer first obtained or shall have an execution levied on the goods or if the Engineer shall certify in writing to the Employer that in his opinion the Contractor.

(a) has abandoned the Contract; or

(b) without reasonable excuse has failed to commence the works or has suspended the progress of the works for 14 (fourteen) days after receiving from the Engineer written notice to commence the work; or

(c) has failed to remove materials from the site or to pull down and replace work for 28 (twenty eight) days after receiving from the Engineer written notice

that the said materials or work have been condemned and rejected by the Engineer under these conditions, or

(d) is not executing the works in accordance with Contract or is persistently or flagrantly neglecting to carry out his obligations under the Contractor; or

(e) has to the detriment of good workmanship or in defiance of the Engineer's instructions to the contrary and without the prior approval of the Engineer sublet any part of the Contract; or

(f) has failed to proceed with the works with due diligence, then the Employer may after giving 7 (seven) days' notice in writing to the Contractor enter upon the site and resume the works and expel the Contractor therefrom without thereby avoiding the Contract or releasing the Contractor from any of his obligations or liabilities under the Contract or affecting the rights and powers conferred on the Employer by the Contract and the Employer may itself complete the work or may employ any other Contractor to complete the works and the Employer or such another Contractor may use for such completion so much of the Constructional plant, temporary works and materials which have been deemed to become the property of the Employer under the provision of clause 41 hereof as the Employer may think proper, and the Employer may at any time sell any of the said Constructional plant, temporary works and un-used materials and apply the proceeds of sale in or towards the satisfaction of any sums due or which may become due to the Employer from the Contractor under the Contract.

65.2 "Evaluation at date of forfeiture". The Engineer shall, as soon as may be practicable, after any such entry, fix and determine or extract after reference to the Contractor certify with the approval of the Employer what amount (if any) had at the time of such entry and exclusion been reasonably earned by or would reasonably accrue to the Contractor in respect of works then actually done by him under the Contract and what was the value of any un-used or partially used materials, any constructional plant and any temporary works which have been deemed to become the property of the Employer under provisions of the Contract.

In the event of the Contractor committing any such default as is specified in sub-clause (1) the Employer may, instead of expelling the Contractor from the Works and the site, require the Engineer to measure up the work of the Contractor and to take such part thereof as shall be un-executed out of his hands and to give it to another Contractor to complete, in which case any expenses (as determined by the Engineer) which may be incurred in excess of the sum which would have been paid to the original Contractor if the whole work had been executed by him shall be borne and paid by the original Contractor and may be deducted from any money due to him by the Employer under the Contract or otherwise or from his security deposit. The Employer also reserves the right, in its sole discretion, to forfeit the whole of the security deposit or a part thereof.

65.3 "Payment after forfeiture". If the Employer shall enter and expel the Contractor or appoint another agency under this clause the Employer shall not be liable to pay to the Contractor any money on account of the Contract until the expiration of the Period of Maintenance and thereafter until the costs of completion, maintenance and damages for delay in completion, if any, and all other expenses incurred by the Employer have been ascertained and the amount thereof certified by the Engineer with the approval of the Employer and paid by or recovered from the Contractor. The

Contractor shall then be entitled to receive only such sum or sums, if any, as the Engineer may certify would deducting the total amount due to the Employer. But if the total amount due to the Employer shall exceed the sum which would have been payable to the Contractor on due completion by the Contractor then the Contractor shall upon demand pay to the Employer the amount of such excess and it shall be deemed a debt due from the Contractor to the Employer and shall be recoverable accordingly.

65.4 "No Claim of Compensation by Contractor". In the event of any of the above courses being adopted by the Employer the Contractor shall have not claim for compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advances on any account of or with a view to the execution of the works or the performance of the Contract. And in case the Contract shall be rescinded under the provisions aforesaid, the Contractor shall not be entitled to recover or be paid any sum for any work theretofore actually performed under this Contract.

66. "Special Powers of Determination". If any time after the acceptance of the tender the Employer shall for any reason whatsoever not require the whole or any part of the work to be carried out, the Employer shall give notice in writing of the fact to the Contractor who shall have no claim to any payment or compensation whatsoever on account of any profit of advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of the foreclosing of the work neither shall he have any claim for compensation by reason of any alterations having been made in the original specification, drawings, designs and instructions which shall involve any curtailment of the work as originally contemplated.

67. "Urgent Repairs". If by reason of any accident or failure or other event occurring to or in connection with the works or any part thereof either during the execution of the works or during the Period of Maintenance any remedial or other works or repair shall in opinion of the Engineer / Consultants be urgently necessary for security and the Contractor is unable or unwilling at once to do such work or repair the Engineer / Consultant may be his own or other workmen do such work repair may consider necessary. If the work or repair so done is work or repair which in the opinion of the Engineer/

Consultant the Contractor was liable to do at his own expense under the Contract, all cost and charges properly incurred by the Employer in so doing shall on demand be paid by the Contractor to the Employer or may be deducted by the Employer from any monies due to or which may become due to the Contractor, provided always the Engineer/Consultants shall as soon after the occurrence of any such emergency as may be reasonably practicable notify the Contractor thereof in writing.

SETTLEMENT OF DISPUTES

68. If any dispute of difference of any kind whatsoever shall arise between the University and the Contractor or the Project Director and the Contractor in connection with or arising out of the Contract (whether during the progress of the works or after their completion and whether before or after the termination abandonment or breach of the Contract) it shall in the first place be referred to and settled by the Vice Chancellor who within a period of ninety days after being requested by either party to do so shall give written notice of his decision to the Contractor. Such decision in respect of every matter so referred shall be final and binding upon the Contractor until the completion

of Works and shall forthwith be given effect to by the Contractor who shall proceed with the work with all due diligence.

GENERAL

69. "Bribes". If the Contractor or any of his sub-contractors agents or servants shall offer or give or agree to offer or give to any person any bribe gifts gratuity or commission as an inducement or reward for doing or forbearing to do any action in relation to the Contract or any other contract with the Employer or for showing or forbearing to show favour or disfavour to any person in relation to the Contract or any other contract with the Employer then the Employer may enter upon the Site and expel the Contractor therefrom and the provisions of Clause 64 hereof shall apply as if such entry and exclusion had been made pursuant to that Clause.

70. "Law Governing the Contract". This Contract shall be governed by the laws of Pakistan. Resort to court by either of the parties in respect of any dispute under the Contract shall be had only to the competent court having Jurisdiction within the local times of Karachi.

C – ADDITIONAL CONDITIONS OF CONTRACT

AD-1 "Water and Power during Construction". The Contractor shall make his own arrangements for water for construction, drinking and other purpose. He shall also arrange temporary power for operation of construction equipment and lighting. The contractor shall also be responsible for provision, maintenance, repair and operation of these services at his own cost throughout the construction period and lay for water and power charges, however, the employer may provide all help to get power and water connections. Contractor shall have sufficient standby diesel operated equipment and water storage at site. No claim of the Contractor shall be entertained due to non-supply or discontinuity of power and/or water supply.

AD-2 "Keeping Foundation & Works free of Water". The Contractor shall provide and maintain power driven pumps etc. to keep the works, excavations and foundations free from water etc. at this own expense. The water shall be disposed of to the satisfaction of the local authorities and the Engineer/Consultant.

AD-3 "Site Order Book". The Contractor shall maintain at the site of works a "Site Order Book" (of triplicate leaves) for taking instructions and directions of the Engineer or Employer or Consultant.

AD-4 "Sign Board" The Contractor shall provide a suitable size Sign Board at his own cost at an approved location indicating the names of the Employer, Project, Contractors and Consultants, as approved by Engineer.

AD-5 "Progress Report" It is obligatory for the Contractor to prepare and submit a fortnightly report on progress of work to the Engineer/Consultant on approved Performa which may be amended from time to time if deemed necessary.

AD-6 "Electrical Works" The electrical works shall be carried out through licensed electrical Contractor/Electricians as per applicable rules.

AD-7 "Co-ordination with Other Works: The work of building construction will have to be co-ordinated with the work or water supply, sanitary and electrification. Nothing extra shall be payable to any Contractor on this account.

AD-8 "Faire Face brick Work" For fire face work, bricks shall be selected for trueness of edges shapes and colour, no extra payment being due for this. Care shall be taken that the bricks are not chipped off or stained as the work proceeds.

AD-9 Rate Inclusive of Lead and Lift" The tendered rates shall be inclusive of all lead and lift.

AD-10 "Weather Conditions" The Contractor shall be expected to make himself acquainted with local features and weather conditions etc. and make his arrangements in such a manner that unfinished work is in no danger from storms, floods, rains, etc. Claims from the Contractor on account of loss arising from weather abnormalities shall not be considered by the Employer. Similarly no extension in the Time for Completion of Works shall be admissible based on such weather abnormalities.

AD-11 The Contractor at his own cost shall provide and maintain proper site office & transport facilities, complete with office furniture, office equipment, for the use of Project Director or his representative.

Transport to be provided shall not exceed 1000 c.c. Vehicle which will remain at site 24 hrs. The transport will not leave the premises of the University without prior approval of the Project Director.

The office shall consist of two rooms each of about 150 sq.ft. for area. The office furniture and office equipment to be provided by the contractor will be as follows:

1.	Office Table 5'x3	-	No.
2.	Filling Cabinet 4 drawer	-	No.
3.	Notice board 8'x4	-	2 Nos.
4.	Chairs with hard rest	-	8 Nos.

AD-12 "Quantities" The quantities of items shown in the Bills of Quantities can be decreased or increased by the Employer to any extent or he can take away any item or part of work at any time if it is deemed necessary by him without assigning any reason and re-allot it to any other agency after giving notice to the Contractor and this shall not invalidate the Contract nor affect the tender rates in any case, nor shall any claim on this account be entertained.

AD-13 "Arrangements to Commence Work items to be Approved" No item of work will be commenced unless Engineer/Consultant is informed before hand and he authorizes commencement after satisfying that the arrangements with regard to setting out, materials, labour, machinery and T&P etc. are complete and adequate in all respects.

AD-14 "Increase or Decrease of Costs" Adjustment of the Contract Price on account of fluctuations in prices shall remain valid and firm throughout the Contract period including extension thereof.

AD-15 "Shop Drawings" The Contractor shall prepare and submit to the Engineer/Consultant for his check, comments and approval (as the case may be) 4 prints of the shop drawings of articles and items as may be required by the Engineer/Consultant including incorporating and changes

required by the Engineer/Consultant and resubmission of the corrected shop drawings, all at no additional cost to the Employer.

AD-16 "Co-ordination with work of other Contractors" The Contractor shall co-ordinate his work, at his own cost, with the work of other specialist and Nominated sub-contractors and shall maintain proper liaison with them for this purpose.

AD-17 "The Tenders/Contractors shall include the cost of providing, maintaining and removing the Site Office at the completion of works, in his rates for other items No. separate payment shall be made to the Contractor on this account.

AD-18 "Assignment" The Contractor shall not assign the Contract or any part thereof or any benefit in or thereunder (otherwise than by a charge in favor of the Contractor's Bankers of any monies due or to become due under this Contract) without the prior written consent of the Employer.

AD-19 "Sub-letting" The Contractor shall not sub-let the whole of the works. Except where otherwise provided by the Contractor shall not sub-let any part of the works without the prior written consent of the Engineer/Consultant (which shall not be unreasonably withheld) and such consent if given shall not relieve the Contractor from any liability or obligation under the Contractor and he shall be responsible for the acts defaults and neglects of any sub-contractor his agents servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor his agent servants or workmen. Provided always that the provision of labour on a piecework basis shall not be deemed to be a sub-letting under this clause.

AD-20 "Contractor's superintendence". The Contractor shall give or provide all necessary superintendence during the execution of the works and as long thereafter as the Engineer/Consultant may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor shall appoint a competent experienced qualified Engineer at Site of Works as his authorized agent upon approval in writing by the Engineer/Consultant (which approval may at any time be withdrawn) and he is to be constantly on the works and shall give his whole time to the superintendence of the same. If such approval shall be withdrawn by the Engineer/Consultant the Contractor shall as soon as practicable (having regard to the requirement of replacing him as hereinafter mentioned) after receiving written notice of such withdrawal remove the agent from the site and shall not, thereafter employ him agent on the site in any capacity and shall replace him by another agent approved by the Engineer/Consultant. Such authorized agent or representative shall receive on behalf of the Contractor directions and instructions from the Engineer/Consultant subject to the limitations of Clause 2 of the General Conditions of Contract.

MODEL FORMS

F-01

FORM OF AGREEMENT

This AGREEMENT made the _____ day of _____ 2016 at Karachi BETWEEN NED University of Engineering and Technology, Karachi, represented by its Vice Chancellor (herein after called the "Employer") of the ONE PART and _____ (hereinafter called "the Contractor") of the other PART.

WHEREAS The Employer is desirous that certain works should be executed viz._____ and has accepted a Tender by the contractor as summarized in the "Summary of Contract Value" for the execution, completion and maintenance of such Works NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement words and expressions shall have the meanings as are respectively assigned to then in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed part of this Agreement viz.
   (a) The said Tender
   (b) Instructions to Tenderers
   (c) The Conditions of Contract
   (d) The Drawings
   (e) The Specification
   (f) Priced bill of Quantities
   (g) Circular Letter, if any
   (h) The Letter of Acceptance
   (i) Performance Bond (Guarantee)
   (j) Any relevant correspondence
3. In consideration for the payments to be made by the Employer to the Contractor as hereinafter mentioned the contractor hereby covenants with the Employer to execute, complete and maintain the Works in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration for the execution, completion and maintenance of the Works the Contract Price at the times and in the manner prescribed by the Contract.

IN WITNESS WHEREOF, the parties hereto have executed this Contract Agreement to be duly signed, as of the day and year therein above set forth.

FOR :	**NED UNIVERSITY**	**FOR (CONTRACTOR)**
SIGNATURE:	_____	SIGNATURE: _____
Designation	Vice Chancellor	Name:_____
Seal	_____	Position:_____
WITNESS NO.1		
SIGNATURE:	_____	SIGNATURE: _____
Designation	Project Director	Name:_____
Seal	_____	Position:_____
WITNESS NO.2		
SIGNATURE:	_____	SIGNATURE: _____
Designation	Assistant Engineer	Name:_____
Seal	_____	Position:_____

FORM OF ADVANCE PAYMENT BOND
(Mobilization Advance)

To,

_____,

_____,

_____.

Advance Payment Bond No._____ Whereas _____ (hereinafter Called the Contractor) has been awarded a Contract dated _____ for construction completion and maintenance of _____ for the Value of Rs._____ (Rupees _____) and in consideration of your making an advance payment of Rs._____ to the Contractor being _____ % of the Contract Value, by this bond, we _____ [The Bank] _____ whose address is _____ _____ guarantee to pay you a sum not exceeding Rs._____ on your first written demand without reference to or contestation on behalf of the Contractor.

It is understood that our liability towards you will be progressively reduced by the amount reduced by the amount repaid to you by the Contractor as contained in the Certificates and Payments against the said advance payment.

This bond will be effective from _____ and shall be valid until _____ or until the amount of the advance payment is fully recovered, which ever is later.

This bond should be returned to us upon its expiry or upon fulfillment of our undertaking whichever is the earlier.

Authorized Signatories

Signature and Seal: _____

Name of Bank : _____

Address: _____

Date: _____

PERFORMANCE BOND

From Approved Insurance Company *

KNOW ALL MEN BY THESE PRESENTS THAT we M/s. _____ _____ as Contractor(s) (hereinafter referred to as the "Contractor") and M/s._____ (Hereinafter called the "Surety") are held and firmly bound upto the Office of the Project Director NED University of Engineering & Technology (hereinafter referred to as "Employer"), a body organized and existing under and virtue of the laws of the Govt. of Sindh, in the sum of Rs._____ in words _____) lawful money of Performance Bond for the payment of which 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 the above obligation is such that:

WHEREAS the above bounden Contractor has as of the _____ day of _____, 2016, entered into a Contract for carrying out the _____ (hereinafter called the 'PROJECT', of which this instrument is a part, with the Employer AND WHEREAS it is a condition of the above Contract that a Performance Bond in the amount mentioned above be furnished by the Contractor for the due performance of the construction work under the above contract now, THEREFORE, we the undersigned Surety waiving all objections and defence under the aforesaid Agreement, hereby irrevocably and independently guarantee to pay to the Employer without delay upon first written demand without any reference to the Contractor, the amount claimed by the Employer upto the extent of _____ in words) against written declaration that the Contractor has refused or failed to perform the work under the aforementioned Contract.

The said surety, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this Bond and it does hereby waive notice or any such change, extension of time, alteration or addition to the terms of Contract or to the work or to the Specifications.

IN WITNESS WHEREOF the above named Contractor and the Surety have signed these presents this _____ day of _____ 2016.

Signed : _____
(Contractor)

Signed : _____
(Surety)

Witness :

1. _____

2. _____

Witness:

1. _____

2. _____

* Approved Insurance Companies.

1. M/s. Adamjee Insurance Co. Ltd.
2. M/s. Eastern Federal Union Insurance Co. Ltd.
3. M/s. New Jubilee Insurance Co. Ltd.

SECTION – 8

LIST OF EQUIPMENT FOR PROJECT

S.No.	Equipment	To be provided as a part of mobilization	Total Quantity of equipment for project. To be completed by the contractor
1.	Concrete Mixers (Diesel)	1 No.	
2.	Mortar mixers	1 No.	
3.	Vibrators (diesel/petrol)	2 Nos.	
4.	Water Pups	1 No.	
5.	Scaffolding	As per requirement at site	
6.	Steel shuttering (with supports)	Do	
7.	Timber shuttering (with supports)	Do	
8.	Social compactors	Do	
9.	Soil compaction testing equipment	Do	
10.	Theodolite	1 No.	
11.	Dumpy levels	1 No.	
12.	Generator	1 No.	
13.	Vehicles (pick-up)	1 No.	
14.	Miscellaneous equipment and tools are required.		

UNDERTAKING

We accept and undertake to provide at the project site the above stated equipments, tools and plant in full working condition within the mobilization period of 15 days after receipt of notice of acceptance of our tender and these equipments shall form part of our mobilization.

We also undertake to provide further equipments, tools and plant as stated above for timely completion of the contracted works.

SIGNATURE : _____

NAME : _____

IN THE CAPACITY OF: _____
Duly authorize to sign tenders for and on
Behalf of:

COMPANY : _____
(TENDERER)

ADDRESS : _____

_____
(IF SIGNED BY ANY PERSON OTHER THAN OWNER/ MANAGING DIRECTOR/PARTNER, THE DULY EXECUTED LEGAL AUTHORITY SHALL BE SUBMITTED ALONGWITH THE TENDER).

NED UNIVERSITY
OF ENGINEERING & TECHNOLOGY–
KARACHI

TENDER DOCUMENTS FOR

Extension of Cowasjee Material Testing Laboratory
@
NED Main Campus

VOLUME – II

Technical Specification

Department of Earthquake Engineering

NED University of Engineering and Technology, Karachi-75270.

TABLE OF CONTENTS

SECTION - 1 GENERAL REQUIREMENTS

1. General

The General Conditions of Contract & Special Conditions of Contract shall form an integral part of these General Requirements.

The Contractor shall notify all sub-contractors of the provisions of the Conditions of Contract and the General Requirement of this Specification.

The arrangement and divisions of these Specifications is not to be construed as establishing the limits of responsibility of sub-trades.

The Contractor is responsible for delineating the scope of Sub-Contracts and for coordinating all the Works.

All works shall be carried out in accordance with the following specifications, supplemented by detailed specifications contained in the following sections. Any inconsistencies or ambiguities shall be brought to the notice of the Engineer for his clarification/decision. Decision and direction of the Engineer, in all such cases shall be final and binding.

The Contractor shall make himself thoroughly familiar with the site conditions, foresee any and all problems likely to the encountered during execution of the works, and shall be able and ready to solve them effectively. Proposals for solutions to the problems shall be submitted to the Consultant for approval before proceeding with the work.

The Tender Drawings, Design Criteria and Specifications are to be read in conjunction and shall be mutually explanatory. In case of any conflict the order of preference shall be as under duly followed by the Special and General Conditions of Contract in Volume I of Tender & Contract documents.

i) Specifications
ii) Tender Drawings
iii) Bill of Quantities

2. Scope of Work

The scope of work comprises **Construction of Allied Building, Residential Buildings & External Development Work at J.I.M.S., Jacobabad, Sindh, including all civil, electrical, plumbing and HVAC works** as per drawings and specification as defined hereunder and as specified in subsequent sections of tender documents. The Contractor shall perform all relevant engineering, procurement, installation, construction and execution, coordination with other services, testing and commissioning including all documentation, drawings, calculations and supply of manuals as required to complete the work. The Contractor shall also be responsible to supply and install all other items not specifically mentioned in these documents but which are necessary for proper completion of the works included in the scope of this Contract.

3. Applicable Codes and Standards

In the absence of other Standards being required by the Contract Documents, all work and materials shall meet the requirement of the Uniform Building Code of the United States, and/or applicable American Society for

Testing Materials (ASTM) American Association of State Highway and Transportation Officials (AASHTO) Specifications and the latest American Concrete Institute Manual of Concrete Practice and American.

Institute of Steel Construction (AISC) Manual relevant to the Works except in cases where the Pakistan Building Code requires s higher standard. In such cases the Pakistani Code shall govern, where the abbreviations listed below are used, it refers to the latest code, standards, or publications of the following organizations:

AASHTO	American Association of State Highway and Transportation Officials.
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASA	American Standard Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Material
AWS	American Welding Society
BSI	British Standards Institute
ICAO	International Civil Aviation Organization
BSICP	British Standard Institute Code of
PCA	Practice Portland Cement Association
PSI	Pakistan Standard Institute
UBC	Uniform Building Code

Should the Contractor, at any time and for any specific reasons, wish to deviate from the above standards or desires to use materials or equipment other than those provided for by the above standards, then he shall state the exact nature of the change giving the reasons for making the change and shall submit complete specifications of the materials and descriptions of the equipment for the Engineer's approval, whose decisions shall be conclusive and binding upon the Contractor.

4. Codes, Standards, Certificates

The Contractor shall supply and have at his site office:

Copies of all latest editions of codes and standards referred to in these specifications by number, or equivalent codes and standards approved by the Engineer.

Catalogues and published, recommendations from manufacturers supplying products and materials for the project.

The Contractor shall provide manufacturer's or supplier's certificates to the Engineer for all products and materials which must meet the requirements of a specific code or standard as stated in these Specifications.

5. Units of Measurements

The British System of Units (FPS) shall be used throughout this Project.

6. Manufacturer's Recommendations

Installation of manufactured items shall be in accordance with procedures recommended by the manufacturer or as approved by the Engineer.

7. Existing Condition at Site

Drawings and information pertaining to existing project conditions are furnished for reference. Neither the Employer nor the Engineer warrants the adequacy or correctness of these.

8. Protection and Precautions

The Contractor and his sub-contractors shall afford all necessary protection to existing structures and will be required to make good at his own expense any damage done to such structures through his own or his representatives or subcontractors' fault and negligence.

The Contractor and his sub-contractors shall afford all necessary protection to existing roads in the area. He will clear and make good at his own expense any damage to or debris on these roads through his own fault and negligence. He must at all time ensure the free and normal flow of traffic and shall not cause obstruction to the traffic system. The Contractor and his sub-contractors shall provide and maintain necessary protection and precautionary measures such as warning signs, warning lamps and barricades etc. to prevent accidents.

The Contractor shall promptly correct all such damage to original condition at no additional expense to the Employer.

The Contractor shall cooperate with trades performing work under other Contracts as necessary for completion.

9. Setting Out of Work

Establish all boundaries, markers, leveling stakes and benchmarks on the site to adequately set out all work. Verify all data and their relationship to establish and Engineer's survey control points and public benchmarks and report discrepancies to the Engineer.

Permanently mark the necessary controls for distance and elevation sufficient to serve throughout the Contract and protect these control points adequately against damage and displacement.

Project setting out is for the use of all trades; each trade is responsible for the layout of its own work.

10. Sequence of Construction

The Contractor shall submit his proposal for approval of the Engineer the sequence of Construction, prior to starting the works. the works shall be executed as per approved sequence of construction.

11. Lines and Levels

Survey control points will be established by' the Engineer. The Contractor shall be responsible for verifying these and shall be responsible for all requirements necessary for the execution of any work to the locations, lines, and levels specified or shown on the drawings, subject to such modifications as the Engineer may require as work progresses.

12. Partial Possession

Whenever, as determined by the Employer any portion of work performed by the Contractor is in a condition suitable for use, the Employer may take possession of or use such portion.

Such use by the Employer shall in no instance be construed as constituting final acceptance, and shall neither relieve the Contractor of any of his responsibilities under the Contract, nor acts a waiver by the Employer of any of the conditions thereof, provided that the Contractor shall not be liable for the cost of repairs, re-work, or renewals which may be required due to ordinary wear and tear resulting from such use. However, if such use increases the cost or delays to the completion of remaining portions of work, the Contractor will be entitled to an equitable adjustment.

If, as a result of the Contractor's failure to comply with the provision of the Contract, such use proves to be unsatisfactory, the Consultant will have the right to continue such use until such portion of the work can, without injury to the Consultant, be taken out of service for correction of defects, errors, omissions, or replacement of unsatisfactory materials or equipment, as necessary for such work to comply with the Contract; provided that the period of such operation or pending completion of appropriate remedial action shall not exceed twelve months unless otherwise mutually agreed upon in writing between the parties.

13. Existing Services

The Contractor shall search for, find locate and protect any visible/un visible wiring, cable, duct, pipe work, etc., within or immediately adjoining the site area.

The Contractor shall take full responsibly for safety of existing service lines, utilities and utility structures uncovered or encountered during excavation, dismantling and construction operations.

The Contractor shall take full responsibility for damaging any such service lines, utility/utility structure and any cost and/or expense that arises or issues from any such damage shall be borne directly by himself. Should any damage to any such service occur the Contractor shall forthwith take remedial action, initiate safety precautions, install temporary services and carryout repair all at his own cost and expense and inform the Engineer and notify all relevant authorities.

Existing utilities which are to remain in service or after the works are to be determined by the Contractor. If any existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during these operations, they shall be safeguarded, protected from damage, and supported.

14. Plant and Equipment

The Contractor shall submit a detailed list of plant and equipment, which he shall undertake to bring to the site to carry out the work. The list shall satisfy the Engineer as to type, size and quantity. The list shall include for each piece of equipment the type, manufacturer, model, identification number and year of manufacture. The Contractor shall provide on the site of the work at his cost all of the equipment listed and all subsequent equipment required for approval of the detailed programme of work and such equipment which may be directed by the Engineer. The Contractor shall supply all plant and equipment necessary for the construction of each phase of the work and it must be on site, inspected and approved by the Engineer.

15. Construction Area and Access

The Contractor shall confine his operations to the areas that are actually required for the Works and shall fence the area accordingly Arrangements for access roads, storage areas and routes for haulage of materials are to be made by the Contractor at his own cost, subject to the approval of the Engineer.

16. Storage & Handling Facilities

The Employer will provide the Contractor possible space within or nearby the area of site of works for the storage of plant, equipment and materials and for Contractor's temporary office, during the currency of the Contract. In case the adjacent area as required by the Contractor is not available within the Project boundary for storage of plant, equipment and machines then the Contractor shall arrange at his own expense possible space for storage of plant, equipment and machines at his own cost and expense. On no account shall such temporary installations conflict/ interfere with any of the permanent installations, services and any operational function of Employer. The handling and storage of all plants, equipment and materials at site shall be the sole responsibility of the Contractor and at no risk and cost to the Employer.

The Contractor shall protect all material against corrosion, mechanical damage or deterioration during storage and erection on site. The protection methods shall be to the approval of the Engineer.

17. Test Laboratory and Testing

17.1 Testing, except as otherwise specified herein, shall be performed by an approved testing agency as proposed by the Contractor and at no extra cost to the Employer. The Engineer may require all testing to be carried out under his supervision only.

17.2 If suitable and adequate material testing laboratory is not available in the vicinity, then the Contractor shall provide and maintain a materials testing laboratory in the vicinity of the Contractor's Camp and the laboratory shall have sufficient working area and shall be equipped with all necessary facilities including a suitable store room.

17.3 The Contractor shall supply and maintain to the satisfaction of the Engineer or his representative complete testing equipment, apparatus. tools, gauges, instruments, etc. in sufficient number and adequate for all tests to be carried out as specified in these specifications. Valid calibration certificates of gauges instruments requirement shall be provided by the Contractor.

17.4 The Contractor, after the approval by the Engineer for the source of cement and steel "shall make available at the site sufficient stock of the materials in advance in order to allow sample testing for quality control prior to use.

17.5 The quality contract testing shall be performed" by the Contractor's competent personnel in accordance with a site testing and quality control programme to be established by the Contractor and approved by the Engineer or his Representative. The Contractor shall keep a complete record of all quality tests performed on site and submit the same to the Engineer. All quality control and related tests shall be carried out in accordance with applicable standards and codes.

18. Construction & Checking At Site

The Contractor shall submit to the Engineer in due time for approval and discussion, his proposals and plans as to the method and procedure to be adopted for the temporary and permanent works involved.

The submitting to these suggestions and arrangements, and the approval thereof by the Engineer shall not relieve the Contractor of his responsibilities and duties under the Contract.

The carrying out of all work included In the Contract is to be supervised by a sufficient number of qualified representatives of the Contractor and full facilities and assistance are to be afforded by the Contractor for the Engineer or his Representative to check & examine the execution of the work.

The Engineer reserves the right to inspect all parts of the works but may at his discretion waive inspection on certain items. This shall in no way absolve the Contractor from his responsibilities. This particularly applies to the checking of materials, the accurate setting out of foundations, and to the leveling, setting and aligning of the various parts, and to the proper fitting and adjustment of manufactured and finished materials and fixtures in position.

If the Engineer or his Representative find that the work progress is slow in such a way that the works or parts thereof will not be completed in the time specified, then he shall order the Contractor to work overtime or in shifts and the Contractor shall comply. These arrangements will be free of all financial encumbrances and at no additional costs to the Employer.

In the event of night work, the Contractor shall provide sufficient and adequate lighting to the satisfaction of the Engineer or his Representative and shall supply the necessary manpower for satisfactory continuation of the work after normal hours.

19. Bar Bending Schedule

Bar bending (reinforcement bars) schedule of all drawings shall be prepared by the Contractor and submitted to Consultants' Head Office for approval. The approved bar bending scheduled shall be followed for cutting of steel and preparation of bills.

20. Drawings

20.1 Tender Drawings: The drawings listed in the General Conditions of contract, Volume I and provided in Volume III are referred to as Tender Drawings and these show the scope of work to be performed by the Contractor. Tender Drawings shall not be used as a basis for fabrication or construction but may be used as a basis for placing preliminary order for materials, subject to corrections based on the future issue of Drawings as provided under sub-clause 19.2 Drawings Issued for Construction. Tender Drawings are subject to be modified and supplemented by additional detail by the Engineer.

20.2 Drawings Issued for Construction: After Award of Contract, Tender Drawings shall be replaced by Drawings Issued for Construction including supplementary Specifications as may be necessary. Such drawings and specifications shall be construed to be included in the

expression Custody of Drawings under Sub-Clause 6.1 of General Conditions of Contract Part I. Drawings Issued for Construction may include some of the Tender Drawings with or without modification and additional drawings as required to express design intent in greater detail. Such drawings may also be modified from time to time. Drawings Issued for Construction will be the drawings from which shop, fabrication, erection installation, concrete placing, formwork, or other construction detail drawings shall be prepared by the Contractor. The work shall be executed in conformity with Drawings Issued for Construction. The Contractor shall prepare a schedule of Drawings Issued for Construction of various parts of the Works based on Construction programme approved by the Engineer for issuance to the Contractor from time to time.

20.3 Study of Drawings: The Contractor shall study all Drawings Issued for Construction carefully as soon as practicable after receipt thereof, and any errors discovered shall promptly be brought to the knowledge of the Engineer for his instructions.

20.4 Copies of Drawing: Drawings will be issued to the Contractor free of charge as follows:

Drawings Issued for Construction - Two copies as specified in sub-clause 6.1 Custody of Drawings, of General Conditions of Contract - Part I Volume I.

20.5 Drawings to be furnished by the Contractor:

Shop Drawings

All shop drawings required for the work including all kinds of fabrication, field erection, installation, placement and layout drawings shall be furnished by the Contractor for approval of the Engineer. If additional detail drawings are necessary to complete any part of the work, such including reinforcing steel, drawings shall be prepared by the Contractor and submitted to the Engineer. for approval. All drawings shall be complete and shall be submitted in due time and in logical order to facilitate proper coordination.

a. Lift and placement Drawings.

At least thirty calendar. days prior to starting construction of any concrete lift or other placement, the Contractor shall submit lift or other placement drawings to the Engineer for approval. Lift or other placement drawings shall be submitted for each lift or other placement of concrete to be placed. These drawings shall be to such scale as to clearly show all recesses, openings, and embedded parts, including embedded structural steel, mechanical and electrical items, reinforcement placement in each lift in sufficient detail for proper execution of the work.

b. Construction Plant Layout Drawings.

Three prints of drawings, showing the layout of construction plant and equipment the Contractor proposes to use on the work, shall be submitted by the Contractor for review to the Engineer. The drawings shall show the locations of the principal components of the construction plant, offices, storage areas and yards which the Contractor proposes to construct or use at the site of the work and elsewhere. The drawings shall also show the unloading facilities for materials and equipment at the work site.

c. Submissions and Approvals:

Except as otherwise specified, three copies of each drawing for approval or review shall be furnished to the Consultant. Within thirty calendar days after receipt the Consultant will send one copy to the Contractor marked Approved, Approved/Except as Noted, or Returned for Correction. The notations Approved and Approved/Except as Noted will authorize the Contractor to proceed with the fabrication of the materials and equipment covered by such drawings subject to the corrections, if any, indicated thereon. Drawings returned for correction will be resubmitted for approval in the same manner as for new drawings. Every revision made during the life of the Contract shall be shown by number, date and subject in a revision block.

Upon receipt of prints which have been Approved or Approved Except as Noted, the Contractor shall furnish three prints plus one reproducible of each drawing to the Engineer. If revisions are made after a drawing has been approved, the Contractor shall furnish 3 additional prints and one reproducible subsequent to each approved revision.

d. Shop drawings to be prepared by a Sub-contractor shall be submitted in the same manner as (a) & (b) above but they will be submitted through the Contractor.

e. All of the applicable requirements of this Clause with reference to drawings to be prepared by the Contractor, including Subcontractors, shall apply equally to catalogue cuts, illustrations, printed specifications, or other data submitted for approval.

f. Any work done on Contractor's drawings shall be at the Contractor's risk. The Engineer will have the right to request any additional details and to require the Contractor to make any changes in the drawings which are necessary to conform to the provisions and intent of design and specifications without additional cost to the Employer. The approval of the drawings by the Consultant shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. Approval by the· Engineer of the Contractor's drawings shall not be held to relieve the Contractor of his obligation to meet all the requirements of the Specifications or of his responsibility for the correctness of the Contractor's drawings or of his responsibility for correct fit of assembled parts in final position or of his· responsibility for the adequacy of method of construction.

21. As-Built Drawings

The Contractor shall, at all times, keep on the site one copy of all drawings and approved samples together with copies of all building, mechanical, electrical and public safety codes and relevant standards applicable to the works. All such material shall be made available to the Engineer.

In addition, the Contractor shall, at all times, keep on site a separate set of prints on which shall be noted neatly, accurately and promptly as the work progresses all significant changes between the work shown on the drawings and that which is actually constructed. The sub-Contractors shall each keep on site, at all times, a separate set of prints of the drawings showing their

parts of the work on which shall be noted, neatly accurately and promptly as work progresses the exact physical location and configuration of the works as actually installed, including any revisions or deviation from the Contract Documents.

At the completion of the works, the Contractor shall at his expense, supply to the Engineer six copies and one reproducible copy of all drawings along with CD containing all as built drawings amended to comply with the work "As Built". The Contractor shall provide in the same format as the original drawings, any additional drawing required to record the work.

22. Restoration and Cleaning

The Contractor shall do regular cleaning and clean away all rubbish and excess materials that may accumulate from time to time on completion and before handing over. Upon completion of the works he shall obliterate all signs of temporary construction facilities such as work areas, structures, foundations of temporary structures, stock piles of excess or waste materials, or any other vestiges of construction, unless otherwise directed by the Consultant/Engineer Incharge. The works and site shall be left in a clean and satisfactory state for immediate use and occupation. Care shall be taken not to use any cleaning materials which may cause damage to the surface to be cleaned.

23. Protection of the Works

The Contractor shall whenever necessary cover up and protect the works from Weather damage by his own or other workmen performing subsequent operation. He shall provide all necessary dust sheets, barriers and guard rails and clear away the same at completion.

The Contractor shall take all proper steps for protection at all places on or about the works which may be dangerous to his workmen or any other person or to traffic. The Contractor shall provide and maintain warning signs, warning lamps and barricades as necessary.

24. Product Data

Manufacture's standard schematic drawings shall be modified or deleted to indicate only information which is applicable to the project. Such standard information shall be supplemented to provide all additional applicable information.

Manufacturer's catalogue sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive literature shall be clearly marked to identify pertinent materials products or models. Dimensions and required clearances shall be indicated. Shop performance characteristics and capacities shall be noted.

25. Samples

25.1 The Contractor shall furnish for approval of the Engineer with reasonable Promptness all samples as directed by the Consultant or specifically called for in these Specifications. The Consultant shall check and approve such samples with reasonable promptness for compliance with the requirements of Contract Documents. All work shall be in accordance with approved samples.

25.2 Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Consultant, one for office

use and the other for the Site.

25.3 Samples shall be furnished so as not to delay fabrication, allowing the Consultant/Engineer Incharge reasonable time for consideration of the sample' submitted.

25.4 Each sample shall be properly labeled with the name and quality of the material, manufacturers name, name of the project, the contractor's name and the date of submission, and the Specifications Article number to which the sample refers.

25.5 The manufacturer's installation directions shall be provided with each sample. The Contractor shall pay all transportation costs and deliver samples to the Engineer's office & Consultants' Head office, Site or testing laboratory as directed by the Engineer. Samples will not be returned unless return is requested at the time of submission; all packing and transportation costs for the return of samples shall be paid by the Contractor.

25.6 Samples shall be of adequate size and number to permit proper evaluation of the material by the Consultant/Engineer Incharge. Where variations in colour, texture, dimensions or other characteristics are to be expected, the Contractor shall submit samples showing the maximum range of variation. Materials exceeding the range of variation of the approved samples shall not be used on the Work.

25.7 If both Shop Drawings and samples are required for the same item, the Consultant/Engineer Incharge may require both to be submitted before approving either,25.7 No acceptance or approval of any Shop Drawings or sample, or any indication or directions by the Engineer on any Shop Drawings shall constitute an authorization for any increase in the Contract Sum.

In the event that the site cannot be connected to a local electricity network or where the available power is insufficient the Contractor has to make his own provision and maintain such installation.

A temporary lighting system shall be furnished, installed and maintained by the Contractor as required to satisfy the minimum requirements for safety and security. The temporary lighting system shall afford adequate general illumination to all building areas. Adequate outdoor lighting shall be provided to illuminate staging trenches and the like to the satisfaction of the Engineer Incharge and general illumination throughout adequate for watchmen and emergency personnel. .

Temporary equipment and wiring for power and lighting shall be in· accordance with the applicable provisions of governing codes. Temporary wiring shall be maintained in a safe manner and utilized so as not to constitute a hazard to persons or property.

When the permanent electrical power and lighting systems are in an operating condition, they may be used for temporary power and lighting for construction purposes provided that the Contractor obtains the written approval of the Client and assumes full responsibility for the entire power and lighting system and pays all charges/costs for operation and maintenance of the system mutually agreed between the Employer and the Contractor.

Approval, license etc. if required under local laws will be obtained by

the Contractor on his own responsibility and cost.

At completion of construction work, or at such time as the Contractor makes use of permanent electrical equipment and devices, temporary electricity services shall be removed by the Contractor as his own expense.

25.6.1 Waste Disposal

The Contractor shall make such temporary provisions as may be required in order to dispose of any chemicals, fuels, grease, bituminous materials, waste and soil waste and the like without causing pollution to either the site or the environment. Disposal of any materials, wastes, effluents, garbage, oil, grease, chemicals and the like shall be in areas specified by the concern d local authority proposed by the Contractor and subject to the approval of the Engineer. If any waste material is dumped in unauthorized areas the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed off as directed by the Engineer In charge and replaced with suitable fill material compacted and finished with topsoil all at the expense of the Contractor.

25.6.2 Fire Protection

The Contractor shall provide and maintain adequate fire protection in the form of barrels of water with buckets, fire bucket tanks, fire extinguishers, or other effective means ready for instant use, distributed around the project and in and about temporary inflammable structures during construction of the works.

Gasoline and other flammable liquids shall be stored in and dispensed from safety containers approved by the Engineer In charge and storage shall not be within building.

Torch-cutting and welding operations performed by the Contractor shall have the approval of the Engineer In charge before such work is started and a chemical extinguisher is to be available at the location where such work is in progress.

The Contractor shall follow the instructions and specifications of the relevant department and or other local authority.

25.6.3 Telephone

The Contractor shall immediately after receiving the Letter of Acceptance take the necessary steps to obtain mobile and land line telephone on site. He shall be responsible for all installation and connection charges and periodic mobile and landline telephone accounts. The telephone shall be made available to the Engineer for the due performance of his duties at all times and free of charges during construction and defects liability period.

26. Construction Schedule

A Construction schedule shall be maintained in accordance with the provisions of the General Conditions of Contract.

The schedule shall be accompanied with sufficient data and information including all necessary particulars of constructional plant, equipment machinery, temporary Works, arrival of plant, equipment at site and their installation, method of operation, work forces employed, etc, for an activities of the Works.

Should the Consultant / Engineer consider any alteration or addition in the programme and time schedule, the Contractor shall conform thereto without any cost to the Employer.

Whenever necessary and wherever the progress of the actual work shows departure, the programme and time schedule shall be undated and submitted to the Consultant/Engineer In charge for his approval.

27. Notification to the Engineer

The Engineer's Representative shall be notified daily in writing of the nature and location of the Works the Contractor intends to perform the next day so as to enable necessary inspection and measurement to be carried out. The Engineer may, if necessary, direct that longer notice be given of certain operations.

28. Night Work

When work is done at night the Contractor shall maintain from sunset to sunrise such lights on or about his work and plant as the Engineer may deem necessary for the proper observations of the work and the efficient prosecution hereof.

29. Weather

No work is to be undertaken when, in the opinion of the Engineer, the weather is so unsuitable that proper protection of the work cannot be ensured.

30. Co-Ordination With Other Contractors

The Contractor shall make all necessary coordination with other Contractor and shall make sure that all embedding components such as pipes, steel bases etc. (as required for completion of electrical works) are properly, accurately and timely installed. The Contractor shall inform the other contractor· the schedule of any construction activity well in advance giving him sufficient time to finish his part of job, before any compaction/concreting etc. The Contractor shall get the signature of the authorized representation of the other contractor before carrying out any construction activity.

If any part of electrical work is damaged or has to be dismantled or redone due to negligence omissions / incorrect position of the embedding etc. on part of the Contractor, all such losses/expensed shall be borne by the Contractor.

All expenses incurred for the above works including coordination are deemed to be covered in his tendered cost and no separate/extra payment shall be paid against such item.

31. Submission Requirements

31.1 Schedule submission at least sixty days before the dates when reviewed submittals will be needed.

31.2 Submit Shop Drawings as per provision given in Sub-Clause 20.5 (a) and number of copies of Product Data which the Contractor requires for distribution plus four copies which will be retained by the Engineer.

31.3 Submit three samples unless otherwise specified.

31.4 Accompany submittals with transmittal letter, in duplicate, containing: Date Project title and number Contractor's name and address The number of each Shop Drawing, Product Data and the Sample submitted. Notification of deviations from Contract Documents. Other pertinent data.

32. Resubmission Requirements Shop Drawings:

Revise initial drawings as required and resubmit as specified for initial submittal. Indicate on drawings any changes which have been made by the Engineer. Product Data and Samples: Submit new data and samples as required for initial submittal.

33. Survey Instruments

All the instruments, equipment, stakes and other material necessary to perform all work shall be provided by the Contractor. The survey work shall be carried out by competent staff consistent with the current practices. The Contractor shall maintain on site surveying instruments in perfect working conditions to enable the Engineer to check lines and level at all times.

Survey instruments and equipment shall include but not limit to the following:

Electronic Total Station

Laser Meter

Precision Level invert Staff

Automatic Levels

Power level

Compass, steel tape, ranging poles

34. Weekly Progress Report and Photographs

34.1 During the continuance of the Contract, the Contractor shall submit weekly progress reports on forms as approved by the Consultant. Such weekly reports shall show the actual progress completed as of date of the report plotted against the schedule as given by the Contractor at the start of work and shall be broken down so as to indicate status of all activities associated - with mobilization design, material procurement, manufacture, surveys works, tests with regard to the agreed contract programme.

34.2 The Employer and the Engineer reserve the right to coordinate the schedules of this Contractor and other Contractors working at the Site, and to adjust and/or change any and all such schedules as required during the course of construction in order to achieve a coordinated project in harmony with the Employer's completion date.

34.3 Commencing after the first week of construction, and continuing every week until completion, the Contractor shall take and submit photographs to the Engineer's Representative, to show progress of his work and completion of each structure or major feature.

35. Contractor to Notify Delays Etc.

Any delay which will affect the completion of Works shall be detailed by the Contractor who shall state the action he is taking for effective completion of the Contract programme.

The Contractor shall submit a report in respect of the various sections of the Works, the equipment in use or held in readiness, 'a return of labour and supervisory staff, and details of any matters arising which may generally affect the progress of the work.

The Contractor shall give a summary of the detailed progress report giving the position with regard to the agreed Contract programme.

The progress reports shall be set out in a format to the approval of the Consultant, and forwarded promptly so that on receipt the information contained therein is not more than 21 days out of date.

If during execution of the Contract, the Employer considers the progress position of any section of the work to be unsatisfactory, or for any other reason relating to the Contract, he will be at liberty to convene a meeting and the Contractor's Representatives are to attend such meeting.

The Contractor's Site Office shall prepare and submit 6 copies of a weekly progress report to the Employer and Engineer's Site Office. This report shall summarize site activities and record and details where difficulties in maintaining the agreed programme are being experienced or are likely to cause subsequent delay.

The Contractor's Site Office shall also prepare and submit to the Engineer's Site Office 2 copies of Daily Activity Report summarizing the main activities to be undertaken each day, noting special activities such a tests, alignment checks, etc. The Contractor shall be responsible for expediting the delivery of all material and equipment to be provided by him and his subcontractors.

36. Photographs

As soon as work commences on Site, the Contractor shall provide photographs (at least 10 to 12) of the works from positions to be selected by the Engineer. Each photographic print shall not be less than 297 mm x 210 mm and shall bear a printed description, a serial number and the date when taken.

The negatives of all photographs shall be held at the Contractor's Site Office, numbered and handed over to the Employer at the completion of the Contract.

37. Facilities for the Engineer

37.1 Site Office

The Contractor shall construct, provide and maintain Consultant's Site Office of about 125-150 square meter covered area as per the specifications. A preliminary layout of the site office shall be provided by the Consultant. After receiving letter of award the Contractor will submit to the Engineer detailed shop drawings for review and approval. Specifications for construction of site office shall be the same as provided in Volume-II of the tender documents.

The Consultant's site office shall be furnished and equipped with new and unused furniture, equipment, air-conditioners, electrical fittings etc., as per the list given below:

1	Wooden office table with drawers and side racks	4 (Four) No.
2	Office Chairs	4 (Four) No.
3	Wooden sitting visitors chairs with arms (standard size)	10 (Ten) No.
4	Steel filing cabinet (standard size)	4 (Four) No.
5	Split type (1-1/2 ton)	4 (Four) No.
6	Electric Kettle	2 (Two) No.
7	Computer Dual Core, Original Intel processor 2GB DDR2 Ram, 160 GB hard disk, 17" LCD Monitor along with Laser Printer (A-3 Size), Scanner, DVD Writer, Speakers, Licensed software for microsoft, MS office and autocad.	3 (Three) No.
8	56 k Speed Modem Card and Min,.1MB USB Internet Device including monthly charges etc.	3 (Three) No.
9	Computer Table & chair	3 (Three) No..
10	Conference Table (1.5 meter x 1.0 meter) & chairs 12Nos.	1 (One) set.

Mobile & Landline Telephone with connections 1 (One) No. Each Engineer. The Contractor shall furnish Rupees 2,000/= per month to the Engineer for the Mobile Cards.

If any equipment, furniture and installations become unserviceable for any reason whatsoever the Contractor shall promptly replace the same as and when directed by the Consultant. The Consultant's Site office with fittings, fixtures and all other equipment/accessories shall be maintained and operated for the entire duration of construction period as well as for the duration of subsequent defects liability period.

The Site Office including fittings, fixtures, furniture, furnishing and all other equipment/accessories shall be the property of the Employer on completion of the Contract.

37.2 Transport

The Contractor shall provide, operate and maintain One brand new, 1000CC, (with AC) & One Brand New 800CC, (with AC) or the equivalent facility will be provided on Rental car facility for the use of the Consultants' site supervision/ monitoring team to meet his transportation needs for the entire duration of actual construction period as well as for the duration of subsequent defects liability period. The use of such transport facility shall be under the control of the Engineer, and the Contractor shall be wholly responsible for providing at all times satisfactory operating services for the Engineer. The Contractor shall furnish, supply and provide, as may be necessary without specific direction of the Engineer, all fuels, lubricants, tires and other supplies, all maintenance, repairs and running costs and suitably qualified drivers at all times. The

Contractor shall furnish Rupees 12,000/= per month per car to the Engineer for the fuel (CNG / Petrol) purposes.

Prior to Ordering the Vehicles, the Contractor shall furnish to the Engineer for approval, detailed specification, name of manufacturer and model no. of the vehicles to be supplied. These data shall be presented within one week from the date of Engineer's Order to proceed with the works and the vehicles shall be furnished to the Engineer upon approval within two weeks from the date of Engineer's Order to supply the Vehicle.

Failure of the Contractor to do so shall make him liable' to bear its cost up to Rs. 80,000 per month, per car. The vehicles shall be right hand dive, and shall be brand new, properly serviced and ready for use. The Contractor shall provide vehicle to replace any such motor vehicle that is temporarily or permanently rendered unserviceable for any reason or declared to be beyond repair by the Engineer. at no additional cost to the Employer. The vehicles shall become the property of the Contractor on completion of the Contract including defects liability period. If the contractor fails to provide the facilities as per tender documents then deductions as specified in tender documents will be made from contractors running bill and same will be compensated / paid to consultant.

37.3 Contractor's Employees

The Contractor shall provide and employ on the Site for the purpose of or in connection with the Contract:

S. No	Staff to be Employed with Qualification	No.	Experience
1	Project Manager - B.E. in Civil	1	Minimum 15 years experience
2	Senior Site Engineer - B.E./B.Tech in Civil	1	Minimum 8 years experience
3	Site Inspector - D.A.E. (3 years)in Civil	2	Minimum 5 years experience.
4	Site Inspector - D.A.E. (3 years) in Electrical / Mechanical	1	Minimum 5 years experience.
5	Surveyor - D.A.E. (3 years) in Civil	1	Minimum 5 years experience.
6	Material Engineer - B.E in Civil / M.Sc. in Geology	1	Minimum 10 years experience.
7	Quantity Surveyor - D.A.E. (3 years) in Civil	1	Minimum 10 years experience.

S. No.	Staff to be Employed with Qualification	No.	Experience
1	Work Superintendents	3	Metric / non-metric with 10 to 15 years experience in the construction of RCC work and can understand drawings well
2	Remaining staff be employed by the Contractor as required at site as per schedule of Work		

38. Payment of Work

No payment shall be made for the works involved within the scope of this section of specification. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

SECTION – 2 CONTRACTOR'S CAMP

1. Scope

The work to be done under this item consists of construction, erection, installation and maintenance of the Contractor's Project Site Offices or main camp and the Contractor's sub-camps or temporary camps, if any, and shall include all offices, shops, warehouses, and other operational buildings; all' housing and related facilities including accommodations for the Contractor's personnel.

The location of the Contractor's camps, including all buildings, utilities and facilities there for, and of the camps or establishments of all persons/parties in the vicinity operating or associated with the Contractor shall be subject to approval of the Engineer.

The work to be done under this item will terminate upon the actual Completion Date. However, if directed by the Consultant or the Employer, the Contractor shall continue such work to the extent required by the Contractor's personnel during the period of maintenance. No compensation shall be paid for the continued operation and maintenance of the Contractor's Camps during the period of maintenance.

Upon completion of the Works, or at such time within the period of maintenance as directed by the Consultant, the Contractor shall remove all buildings utilities and other facilities from the Site and restore all camp areas to a neat and clean condition.

The construction, operation and maintenance of all camps of the Contractor shall comply with all applicable provisions of current Pakistan Labour Camp Rules.

Adequately equipped and properly staffed portable first aid stations or dispensaries shall be provided by the Contractor at camps and other strategic locations to administer first aid treatment at any time required and free of charge to all persons on the Site, including employees of the Consultant and the Employer.

2. Payment of Work

No payment shall be made for the works involved within the scope of this section of Specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been include in the quoted unit rate of other items of the Bills of Quantities.

SECTION – 3 STAKE-OUT SURVEY

1. Scope

Under this item the Contractor shall make the stakeout survey for construction purposes with competently qualified men, consistent with the current practices. The work shall proceed immediately upon the award of the contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stakeout survey. The scope of this section of specifications is covered by detailed specifications as laid down herein.

2. Material and Equipment

All instruments, equipment, stakes and other material necessary to perform all work shall be provided by the Contractor. These instruments and equipment shall be available to Engineer at all times for the purpose of checking the work of the Contract.

All stakes used shall be of a type approved by the Engineer, clearly and permanently marked so as to be legible at all times. It shall be the Contractor's responsibility to maintain these stakes in their proper position and location at all times. Any existing stakes or markers defining property lines and survey monuments which may be disturbed during construction shall be properly tied into fixed reference point before being disturbed and accurately reset in their proper position upon completion of the work.

3. Construction

The Contractor shall trim trees, bushes and other interfering objects, not consistent with the plan, from survey lines in advance of all survey work to permit accurate and unimpeded work by his stake-out survey crews and the Engineer's survey crews. The exact position of all work shall be established from control points, which are shown on the plans or modified by the Engineer. Any error, apparent discrepancy in or absence of data shown or required for accurately accomplishing' the stakeout survey shall be referred to the Engineer for interpretation or furnishing when such is observed or required.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc. throughout the life of the contract. Damaged, destroyed or inaccessible reference points, bench marks or stakes shall be replaced by the Contractor. Existing or new control points that will be or are destroyed during construction shall be re-established and all reference ties recorded thereon shall be furnished to the Engineer. All stakeout survey work shall be referenced to the centerlines shown on the Plans. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be kept neatly and made available to the Engineer upon request and furnished to the Employer upon Contract completion.

The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be immediately made. Such checking by the Engineer shall not relieve the

Contractor of any of his responsibilities for the accuracy or completeness of his work.

Reference points, base lines, stakes and benchmarks for borrow pits shall be established by the Contractor.

All required right-of-way and easement limits shall be established, staked and referenced by the Contractor concurrent with the construction stakeout survey.

The Contractor shall place at least two offset stakes or references at each centre lines station and at such intermediate stations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly marked with the correct centre line, station number, offset and cut or fill so as to permit the establishment of the true centre line location during construction. He shall locate and place all cut, fill, slope, line grade or other stakes and points as the Engineer may direct to be necessary for the proper progress of the work.

4. Payment of Work

No payment shall be made for the Works involved within the scope of this section of Specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

SECTION – 4 CLEARING AND GRUBBING

1. Scope

The clearing and grubbing shall consist of clearing the designated area of all trees, down timber, snags, bush, other vegetation, rubbish and all other objectionable material, and shall include grubbing stumps, roots, and matted roots, and disposal of all spoil material resulting from the clearing and grubbing. It shall also include the removal and disposal of structures that protrude, encroach upon, or otherwise obstruct the work, except when other vise provided for on the plans or directed by the Engineer to be saved. The scope of this section of specifications is covered with detailed specifications laid down herein.

2. Limit of Area

2.1 Location of Works

The Engineer will define the limit of areas where clearing and grubbing is to be done. Normally it will include all land within the right of way and all other construction area including ditches, detours, minor road crossings and other areas shown on the plans or as specified or as directed by the Engineer. The Engineer will designate the fences, structures and debris and trees and bushes to be cleared where grubbing is not required. It shall not include clearing and grubbing of borrow or other pit areas from which material is secured. It shall include the leveling or removal of all bunds or mounds within the right of way unless otherwise directed by the Engineer.

2.2 Grubbing and Cutting

All roots and stumps within the limits of the site shall be grubbed and excavated unless otherwise specified or approved by the Engineer.

2.3 Disposal

All wood and bush shall be burned or otherwise disposed off within fifteen (15) days after cutting or felling unless otherwise approved. No tree trunks, stumps or other debris shall be left within Site unless approved in writing by the Engineer. The location of disposal areas shall be within or outside the limits of the project or as approved in writing by the Engineer and shall be acquired by the Contractor at his own expense. Any useable material shall remain the property of the Employer.

2.4 Protection and Restoration

The Contractor shall prevent all damage to pipes, conduits, wires, cables or structures above or below ground. No land monuments, property markers, or official datum points shall be damaged or removed until the Engineer has witnessed or otherwise referred their location and approved their removal. The Contractor shall so control his operations as to prevent damage to trees and shrubs, which are to be preserved. Protection may include fences and boards lashed to trees tv prevent damage from machine operations. The existing

covered or open benchmarks should be relocated as directed by the Engineer. In the event that anything specified herein to be saved and protected is damaged.

SECTION – 5 DISMANTLING WORKS

1. Scope

The work covered by this Section of the Specifications consists of furnishing all plant, labour, equipment, appliances and performing all operations in connection with demolition! dismantling and removal of existing building components, walls, floors, skirting, plaster and removing of doors, windows and ventilators, removal / re-routing of utility services of the building with accessories, removal of existing roof finishes and disposal/stacking of material to designated places. Whole work shall be done in accordance with these and other relevant specifications and as directed by the Engineer.

2. Procedures

2.1 The Engineer will define the limits where demolition/ dismantling and removal activity is to be done and shall approve the procedures/methods to be adopted by the Contractor.

2.2 Whole work shall be performed in an orderly manner and the Contractor shall take all necessary precautions and expedients to prevent damages to the adjacent structures, installed equipment/machinery, pipes, conduits etc. Any damage caused to the structures and installations due to negligence of the Contractor during demolition dismantled and removal operations shall be repaired/replaced by the Contractor at his cost and to the satisfaction of the Engineer.

3. Demolition of Building Components

3.1 The Contractor shall demolish walls, floors skirting, cutting of plaster, removing of doors, windows, ventilators, concrete/ masonry works and other associated parts to the line and depth as shown on the Drawings or as directed by the Engineer. Explosives shall not be used to remove the plain and reinforced cement concrete or any other material whatsoever. Manually or where required mechanically operated breakers, concrete saws, chipping hammers or other approved methods shall be employed for cutting. Care shall be taken that existing services and structures are not damaged. It shall be the responsibility of the Contractor to replace at his cost any services, Structures damaged by the Contractor due to his negligence during cutting operations or thereafter until the whole of cut parts areas are restored to original condition to the satisfaction of the Engineer.

4. Removal of Existing Services/ Utilities/Finishes

4.1 The Contractor shall mark all the services/ utilities falling within the Contract area. After getting approval from the Engineer, the contractor shall remove all such Services/utilities/finishes as per the requirement specifications of the relative department whose utilities/services finishes are being removed/ shifted.

5. Disposal

5.1 All debris materials resulting from demolition / dismantling works

shall be disposed off to places designated by the Engineer in the manner of disposition required and directed by the Engineer.

5.2 All useable materials resulting from demolition and removal shall remain the property of the Employer and shall be stacked at designated places.

6. Measurement and Payment

6.1 General

Except otherwise specified herein or elsewhere in the Bill of Quantities/Contract Documents no measurement and payment will be made for the under mentioned items related to this section. The cost thereof shall be deemed to have been included in the quoted unit rate of the other items of the Bill of Quantities under this section.

6.1.1 Temporary diversion and safety measures.

6.1.2 Loading, unloading, transportation and disposal of demolished dismantled/removed/useable material to the place designated by the Engineer.

6.1.3 Permissions/approvals, if required, from the relative department.

6.1.4 Stacking of all useable material to the place designated by the Engineer.

6.1.5 Earth work

6.1.6 Shifting of Existing lines, Sewer line, and water supply lines or rerouting the same as per new design and drawing.

6.1.7 Shifting of Existing Generators, Transformers, Panels, Switch boards and all electrical / plumbing accessories including motors / pumps as per new design and drawing.

6.2 Dismantling of Tile Floors/Dado/Skirting / Wall fly proof jail

6.2.1 Measurement

Measurement for acceptably completed works of dismantling and removal of existing tile floors/dada/skirting/wall/fly proof jali and staking of useable material at designated places will be made on the basis of actual area in square foot of dismantled floor/dado/skirting/wall/fly proof jali as directed by the Engineer.

6.2.2 Payment

Payment will be made for acceptably measured quantity of dismantled tile floor/dado/skirting/wall/fly proof jali on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

6.3 Removal of Doors and Windows with Chowkhats

6.3.1 Measurement

Measurement for acceptably completed works of removal of

existing doors/windows with chowkhats and staking of useable material at designated places will be made on the basis of actual number of removed doors/windows with chowkhats as directed by the Engineer.

6.3.2 Payment

Payment will be made for acceptably measured quantity of removal of existing doors/windows with chowkhats on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

6.4 RCC Slab

6.4.1 Measurement

Measurement for acceptably completed works of removal of existing RCC slab will be made on the basis of actual volume in cubic feet of dismantled concrete as directed by the Engineer.

6.4.2 Payment

Payment will be made for acceptably measured quantity of dismantling of existing RCC slab on the basis of unit rate per cubic feet quoted in the Bill of Quantities full compensation for all the works related to the item.

6.5 Removing / Chipping of Plaster (Int. / Ext.) at any level at any height.

6.5.1 Measurement

Measurement for acceptably completed works of removing and chippimg of existing Plaster and debris to be shifted out side the premises / at designated places will be made on the basis of actual area in square foot of removed plaster as directed by the Engineer.

6.5.2 Payment

Payment will be made for acceptably measured quantity of removing / chipping of existing plaster on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

6.6 Removing / Electrical / Plumbing fitting and fixtures at any level at any height.

6.6.1 Measurement

Measurement for acceptably completed works of removing of

Electrical / Plumbing fitting and fixtures and stacked at designated places will be made on the basis of actual in Nos. of removed items as directed by the Engineer.

6.6.2 Payment

Payment will be made for acceptably measured quantity of removed fittings and fixtures on the basis of unit rate per Nos. quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

SECTION – 6 EARTH WORK

1. Scope of Work

The work under this section of the specification consist of furnishing all plant, labour equipment, appliances and materials and in performing all operations in connection with earthworks of all underground services and structural units, stock piling of suitable excavated material, disposal of unsuitable and surplus excavated material in accordance with this section of specifications, the applicable drawings and subject to terms and conditions of the Contract.

2. General

2.1 The Contractor shall be deemed to have made. local and independent inquires as to, and shall take the whole risk of, the nature of the ground subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive an extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.

2.2 All excavations, cut and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Period of Maintenance· the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Period of Maintenance any damage or defects in cuts and fills, in structures and other works, caused by slips, falls of wash-ins or any other ground movement due to the Contractor's negligence shall be made good by the contractor at his own cost.

3. Site Preparation

3.1 The Contractor shall set out the works and shall be responsible for true and perfect Setting out of the same and for correctness of the positions levels, dimensions and alignments of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall at his own expense rectify such error, to the satisfaction of the Engineer.

3.2 The Contractor shall construct and maintain accurate bench marks so that the Lines and Levels can be easily checked by the Engineer.

3.3 The Contractor shall perform a joint surely with the Engineer's Representative, of the area where earth work is required, plot the ground levels on the drawings and obtain approval from the Engineer before starting the earth work and shall supply a copy to the Employer duly checked, signed and authenticated by the Engineer before start of work.

4. Excavations

4.1 Excavation shall include the removal of all material of every name and nature. It is expected that rock and other hard material will be encountered during excavation, The rate of excavation shall include the removal of all sub-surface material of every name and nature and

no classification of sub-surface material shall be made nor any additional payment shall be made.

4.2 The major portion of excavations shall be carried out by mechanical excavators and excavated materials disposed off to stock on spoil as directed by the Engineer. The excavation may be done by normal means, unless otherwise specified by the Engineer, leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and backfill if approved by the Engineer shall be stockpiled within the limits of whole of the Site as directed by the Engineer. Excavated material unsuitable for use as fill and backfill shall be disposed off by the Contractor at locations approved by the Engineer within specified free haulage limit.

4.3 The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the Engineer full details of his proposals. The Engineer's approval shall not relieve the Contractor of his responsibility with respect to such work.

4.4 The Contractor shall preserve the completed excavation from damage due to slips' and earth movements, ingress of water from any source whatsoever and deterioration by exposure to the sun and the effects of the weather.

All excavations shall be kept free of water and shall be maintained dry to the satisfaction of the Engineer. Prevent surface water and sub-surface water and sub surface ground water from flowing into the excavation and flooding the project site and surroundings.

Do not allow water to accumulate in excavations, remove water from excavations to present softening of foundation bottoms, under cutting footings and soil changes determined to the stability of sub-grades and foundations. Provide and discharge lives necessary to convey the water away from the excavations convey water removed from excavation and rain water to outside the limits in manner that no damages is caused to the surrounding services properties.

4.5 Excavation for pits, cable trenches, equipment-foundations and other structures shall be taken out to the levels and dimensions shown on Drawings or such other levels and dimensions as the Engineer may direct.

4.6 Excavation shall extend to adequate distance from walls and footings to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted. The additional excavation for placing and removal of forms, installation of services, for inspection and generally for working area on slopes for stability shall not be measured for payment and shall be deemed to be included in the rates for excavation as measured net.

4.7 All' excavations in foundations shall be taken to 6 inch above the final excavation elevations shown on the drawings and the 6-inch shall be trimmed carefully to a smooth and level surface. Immediately after trimming to the final elevation, a layer of blinding concrete shall be placed to the thickness shown on the drawings. All excavations for foundations which have been trimmed and disturbed shall be

compacted and covered by lean concrete by the end of the day.

4.8 No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Engineer and his permission to proceed is given.

4.9 If excavation for sub-structures are carried below the required level, as shown on the Drawings or as directed by the Engineer, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the Contractor.

4.10 All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry.

4.11 Shoring, where required during excavation, shall be installed to protect workmen and the bank, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of the Engineer, for upholding the sides of excavation and also for planking and strutting to excavation against the side of roadways and adjoining properties in existing hardcore of any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect.

4.12 Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his own expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Engineer. When utility lines which are to be removed, ace encountered within the area of operations the Contractor shall notify the Engineer in. ample time for the necessary measures to be taken to prevent interruption of the service.

4.13 Where applicable the excavation work shall include the excavation in above water table and excavation below water table. The Contractor shall provide all plant, equipment, pumps, sheeting, well points as required to keep the water table 3.0 feet below the deepest foundation as shown on the drawings till the completion of foundation works.

4.14 4.14 Before starting the excavation for pipelines, the Contractor shall ensure the correct alignment of the pipeline on the ground the depth and width of excavation of the trench, all in accordance with the Drawings and instructions of the Engineer. The Contractor shall make profile with cement concrete pillars.

4.15 Excavation shall be carried out true to lines, levels, grades and widths as shown on the drawings or as directed by the Engineer ensuring proper laying of the pipe line, the bedding fill, construction of chambers for appurtenances and any other structures. The trench bottom shall be graded to provide even and substantial bearing over the specified bedding and of the structure.

Without the written permission of the Engineer, not more than 600

feet of the trench shall be opened in advance of the completed pipeline.

4.16 The Engineer may require the Contractor to excavate below the .elevations shown on the drawings or he may order him to stop above the elevations shown depending upon the suitable foundation material encountered,.

4.17 If for any reason, the levels, grades or profiles of the excavations are changed adversely by the Contractor, the Contractor shall at his own cost, be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the Engineer.

5. Excavation Tolerances

Excavation shall be performed within the tolerances for excavation limits indicated on the drawings, where no tolerance limits are indicated excavation shall be performed to tolerances established by the Engineer as acceptable for the design and type of work involved.

6. Fill and Backfill

6.1 The backfilling shall include filling under the floors, around the foundation trenches, pipes, conduits, ducts and channels.

The backfilling shall include loading, unloading, transporting, placing, stacking, spreading of earth, watering, rolling, ramming and compacting, etc., complete as specified herein.

6.2 The excavated material if found suitable shall be stockpiled within the free haulage limit of the Project Boundary. This material shall be used for filling/back-filling if approved by the Engineer and shall be transported by the Contractor anywhere required for the purpose of filling/back-filling work in this Contract.

The Contractor shall provide the approved quality of backfill and fill material required to complete the fill and back- filling work from the places /borrow areas as designated by the Engineer. All necessary permissions from any authority for excavation within Borrow areas/ designated places shall be of contractor's responsibility. Deep filling shall be predominantly granular material and free from slurry mud, organic or other unsuitable matter and capable of compaction by ordinary means.

6.3 Material for backfilling shall be as approved by the Engineer and shall be placed in layers not exceeding 6 inches measured as compacted material with sufficient water and compacted to produce in-situ density not less than 95% of the maximum dry density at optimum moisture content.

6.4 Depending on the depth of fill the Engineer may instruct increased thickness of successive layers to be placed. The filling shall be compacted by mechanical means as approved by the Engineer.

6.5 Filling around pipes and cables shall be carefully placed with fine material to cover the pipe or cable completely before the normal fill is placed.

6.6 Backfilling of trenches/foundations shall be carried out only after the pipe line/structural works within the excavations have been inspected, tested and approved by the Engineer.

Fill shall not be placed against foundation walls prior to approval by the Engineer. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the wall.

7. Tolerances

The stabilization of compacted backfill / fill surface shall be smooth and even and shall not vary more than 3/8 inch in 10 feet from true profile and shall not be more than 1/2 inch from true elevation.

8. Disposal of Surplus Excavated Material

8.1 The rejected unsuitable material and surplus excavated material shall be disposed off at designated place or as directed by the Engineer. No compensation of any lead/lift is . admissible and rates quoted shall be deemed to include the same.

8.2 The disposal of surplus/unsuitable excavated material shall include loading, unloading, transporting, stacking, spreading and leveling as directed by the Engineer.

9. Measurement and Payment

9.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned works 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.

9.1.1 Timber shoring, planking, strutting and providing slope for upholding the sides of excavations.

9.1.2 Any fill with approved material necessitated by over excavation due to fault or convenience of the Contractor except under structural members.

9.1.3 Stockpiling the excavated material at approved location within free haulage limit of the Project Boundary and transporting back suitable material to places requiring fill or backfill.

9.1.4 Specified foundation bed preparation.

9.1.5 Excavation involved in providing adequate working space around sides of foundation and service line trenches.

9.1.6 Providing approved quality fill/backfill material obtained from excavated material as designated by the Engineer.

9.1.7 Rolling, leveling, watering & compacting the fill and backfill to required density.

9.1.8 All laboratory and field tests stipulated in these specifications.

9.1.9 Disposal of rejected surplus and unsuitable excavated material at designated place or as directed by the Engineer. No compensation of any lead/lift is admissible and rates quoted shall be deemed to include the same.

9.1.10 De-watering to keep the foundations dry during construction.

9.1.11 All cost inclusive of borrow area's royalty charges

9.1.12 Testing of Sub-grade material equal to or greater than CBR value 10%

9.1.13 Providing and testing of sweet earth.

9.2 Excavation

9.2.1 Measurement

Quantities of excavation shall be, circulated / measured from the pre-work levels of leveled and graded ground taken jointly by the Contractor and the Engineer before commencement of the work.

The quantities set out for excavation and its subsequent disposal shall be deemed to be the bulk quantity before excavating and no allowance shall be made for any subsequent variations in bulk or for any extra excavation.

Unless otherwise shown on the Drawings quantities of excavation shall be measured of acceptably completed works on the basis of vertical excavations required in accordance with lines of concrete.

Quantities of excavation for laying service line trenches shall be measured for payment on the basis of vertical excavation faces for the specified width for the trench as shown on the drawings.

Measurement for acceptably completed excavation works shall be made on the basis of number of cubic feet of material excavated for foundation and service trenches as shown on the Drawings or as directed by the Engineer.

9.2.2 Payment

Payment will be made for acceptably measured quantity of excavation on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item, including but not limiting to back filling.

9.3 Backfill/Fills

9.3.1 Measurement

Measurement for acceptably completed backfill/fill works will be made on the basis of number of cubic feet of compacted back fill / fill in position in accordance with the lines, levels and grade as shown on Drawings or as directed by the Engineer.

9.3.2 Payment

Payment will be made for acceptably measured quantity of backfill/fill on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 7 FORM WORK

1. Scope

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in any floor and roof and floor and at any height in connection with the supply and installation of formwork for the purpose of shuttering in concreting work, complete in strict accordance with this section of the' specifications and the applicable drawings and subject to the terms and conditions of the Contract. The works include all formwork required at any floor and at any height required for the completion of the work as per drawings/specifications.

2. General

It shall be the responsibility of the Contractor to perform the work by engaging well-trained & experienced staff or by the sub-contractor who shall have enough number of well-trained and experienced staff to coordinate his activities with the other operations. However the Contractor shall be responsible for the quality of work performed by the sub-contractor -as per the requirements of these specifications.

3. Materials

The Contractor shall use the following formwork materials for different purposes as stated below:

3.1 Timber

Form framing, sheathing and shoring.

3.2 Plywood

Form sheathing and panels.

3.3 Steel

Heavy forms and false Work Column and joint forms Permanent forms Welding of permanent forms

3.4 Form Ties Anchors and Hangers

For securing formwork against. placing loads and pressures.

3.5 Coatings

To facilitate form removal.

3.6 Steel Joists

For formwork support.

3.7 Steel frame shoring

For formwork support.

4. Delivery And Storage

4.1 Delivery

The delivery of formwork materials shall be done in such a manner that damage can be prevented.

4.2 Storage

Formwork should be stored, after cleaning and preparing for re-use if used before, in. such a manner that access to all different materials is available.

Material which can be affected by weathering :)hall be stored in appropriate building or under covers and shade.

5. Workmanship

5.1 Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

Where required details and locations of special forms to be used are set out on the drawings. The Engineer shall refuse any formwork in any part of the building, which has been constructed with a non-approved formwork. The Engineer shall refuse any concreting which will not be perfect or may not conform to the approved model.

5.2 Earth cuts shall not be used as forms for vertical surfaces of reinforced concrete work unless required as such or permitted by the Engineer.

5.3 Mud centering shall not be permitted without the prior approval of the Engineer.

5.4 Formwork shall be of wrought timber steel, plywood, proprietary building boards and such special materials, as may be shown on the drawings or approved by the Engineer, which give the required finish to the surface of concrete. Wooden formwork shall be free from loose knots and shall be well seasoned.

The responsibility of the safe design of the formwork shall be entirely that of the Contractor.

a) No wooden props, bamboo, ballies etc., shall be used as supports to beams or roofs and floors. Only steel pipe scaffoldings (tubular) to be used for all works.

b) No wooden formwork shall be allowed to be used in columns, roofs and floors and beams etc. All the form work shall be of steel as approved.

c) Only wooden planks of approved quality and thickness of 2 inches minimum on the sides of beams shall be allowed.

d) All the erected formwork shall be inspected and approved in all respects by the Engineer or his representative prior to concreting.

e) Where concrete will be exposed to view, special care shall be taken in the selection of the form material and the construction of the forms, to the end that the concrete will be smooth, uniform in texture, true in line and face and free from honey-combing and other projections. All sides and joints on the forms shall be flush (without lipping) and inconspicuous, wood used for such work shall be thoroughly cleaned before each reuse

and shall be free from cracks, splinters, nails, or other defects effecting the appearance of the concrete.

5.5 The formwork shall conform to the shape, lines and dimensions as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete, and shall be sufficiently tight to prevent loss of liquid from the concrete. The design and Engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Where necessary, to maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. The Contractor shall establish and maintain in an undisturbed conditioned until final completion and acceptance of the project, sufficient control points and benchmarks to be used as references for checking upon tolerances.

5.6 Forms for architectural concrete shall be designed to produce the required finish or finishes. Deflection of facing materials between studs as well as deflection of studs and wailers shall be limited to 0.0025 times the span or as otherwise specified. Forms shall be designed to permit easy removal. Prying against the face of the concrete shall not be allowed. Only wooden wedges shall be used.

5.7 Where natural plywood-form-finish, grout-cleaned-finish, smooth-rubbed- finish, scrubbed-finish or sand-floated-finish is required, forms shall be smooth (faced with plywood, liner sheets, or pre-fabricated panels) and true to line, in order that the surfaces produced will require little dressing to arrive at true surfaces. -Where any as-cast finish is required, no dressing shall be permitted in the finishing operation.

5.8 Where as-cast surfaces, including natural plywood-form-finish are specified, the panels of material against which concrete is cast shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features.

5.9 Where panels for as-cast surfaces are separated by recessed or otherwise emphasized joints, the structural design of the forms shall provide for locating form ties, where possible, within the joints so that patches of tie holes will not fall within the panel areas.

5.10 Forms shall not be re-used if there is any evidence of surface wear and tear or defect, which would impair the quality of the surface finish. Forms shall be thoroughly cleaned and properly coated with form oil before re-use.

5.11 The formwork shall be designed so that the soffits of slabs and sides of beams, columns and walls may be removed first, leaving the forms to the soffits of beams and their supports in position.

5.12 Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Unless otherwise specified in the Contract Documents chamfer strips shall be placed in the corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on

such surfaces and the edges of formed joints will not require beveling unless required by the Contract Documents.

5.13 Positive means such as wedges or jacks for accurate adjustment and for proper removal of shores and struts shall be provided and all settlement shall be monitored during concrete placing operation. Forms shall be securely braced against lateral deflections.

5.14 Where concreting of thin members is required to be carried out within formwork of considerable depth, temporary openings in the sides of the formwork shall be provided where necessary to facilitate the placing and consolidation of concrete. Small temporary openings shall also be provided at the bottom of the formwork for columns, walls and deep beams to permit the cleaning out of debris and observation immediately before concrete is deposited.

5.15 Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spelling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 diameter or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4 inch. When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut of flush with the formed surfaces. Precaution shall be taken not to rotate form ties. Through bolts may be permitted provided that they are greased to allow for easy withdrawal and the holes subsequently made good. Through bolts are not to be used on water-retaining structures and basement walls.

5.16 At construction joints contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by no less than 1. Inch. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint so as to maintain a true surface.

5.17 Wood forms for wall opening shall be constructed to facilitate loosening, if necessary to counteract swelling of the forms.

5.18 Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check.

5.19 Formwork shall be so anchored to shores or to other supporting surfaces or members that upward or lateral movement of any part of the formwork system during concrete placement will not occur.

5.20 Runways or planks for moving labour and equipment shall be provided with struts or legs and shall be supported directly on the formwork or upon the structural member without resting on the reinforcing steel.

5.21 All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before placing fresh concrete.

Forms shall be sufficiently tight to prevent leakage of grout or cement paste. Board forms having joints opened by shrinkage of the wood shall be removed and replaced. Plywood and other wood surfaces not subject to shrinkage shall be sealed against absorption of moisture from the concrete by either:

1. A field applied, approved form oil or sealer, or
2. A factory applied non-absorptive liner .

When forms are coated to prevent bond will concrete, it shall be done prior to placing of the reinforcing steel. Excess coating material shall not be allowed to stand in puddles in the forms nor allowed to come in contact with the concrete against which fresh concrete will be placed. Care shall be taken that such approved composition is kept out of contact with the reinforcement. Whereas-cast finishes are required, materials, which will impart a stain to the concrete shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surfaces shall be compatible with the type of paint to be used.

5.22 For reinforced concrete, in no circumstances shall forms be struck until the concrete attains 75% of ultimate strength.

The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions, and cured under conditions of temperature and moisture similar to those obtaining in the work. Where possible, the formwork should be left for longer time as it would assist the curing.

In normal circumstances (generally where temperatures are above 20° C and where ordinary cement is used, forms may be struck after expiry of the following periods. Walls, columns and vertical sides of beams.48 hours or as may be decided by the Engineer.

Side of slab (shores of props left under)	6 days.
Beams soffits (shores or props left under)	12 days.

Removal of shores or props to slabs.

Spanning up to 12 feet.	10 days.
Spanning over 12 feet.	16 days.

Removal of shores or props to beams.

Spanning up to 18 feet.	18 days
Spanning over 18 feet.	25 days

For rapid hardening cement 3/7 of the above period will be sufficient in all cases except vertical sides of slabs, beams and columns which should be retained for a minimum of 24 hours.

The number of shores or props, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab and beams, as the case may be.

Proper allowance shall be made for the decrease in rate of hardening of concrete in cold weather and the above minimum duration must be increased when the mean daily temperature is below 20° C.

5.23 When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

5.24 Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping .surfaces

shall be performed at once and be followed by the specified curing.

5.25 Wood forms for wall openings shall be removed as soon as this can be acomplished without damage to the concrete.

5.26 All formwork shall be removed without such shock or vibration as would damage the reinforced concrete. Before the top plank and struts are removed, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. Proper precautions shall be taken to allow for the decrease in the rate of hardening that occurs with all cement in the cold weather.

5.27 When reshoring or repropping is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is underway no live load shall be permitted on the new construction. In no case during reshoring shall concrete in beam, slab, columns or any other structural member be subjected to combined dead and construction loads in excess of the load permitted by the Engineer for the developed concrete strength at the time of reshoring.

Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of working day on which stripping occurs.

Reshores shall be tightened to carry their required loads without overstressing the construction. Reshores shall remain in place at least until tests representative of the concrete being supported have reached the strength specified in sub-clause 5.23 hereof.

5.28 Floors supporting props or shores under newly placed concrete shall have their original supporting props or shores left in place or shall be reshored. The reshoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one half the capacity of the shoring system above. The reshores shall be located directly under a shore position above unless other locations are permitted.

The reshoring or re-propping shall extend over a sufficient number of storey’s to distribute the weight of newly placed concrete, forms, and construction live loads in such. a manner that the design superimposed loads of the floors supporting shores or props are not exceeded.

5.29 It is generally desirable to give forms for reinforced concrete an upward camber to ensure that the beams or slabs (specially cantilever slabs) do not have a sag when they have taken up their deflection, but this should not be done unless permitted by the Engineer.

5.30 No loads, other than man and light plant required in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland Cement is used and 14 days when rapid hardening Portland Cement is used.

5.31 Prior to placing concrete, all forms shall be inspected and all debris and extraneous matter removed. The form oil or release agent shall not react with concrete to afect the strength nor shall it give any colour.

6. Measurement and Payment

No payment will be made for the works involved within the scope of this section of the specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of relevant items of the Bills of Quantities.

SECTION – 8 REINFORCEMENT

1. Scope

The work under this section of specifications consists of furnishing, cutting, fabricating, bending and placing steel reinforcement in concrete structures or elsewhere as shown on the drawings or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. Applicable Standards

Latest editions of the following Pakistan, British and ASTM Standards are relevant to these specifications wherever applicable.

British Standard

B.S 4449 Carbon steel bars for the reinforcement of concrete.

B.S 4466 Specifications for bending dimensions and scheduling of bars for the reinforcement of concrete.

ACI Standard

ACI315 Details and detailing of concrete reinforcement.

ACI318 Building Code Requirements for Reinforced Concrete and commentary.

ASTM Standard

A 82 Cold - Drawn steel wire for concrete reinforcement.

A 305 Minimum requirement for the deformations of deformed steel bars for concrete reinforcement.

A 615 Deformed Billet Steel Bars concrete Reinforcement.

In addition to the above, the latest editions of other Pakistan Standards, British standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other standard as may be specified by the Engineer for Special Material and construction are also relevant.

3. Material

3.1 Unless otherwise specified, all steel bars for reinforcement of concrete shall be conforming to ASTM A615, Grade 60 deformed hot rolled billet steel bars with minimum yield strength of 60,000 Psi (414Mpa).

3.2 Reinforcement shall be free from all loose or flaky rust and mill scale, or coating, Including ice, and any other substance that would reduce or destroy the bond.

4. Compliance With Specifications

The Contractor shall submit certificates of compliance from the manufacturer stating that the supplied reinforcement conforms to the specifications. In addition, wherever and as directed by the Engineer, conformance of the supplied reinforcing bars with the specifications shall be demonstrated by the

Contractor through laboratory tests, in accordance with the relevant standards.

5. Delivery & Storage

5.1 Delivery

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks as per relevant BS standards.

5.2 Storage

The method of storage shall be approved by the Engineer. Reinforcing bars shall, be stored in racks or platforms above the surface of ground and shall be protected against scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades shall be so labeled and kept separately.

6. Bar Bending Schedules

The Contractor shall prepare bar bending schedules of all the reinforcing steel bars and these bar bending schedules shall be submitted to the Engineer for his approval. The Contractor shall obtain approval of the bar bending schedules before starting actual bar bending works.

The Engineer's approval, however, will not relieve the Contractor of his responsibility in this regard.

7. Fabricating, Bending & Placing

7.1 Reinforcement is to be accurately placed as shown in the drawings, and secured against displacement by using 16 guage G.I wire ties or suitable slips at intersections and supported from the formwork by using concrete, metal or plastic chairs and spacers or hangers of an approved pattern.

Where concrete blocks are used for ensuring the cover, they shall be made of mortar not leaner ·than 1 part of cement to 2 parts of sand.

Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories in contact with the form work shall be galvanized or shall be made of plastic.

7.2 Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the bar bending schedule approved by the Engineer.

7.3 The cutting tolerance for all bars shall be + 25 mm

7.4 Fabrication tolerances shall be as per ACI-315

7.5 Placing tolerances shall be as per ACI-318 & 317.

7.6 Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval of Engineer.

7.7 Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be

furnished for all columns dowels.

7.8 Reinforcement shall not be bent or straightened in a manner that will injure the material. No bars shall be bent twice in the same place, nor shall they be straightened after bending. Unless permitted by Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete.

7.9 No splice of reinforcement shall be made, except as shown on the working drawings.

7.10 Welding of reinforcement shall not be done unless permitted and approved by the Engineer.

7.11 Exposed reinforcement intended for bonding with future extensions is to be effectively protected from corrosion. Protection is also to be provided to reinforcement partly built into concrete where the exposed part is to be built into later concrete.

7.12 No concreting is to be carried out until the reinforcement has been checked and approved by the Engineer.

7.13 All detailing shall be done as per ACI-315, ACI-318 and ACI-350R, as and where required.

7.14 Standard or actual weight whichever is lesser shall be used for calculation of weight.

8. Measurement & Payment

8.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the· quo+9d unit rate of the respective items of the Bill of Quantities.

8.1.1 Providing and installing chairs, supports, hooks, hangars, spacers, binding wires, corrosion protection and laps not shown on Drawings including wastage and rolling margin.

8.1.2 Testing of mild and deformed steel bars.

8.2 Reinforcing Bars

8.2.1 Measurement

Measurement for acceptably completed works of reinforcement bars shall be made by weight according to bar bending schedules approved by the Engineer.

8.2.2 Payment

Payment will be made for access table measured quantity of reinforcement on the basis of unit rate per metric ton quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 9 PLAIN AND REINFORCED CONCRETE

1. Scope

The work under this section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the supply. and installation of plain and reinforced concrete work complete in any floor and at any height as per drawings except where specifically stated in the relevant item of Bill of Quantities, in strict accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the Contract. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. General

2.1 Full co-operation shall be given to trades like electrical, mechanical and other services.

2.2 Suitable templates or instructions or both shall be provided for setting out items not placed in the forms. Embedded items and other materials for mechanical and electrical operations shall have been completed, inspected, tested and approved before concrete is placed.

2.3 For special concrete finish and for special methods of construction (e.g. slip forms), formwork shop drawings shall be designed and prepared by the Contractor, at his own cost. Approval of shop drawings as well as that of actual samples of concrete finish shall be obtained before work is commenced.

3. Applicable Standards

Latest editions of the following Pakistan, British and ASTM Standards are relevant to these specifications wherever applicable.

3.1 Pakistan Standards

PS 177 PS 232 PS 243	Compaction proctor test.
PS 279	Portland Cement (ordinary & rapid hardening). Natural aggregates for concrete.
PS 280	Abrasion of coarse aggregates by the use of Los Angeles machine
PS 281	Determination of aggregate/crushing value.
PS 282	Organic impurities in sand for concrete aggregates.
PS 283	Material finer than No. 200 B.S. test sieve in aggregates, method of test for. Soundness test for aggregates by the use of sodium sulphate or

	magnesium sulphate. Sampling aggregates for concrete.
PS 284	Sampling aggregates for concrete.
PS 285	Sieve or screen analysis of fine and coarse aggregates. Description and classification of mineral aggregates. Sampling fresh concrete.
PS 286	Sampling fresh concrete.
PS 421	Slump test for concrete.
PS 422 PS 560	Making and curing concrete compression test specimen in the field. Sulphate-resistant Portland cement type "A' and sampling fresh concrete in the laboratory.
PS 612	Mixing and sampling fresh concrete in the laboratory.
PS 716	Compacting factor test for concrete.
PS 717	Definitions and terminology of cements.
PS 746 PS 849	Making and curing concrete compression test cubes.

3.2 ASTM (American Society for Testing and Materials)

B 370 C 33 Copper sheet and strip for building construction. Concrete Aggregates.

C40	Organic impurities in sand for concrete.
C87	Effect of organic impurities in fine aggregates on of mortar. Soundness of aggregates. Ready mixed Concrete.
C88	Compressive strength of hydraulic cement mortars.
C94	Material finer than NO.200 (0.075mm) sieve. Light-weight pieces in aggregates.
C109	Concrete and concrete aggregates.
C117	Specific gravity and absorption of coarse aggregate.
C123	Specific gravity and absorption of fine aggregate.
C125	Resistance to abrasion of small size coarse aggregates.
C127	Sieve or screen analysis of fine and coarse aggregate. Clay lumps and friable particles in aggregates.
C131	Slump of Portland Cement Concrete.
C136	Aggregate for masonry mortar.
C142	Portland Cement.
C143	Water retention by concrete cunning material
C144	Sheet material for curing concrete.
C150	Air content or hydraulic cement mortar.
C156	Density of hydraulic cement.
C171	Time of setting of hydraulic cement by vicat needle.
C185	Air entraining admixtures for concrete.
C188	Potential reactivity of aggregate.
C191	Liquid membrane-forming compounds for curing concrete.
C260	Lightweight aggregates for structural concrete.
C289	Lightweight aggregates for concrete masonry.
C309	Lightweight aggregates for insulating concrete.
C330	Chemical admixtures for concrete.
C331	Resistance to abrasion of large size coarse aggregates.
C494	Unit weight of structural lightweight concrete.

C535 Aggregate sampling.
C567 Preformed expansion joint filler for concrete.
D75 Concrete joint sealer (hot poured elastic type).
D994 Preformed expansion joint filler for concrete paving and structural construction.
D1190
D1751 Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.
D1752
D1850 Concrete joint sealer (cold application type).
E11 Wire cloth sleeves for testing purposes.
E96 Water vapor transmission of materials in sheet form.
E154 Materials for use as vapor barrier under concrete slabs.
E337 Relative humidity by wet and dry bulk psychomotor.

3.3 ACI (American Concrete Institute)

3.3.1 Recommended practice for selecting proportions for normal and heavy weight concrete.

214 Recommended practice for evaluation of strength test result of concrete

301 Specifications for structural concrete for buildings.

304 Recommended practice for measuring, mixing, transporting and placing concrete.

305 Hot weather concreting.

308 Recommended practice for curing concrete.

309 Recommended practice for consolidation of concrete.

318 Building code requirements for reinforced concrete.

347 Recommended practice for concrete for work.

512 Precast structural concrete in building.

517 Low pressure steam curing.

533 Fabrication, handling and erection of Precast concrete wall panels.

3.4 British Standards

BS 12 BS Portland cement, ordinary and rapid hardening.

410 Test Sieves.

BS 812 BS 882 Methods for the sampling and ~~sting of mineral aggregates, sands and fillers.
BS 1305 Coarse and fine aggregates from natural sources.
BS 1881 Batch Mixer.
BS 3148 Methods of testing and sampling concrete.
BS 3837 Tests for water for making concrete.
BS 5328 Expanded polystyrene boards.
BS 3869 Structural Concrete.
BS 3927 Rigid expanded polyvinyl chloride for thermal insulation.
BS 4027 Phenolic foam materials for thermal insulation and building applications. Sulphate-resisting Portland cement.

BS 8110	Structural use of concrete.
CP 114	Structural use of reinforced concrete in buildings.
CP 116	Structural use of Precast concrete.
CP 5337	The structural use of concrete for retaining aqueous liquids

In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other Standards as may be specified by the Engineer for special Materials and Construction are also relevant.

4. Materials

4.1 Aggregates

4.1.1 The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer.

4.1.2 All fine and coarse aggregates shall be clean and free from clay, loam, silt and other deleterious matter. If required, the Engineer reserves the right to have them washed by the Contractor at no additional expense. Coarse and fine aggregates shall be delivered and stored separately at site. Aggregates shall not be stored on muddy ground or where they are likely to become dirty or contaminated.

4.1.3 Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings shall conform to requirements of PS 243 and/or BS 882 and/or ASTM C 33. Only fine aggregate of grading zones 1 to 3 (BS 882) shall be used.

4.1.4 Coarse aggregate shall be gravel or crush stone of hard, durable material free laminated structure and conforming PS 243 and/or BS 882 and/or ASTM C 33 graded as follows for use in mass concrete as in foundations:

Total Pressure B.S.Sieve	**Percent by weight**
3 inc. (76.2mm)	100
1.5 inc. (38.10mm)	95-100
0.75 inc. (19.05mm)	30-70
0.38 inc. (9.52mm)	10-35
0.19 inc. (4.76mm)	0-5

Coarse aggregate for all cast-in-place concrete other than mass concrete as for foundations shall be graded with the following limits:

Total Passing B.S. Sieve	**Percent by weight**
1.5 in. (38.10 mm)	100
0.75 in. (19.05 mm)	95-100

4.1.5 Wherever feasible, the nominal maximum size of aggregate for cast- in- place reinforced concrete slabs and other members shall be 3/4 inch. If there are difficulties in placing such a concrete the maximum size may be restricted to 1/2 inch provided the requirements for strength are satisfied. The grading requirements of 1/2 inch or 3/8 inch down aggregate

shall be agreed to with the Engineer as per relevant ASTM/BS standards.

4.1.6 The nominal maximum size of the aggregate for Precast concrete shall not be larger than one fifth of the narrowest dimension between sides of forms, or one-third of the depth of slabs or three-fourths of the minimum clear distance between. reinforcing bars or between bars and forms, whichever is least. In Precast columns the nominal maximum size of the aggregate shall be limited as above but shall not be larger than two-thirds of the minimum clear distance between bars.

4.1.7 Coarse aggregates in Precast concrete of normal weight may be of one maximum size for all concrete placed in 1 day when quantities to be placed are too small to permit economical use of more than one mix design.

When a single mix design is so used. the maximum nominal size shall be as required for the most" critical condition of concreting, in accordance with the requirements of clause (4.1.6) above.

4.1.8 Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregate of uniform quality can be maintained over the period of the work, the grading of the aggregates shall be controlled by obtaining the 3/4" maximum nominal size, the different sizes being stocked in separate stock piles and recombined in the correct proportion for each batch at the batching plant. The materials shall be stock-piled for a period before use so as to drain nearly to constant moisture content (as long as site and other conditions permit, preferably for at least a day). The grading of the coarse and fine aggregates shall be tested at least once for every 100 tons supplied, to ensure that the grading is uniform and same as that of the samples used iri the preliminary tests.

4.1.9 For use in fire proof concrete, the aggregates shall be fire clay and semi-acidic fine ground. The use of broken fire clay bricks as coarse aggregate and waste of semi-acidic refractory particles as fine aggregate can be allowed.

4.2 Cement

4.2.1 The cement shall be fresh and of approved origin and manufacture. It shall be one of the following as may be specified by the Engineer.

Ordinary or Rapid Hardening Portland cement complying with the requirements of PS 232 or BS 12 or ASTM C 150.

Sulphate Resisting Portland/Cement complying with the requirements of PS 612 or BS 4027 or ASTM C 150.

4.2.2 Unless otherwise specified, ordinary Portland Cement complying with the requirements of BS 12 shall be used.

4.2.3 For all fair faced concrete it will be necessary to use approved cement with a view to obtain light shade concrete as approved by the Engineer.

4.2.4 The Contractor shall supply to the Engineer at fortnightly intervals, test certificates with the appropriate standard in respect of the samples of cement from the work-site. These tests shall be carried out in a laboratory approved by the Engineer.

4.2.5 Only one brand of each type of cement shall be used for concrete in any individual member of the structure. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed.

4.2.6 There shall be sufficient cement at site to ensure that each section of work is completed without interruption.

4.2.7 Cement reclaimed from cleaning of bags or from leaky containers shall not be used.

4.2.8 The Contractor shall provide and erect (at his cost) a suitable plain, dry, well ventilated, weatherproof and water proof shed of sufficient capacity to store the cement.

4.2.9 Cement shall be used as soon as possible after delivery and cement which the

4.2.10 Engineer considers has become stale or unsuitable through absorption of moisture' from the atmosphere or otherwise shall be rejected and removed immediately from the site at the Contractor's expense. Any cement in containers damaged so as to allow the contents to spill or permitting access of the atmosphere prior to opening of the container at the time of concrete mixing shall be rejected and removed immediately from the site at the Contractor's expense.

4.2.11 The mixing together of different types of cement will not be permitted.

4.3 Water

Only clean water from the city supply, tube well installed at the site or from other sources approved by the Engineer shall be used. The Contractor shall supply sufficient water for all purposes, including mixing the concrete, curing, "d cleaning plant and tools. Where doubt exists as to the suitability of the water, it shall be tested in accordance with BS 3148. Where water can be shown to contain any sugar or an excess of acid, alkali or salt, the Engineer may refuse to permit its use.

In case of doubt, the Engineer may require that concrete mixed with water proposed to be used should not have a compressive strength lower than 90 percent of the strength of concrete mixed with distilled water.

4.4 Additive

All additives such as foaming and water proofing agents shall be from a manufacturer approved by the Engineer.

Air Entraining Admixtures shall conform to APM C 260. Other Admixtures shall conform to ASTM C494.

5. Nominal Concrete Mixes

5.1 Proportions of Mix

5.1.1 Cement and aggregates:

Cement, fine aggregate and the coarse aggregate shall be weighed separately. The proportions of cement to fine aggregate and coarse aggregate shall be adjusted so as to provide the concrete of the required crushing strength when tested as set out in Table 1.

5.1.2 The Contractor shall regulate and arrange mixing of the ingredients for the designed mix of the concrete by weight batching. The cost of designing the mix shall be borne by the Contractor.

5.1.3 Water / Cement ratio:

The quantity of water used shall be just sufficient to produce dense concrete of adequate strength and workability for its purpose. For all external work and foundations the water/cement ratio should not exceed 0.55 for concrete Class A, B and C.

5.1.4 Workability:

The workability shall be controlled by direct measurement of the water content, allowance being made for any water in the fine and coarse aggregates. The concrete shall be just sufficiently workable to be placed and compacted, without difficulty, by the available means.

'Workability' shall be determined by either the slump or compaction factor tests as directed by the Engineer and these shall be performed in accordance with the methods given in PS 422 to PS 177 or ASTM C 143.

The slump or compaction factor for each class of concrete shall be determined during the preliminary Test mixes and the value obtained shall not be modified without the written consent of the Engineer. Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 3 inch or less for consolidation by vibration. A tolerance of up to 1 inch above- the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, which ever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

5.2 Strength requirements for concrete :-

5.2.1 Portland cement concrete when aggregates comply with BS 882.

5.2.2 Concrete made with Portland cement shall comply with the strength Table 1 columns 4&6 (Works Test).

Table 1: Strength requirements for Portland concrete with aggregates complying with BS. 882.

Class Min Cement per of concrete	Min Cube Crushing of Strength at 28 days (psi) (lb)	Min. water per 110 lb. bag of (gallon)	Class Min Cement per of concrete
1	2	3	4
A	30.00	4350	4.40
B	22.00	3750	5.06
C	18.00	3000	5.28
D	13.00	1550	7.05
E	9.50	1000	7.27

Note: Conversion Factors. 1 psi = 006897 MPa 1 gal = 4.54 liter

1 lb. = 0.4537 Kg. 1cu.ft. = 0.028 cum.

5.2.3 The strengths given in Table 1 are based on the assumption that average temperature is 20 degree C. Where accurate records of temperature are kept, allowance may be made for change of temperature or the cubes may be tested at the equivalent maturity.

5.2.4 Unless otherwise stated, the types of concrete shall be classified on the basis of compressive strength requirements. The Contractor shall provide Mix design by weight for each class of concrete.

Manufacture 12 test cubes for each 3 mix design batches (6 x 6 x 6) inches in accordance with the Mix design batching by weight and test 3 cubes each at 3,7,14 & 28 days intervals in the presence of Engineer's Representative and submit all relevant data and results of tests for approval of the Engineer. The Contractor shall obtain approval from the Engineer in writing for each Mix design before producing the actual concrete for the Works.

No payments for producing the Mix design, manufacture of test cubes and testing shall be paid. The Contractor shall include this cost in the relevant item of concrete.

5.3 Batching

5.3.1 All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement may be taken as weighing 110 lb. with the prior approval of the Engineer.

5.3.2 Aggregates shall be batched by weight, due allowance being made for water content. Aggregates may be batched by volume through conversion of weigh batching, only with the prior permission of the Engineer. The apparatus for weight batching may be an integral part of the mixer or a separate unit of a type approved by the Engineer. It shall be accurate within 2% and shall be checked for accuracy at least once a week.

5.3.3 The quantity of additives i.e. foaming and water proofing agents etc. shall be as prescribed by the manufacturer or as

directed by the Engineer.

5.3.4 Where the batching plant is of the type in which cement and aggregates are weighed in the same compartment. the cement shall be introduced into the compartment between two sizes of aggregates.

5.3.5 Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period, which may extend to the end of the first 25 percent of the specified mixing time. Controls shall . be provided to prevent batched ingredients from entering the mixer before the previous batch has ·been completely discharged.

5.4 Mixing

The concrete shall be mixed in an approved batch mixer conforming to the requirements of BS 1305. It shall be fitted with the manufacturer's plate stating the rates, capacity and the recommended number of revolutions per minute and shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water-measuring device. The mixer shall be capable of thoroughly combining the aggregates, cement and water into a uniform mass within the specified mixing time and of discharging the concrete without harmful segregation.

5.4.1 Mixing shall continue for the period recommended by the mixer manufacturer or until there is apparently a uniform distribution of the materials and the mass is uniform in colour, whichever period is longer. If it is desired to use a mixing period of less than 1-1/2 minutes, the Engineer's approval shall be obtained in writing.

5.4.2 Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.

5.4.3 The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10 percent of their original height.

5.4.4 Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be re tempered, but shall be discarded.

5.5 Transporting:

5.5.1 The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means, which will prevent segregation or loss of ingredients. All skip vehicles, or containers used for transporting the concrete shall be thoroughly cleaned.

5.5.2 During hot or cold weather, concrete shall be transported in deep containers, on account of their lower ratios of surface area to mass, which reduces the rate of loss' of water, by evaporation during hot weather and loss of heat during cold weather.

5.6 Placing

5.6.1 Before placing of concrete, formwork shall have been completed; water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors and other embedded items shall have been kept in position; and the entire preparation shall have been approved by the Engineer.

No concrete is to be placed into the foundation trenches until the ground to receive the same has been examined and approved by the Engineer for this purpose.

5.6.2 Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited on concrete, which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the Contract Documents or as approved by the Engineer. Placing shall be carried out at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

5.6.3 The actual sequence of construction proposed by the Contractor shall be subject to 'the Engineer's a approval before construction starts on any part of the structure, and this sequence shall not be varied without the Engineer's approval.

5.6.4 The concrete after it has been mixed shall be placed as soon as it is practicable. Once the concrete has left the mixed, no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means available.

The time between mixing and placing should be reduced, if the mix is richer or the initial workability of the mix is lower than normal, or if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere.

The Contractor shall ensure that the delay between mixing and placing including consolidation does not exceed 45 minutes under any circumstances. Any concrete which does not satisfy this requirement shall be rejected.

5.6.5 Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to re handling or flowing. In no circumstances may concrete be railed or made to flow along the forms by the use of vibrators, Concreting shall be carried on as a continuous operation using methods, which shall prevent segregation or loss of ingredients.

5.6.6 The free fall of concrete shall not be allowed to exceed 6 feet.

Where it is necessary for the concrete to be lowered more that this depth, it is not to be dropped into its final position, but shall be placed through pipes fed by a hopper. When a pipe is used for placing concrete the lower end shall be kept inside or close to the freshly deposited concrete. The size of the pipe shall be not less than 9 inch in diameter.

5.6.7 'Mass-concrete' shall be placed in layers approximately 18 inch thick. Vibrator heads shall extend into the previously placed layer.

5.6.8 The workmen carrying concrete to the site, and all other workmen moving about on the reinforcement before the concrete is placed, shall move only along runways or planks placed for the purpose and no person shall be allowed to walk on the reinforcement itself.

5.6.9 Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by the Engineer, the surface will be brought to a true, hard and smooth level surface using cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of building paper weighing .082 Ib./will then be laid flat to separate the concrete from the surface on which it is to be laid.

5.7 Construction Joints

5.7.1 Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be predetermined by the Engineer.

5.7.2 Joints not shown on the drawings shall be so made and located as to least impair the strength of the structure and shall need prior approval of the Engineer. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floors, slabs or beams and at the top of footings or floor slabs. Beams, brackets, columns capitals, haunches and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the r:nain reinforcement.

5.7.3 All reinforcing steel shall be continued across joints. Keys and inclined dowels shall be provided as directed by the Engineer. Longitudinal keys at least 1-1/2 inches deep shall be provided in all joints in walls and between walls and slabs or footings.

5.7.4 When the work has to be resumed; on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

5.7.5 The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in un-exposed walls and all others not mentioned herein shall be

dampened (but not saturated) immediately prior to placing of fresh concrete.

5.7.6 The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs; and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout similar in proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2 inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained initial set.

5.7.7 Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle, and brushed, care being taken to avoid dislodgment of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 6 inch in thickness, and shall be well rammed against old work, particular attention being paid to corners and closed spots. 5.7.8 Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement passing through them, so that each portion can be positioned and removed separately without disturbance or shock to the reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in' the concrete with prior written approval of the Engineer. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement.

5.8 Expansion Joints

Expansion joints shall be provided wherever indicated on the Drawings or as directed by the Engineer. In no case shall the reinforcement, corner protection angles, or other embedded' items be permitted to extend continuously through any expansion joint.

All expansion joints shall be carefully placed so as not to be displaced during concreting. The method of placing the expansion joints shall be strictly in accordance with the Drawings and/or as directed by the Engineer. All materials for use in the expansion joints shall have prior approval of the Engineer before placing order for supply.

5.9 Embedded Items

5.9.1 The material, design and location of water stops in joints shall be as indicated in the Contract Documents. Each piece of pre molded water stop shall be of maximum practicable length in order that the number of end joints will be held to a minimum.

Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective water-tightness fully equal to that of the continuous water stop material, shall permanently develop not less than 50 percent of the mechanical strength of the parent section and shall permanently retain their flexibility.

5.9.2 Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than four

percent of the area of the cross section of a 'column on which Stress is calculated or which is required for fire protection. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall be of such size or in such location as not to impair unduly the strength of the construction; such sleeves, conduits, or pipes mi1Y be considered as replacing structurally in compression the displaced concrete/ provided that they are not exposed to rusting or other deterioration, are of uncoated or galvanized iron or steel not thinner than standard steel pipe, have a nominal inside. diameter not over 2 inch and are spaced not less than three diameters on centers. Except when plans of conduits and pipes are approved by the Engineer, embedded pipes and conduits other than those merely passing through, shall not be larger in outside diameter than one third the thickness of the slab, wall, or beams in which they are embedded nor so located as to impair unduly the strength of the construction. Sleeve pipes, or conduits of any material not harmful to concrete and within the limitations of this section may be embedded in concrete with the approval of the Engineer provided they are not considered to replace the displaced concrete.

5.9.3 All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

5.9.4 Expansion joint material, water stops and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

2.2 Pre-Cast Concrete

Pre-cast concrete units shall be fair faced, cast to the sizes and dimensions as indicated on the Drawings. The concrete used for pre-cast units shall conform to the specifications laid down for cast in situ reinforced cement concrete unless otherwise required and directed by the Consultant.

The Contractor shall be required to submit a sample of pre-cast unit for the approval of the Engineer; all pre-cast units shall strictly conform to the approved sample.

Pre-casting platform of the size and at the location approved by the Engineer shall be constructed. The concrete in one pre-cast unit shall be placed in one operation, in accordance with the details shown on the Drawings.

The material and design of formwork .and the method of pre-casting the units shall be approved by the Engineer. The erection/installation and removal of the pre-cast units from the pre-casting platform shall not be permitted until and unless they are properly cured to the satisfaction of the Engineer.

All pre-cast units shall be smoothly finished to the required lines, grades, angles, etc. Holes, grooves, pockets and hooks shall be provided as shown and/or as directed by the Engineer. The units shall be properly stacked on a platform without causing any cracks and damages. Curing of all the pre-cast units shall be done in accordance with the relevant BS code/approval of the Engineer.

2.2.1 Erecting Pre-cast Units

All the pre-cast units shall be transported and erected into position in a manner as approved by the Engineer.

The Contractor shall submit his proposal in this regard and obtain approval from the Engineer in advance.

2.2.2 Lifting Beams

The Contractor shall use lifting beams at his own cost for erecting pre-cast members where the Engineer so directs. Lifting beams shall be supplied and erected by the Contractor, at his own cost, at all points where lifting is necessary for maintaining the plant but is inaccessible to mobile/cranes or, alternatively, covered by overhead traveling cranes. The Contractor, however, is to supply the trolleys and erect them on the lifting beams, and to test operation of installed equipment.

3. Cement Concrete Pavements

For all concrete work relevant specifications of this section shall apply.

3.1 Side Forms and Construction

Side forms shall be of steel or any other suitable material and of a design as approved by the Engineer.

In general, only materials and methods that have proved their acceptability by past performance will be considered. All form shall be constructed so that they can be removed without hammering or prying against the concrete.

Horizontal joints in the forms will not be permitted. Forms shall be thoroughly cleaned and oiled with linseed/mineral oil shall be given two coats of niter-cellulose lacquer each time they are used.

The forms shall be set on a thoroughly compacted base true to line and level and firmly secured in position by appropriate methods. Conformity with the alignment and levels shown on the Drawings shall be checked as and when required by the Engineer. Where necessary corrections shall be made immediately before placing the concrete; where any form has been disturbed it shall be reset and rechecked.

Pavements shall be constructed in panels of sizes as shown on the Drawings. The panels shall be laid alternately, the adjoining panels being concreted when the side forms are struck and the jointing materials placed, inspected and approved by the Engineer. Each panel is to be concreted in one operation and no interruptions shall be permitted during the operation. The concrete shall be tipped from the trolley slightly in advance of the working place and then shoveled into position. The spreading shall be carried out very carefully. Compaction shall be done by means of vibrators compactors of

approved surface vibrators. If a vibrators compactor is used,' if. shall be operated on the concrete and will not be allowed to strike or displace the forms. The spreading and compacting,. of the successive layers shall proceed without interruptions and as quickly as practicable so as to ensure that the slab is ' monolithic throughout its depth.

The wearing surface shall be laid while the base concrete is still wet and screeded to line and level. When the initial set takes place the surface shall be troweled smooth with a steel trowel to provide a dense closed surface.

All the joints shall be carefully formed as shown on the Drawings or as directed by the Engineer. The joint filler together with performed groove shall provide complete separation of adjacent slabs. The joints shall all be sealed with bitumen as shown on the Drawings and as directed by the Engineer.

3.2 Protection and Curing

General Requirements:

Concrete shall be protected adequately from injurious action by sun, rain, flowing water and mechanical injury, and shall not be allowed to dry form the time it is placed until the expiry of the minimum curing periods specified hereinafter. Water curing shall be accomplished by keeping the surface of the concrete continuously wet by covering with water or with approved water saturated covering. Where wood forms are left in place for curing, they shall be kept sufficiently damp at all times to prevent openings at the joints and drying out of the concrete. All portions of the structure shall be kept moist for the full curing periods, specified hereinafter.

When liquid membrane curing compound is used the surface of the concrete shall be protected .form traffic or other abrasive action, that may break the membrane, for the full period of curing. The membrane curing compound shall be colorless or light colored and shall be approved by the Engineer and shall comply with ASTM Designation C 309.

Curing Periods:

The curing period shall be at least 10 days, or as directed by the Engineer.

Removal of Forms:

The Contractor shall exercise great care in avoiding damage to joints, arises, dowel bars etc., while removing the forms. Under no circumstances will the use of pry bars between the forms and pavement be permitted. Side forms shall not be removed until at least 40 hours have elapsed from the time of completing the concreting of the slab, which they contain. In no case shall forms be removed until the concrete has hardened sufficiently to permit removal without damage to the concrete. Concrete work shall be protected from injury resulting from the storage or movement of material during construction.

3.3 Finishing

All unformed surfaces shall be finished with a wood float except as otherwise specified. Visible vertical surfaces shall have all projections and irregularities removed. The entire surface shall be rubbed if required by the Engineer, with a No. 16 carborundum brick, or other abrasive until even, smooth and of uniform appearance, and shall be shed clean. Plastering of surface, application of cement or other coating will not be permitted.

All exposed corners shall be chamfered, 1"x 1" (2.5 cms x 2.5 cms) unless otherwise mentioned or shown on the plans or directed by the Engineer. Concrete surfaces which will be covered with other materials shall be screeded without floating.

3.4 Spreading, finishing and floating of concrete in pavements General Requirements

The striking of, compacting and floating of concrete shall be done by mechanical methods, if approved by the Engineer. Where the Engineer determines that it is impracticable to use mechanical methods, manual methods of spreading, finishing and floating may be used on pavement lines as indicated on the Drawings.

Mechanical Methods

The concrete shall be spread uniformly between the forms, immediately after it is placed, by means of an approved spreading machine. The spreader shall be followed by an approved finishing machine equipped with two oscillating or reciprocating screeds. The spreading machine or the finishing machine shall be equipped with vibrating equipment that will vibrate the concrete for the full paving width. internal vibrators shall be used adjacent to the longitudinal edge of the pavement. These vibrators shall be attached to the rear of the spreading machine or to the finishing machine. Vibrators shall not rest on new pavements or side forms or in contract with any dowel bars and the arrange:-'1ent of power supply to the vibrators shall be such that then the motion of machine is stopped, vibration shall cease. The rate of Vibration shall be not less than 8000 vibrations per minute. The concrete shall be spread to full width before being struck of and compacted so that the sure will conform to the finished grade and cross-section as shown on t plans and at the same time leave sufficient material for the floating operation. The spreading & finishing machine shall move over the pavement as many times and at such intervals as may be required by the Engineer to ensure thorough compaction.

Except as otherwise specified, after the pavement has been struck of and compacted, it shall be finished with an approved longitudinal float. The Contractor may use a longitudinal float composed of one or more cutting and smoothing floats suspended from and guided by rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with the forms.

The contractor may use a longitudinal float which works with a sawing motion, while held in a floating position parallel to the road centre line and passing gradually from one side of the pavement to the other. Movements ahead, along the centre line of the road, shall be in successive advances of not more than half the length of the float.

Instead of using other type of longitudinal float a single machine, which will afect satisfactory compaction, finishing and floating may be used. This machine may be towed by a spreading machine. This combination, finishing floating machine shall be equipped with screeds and vibrators as hereinafter specified for spreading and finishing machine. Floating shall be. accomplished by means of a non-oscillating float held in a suspended position form the frame.

If any spreading, finishing and floating equipment is not maintained in full working order or if the equipment as used by the Contractor proves inadequate to obtain the results prescribed, such equipment shall be improved or satisfactory equipment substituted or added at the direction of the Engineer.

Manual Methods

When striking-off and compacting by manual methods is permitted, the concrete shall be leveled and then struck-off to such an elevation that, when properly compacted, the surface will conform to the required grade' and cross-section. The strike board shall be moved forward with a combined longitudinal. and transverse motion, the manipulation being such that neither ends is raised from the side forms during the process. While striking off, a slight excess of concrete shall be kept in front of the cutting edge at all times. Prior to tamping, the concrete along the forms shall be thoroughly spaded or vibrated The entire area of pavement shall be tamped or vibrated a manner that will ensure maximum compaction. The concrete shall be brought to the required grade and shape by the use of a tamper consisting of a heavy plank whose length exceeds the width of the pavement by 1 foot or by the use of a mechanical vibrating unit spanning the full width of the spread. The tamper shall be constructed with properly trussed roads to stiffen it and prevent sag and shall be shod with a heavy strip or metal for a tamping surface. The tamper shall be moved with a combined tamping and longitudinal motion, raising it form side form and dropping it so that the concrete will be thoroughly compacted and rammed into place. A small surplus material is compacted and rammed into front of the tamper or vibrating unit and tamping or vibrating shall continue until the true cross-section is obtained and the mortar flushes slightly to the surface.

On grades in excess of 5 percent where hand methods are permitted, a little strike board shall follow at a speed of 25 ft to 50 ft per hour back of the heavy strike board, and shall be used in the same way, so as to remove waves caused by flow of concrete.

Where hand tamping is permitted, not less than two strike boards or tampers shall be used for production in excess of 350 CU.ft. After the concrete has been compacted, it shall be smoothed with a wooden float where necessary, as directed by the Engineer.

Longitudinal Floating

Manual floats shall be at least 12 ft. in length not less than 6 inches in width and shall be properly stiffened to prevent bending or warping. In using the float, it shall be held parallel to centre line of the pavement at all time and shall be moved laterally across the pavement from one

side or edge to the other until all high areas are cut down and floated into depressions, leaving a surface that is smooth and true to grade. Batch transverse passage of the longitudinal manual float shall lap the proceeding passage by half.

First Straight Edge Testing

Immediately following final floating the entire area of the pavement shall be tested with a 10-ft. (approx. 3. meters) straight edge. Any depressions found shall be immediately fillet." with fresh concrete which shall be struck off compacted and finished. High areas shall be worked down and refinished. The straight edge testing and refloating shall continue until the pavement has the required surface contour.

After the first straight edge testing and when most of the water sheet has disappeared from the surface. and just before the concrete becomes non-plastic, the surface shall t.',: dragged with a strip of burlap (coarse canvas) 3 ft. to 10 ft. wide and having a length 4 ft. more than the width of the slab. The burlap shall be dragged along the surface of the pavement in a longitudinal direction. Burlap shall be clean and kept free from coatings of hardened concrete. It shall be moist at the time of use.

Second Straight Edge Testing:

After the concrete has hardened sufficiently to permit walking on it, the surface of the pavement shall again be tested with a 1 a-ft. straight edge. 'Any portion of the pavement which shows a variation from the testing edge of more than 1/8 inch shall be corrected by cutting, or shall be removed and replaced at the expense of the Contractor.

3.5 Expansion and Construction Joints

i) All the expansion and contraction joints shall be carefully formed as shown on the Drawings or as directed by the Engineer. As regards dowel bars and joint assemblies, such stakes, brackets or other devices shall be used, as necessary to keep the entire joint assembly in true vertical and horizontal position. The joint filler together with the preformed groove shall provide complete separation of adjacent slabs. The joints shall all be sealed with the specified non-extruding sealing compound set in a 3/4 inch wide preformed chase as shown on the Drawings. The preformed chase shall be thoroughly cleaned of all dust, debris, stones or other hard material prior to its sealing. The riser of all joints shall be rounded to a radius as shown on the Drawings before the concrete hardens.

ii) The joints sealing compound shall be hot poured bitumen or approved sealing compound for concrete pavements complying with BS-2499 for hot tropical climates and heavy duty industrial site subject to severe exposure. All joints)o be filled with flex cell expansion joint filler, or an approved elastic, compressible, durable and rot-proof equivalent of sufficient rigidity to enable it to be satisfactorily installed in the joint and resist deformation during the passage of the concreting equipment. The filler is to be of the same thickness as the joint Width. Holes to accommodate the dowel bars shall accurately be drilled or

punched out. Where shown on the Drawings, dowel bars of required diameter shall be placed at the specified spacing. The bars shall be lubricated with an approved lubricant. One end of the dowel bar at expansion joints shall be provided with a closely fitting sleeve 3 inch long, consisting of bitumen coated plastic or other approved material to permit expansion. A loose plug 1 inch deep of approved compressible filling material shall be inserted into the sleeve as shown on the Drawings at the end of the bar. All the dowel bars shall be mild steel bars of the size shown on the Drawings and shall conform to the requirements as specified in the section 'Concrete.

iii) Contraction joints shall be provided as shown on the Drawings. The assembly and method of constructing the expansi9n joints/contraction joints shall be subject to the approval of the Engineer.

3.6 Consolidation

3.6.1 All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items and into corners of forms, elimir'3ting all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. They shall be operated by competent workmen. Use of vibrators to transport within forms shall not be allowed. vibrators shall be inserted and withdrawn at points approximately 18 inch apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not excessive so as to cause segregation, generally from 5 to 15 sec. A spare Vibrator shall be kept on the job site during all concrete placing operations.

Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented, if necessary, by spading to work the coarse aggregate back from the formed surface.

3.6.2 If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to effect an improvement in the quality of the concrete to the satisfaction of the Engineer and in ' conformity with the provisions of Clause 5.

3.6.3 Vibrator shall not be allowed to contact the formwork for exposed concrete surfaces.

3.6.4 Mechanical vibrators shall be of a type suited in the opinion of the Engineer to the particular conditions.

3.6.5 Over-vibration or vibration of very wet mixes is harmful and should be avoided.

3.7 Curing and Protection

3.7.1 Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold

temperatures and mechanical injury and shall be maintained with minimum moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of the Engineer.

3.7.2 For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing: Ponding or continuous sprinkling. Application of absorptive mats fabric kept continuously wet. Application of waterproof sheet materials approved by the Engineer. Application of other moisture-retaining covering as approved. Application of a curing compound conforming to ASTM C 309. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheen, which may develop after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.

3.7.3 Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal the concrete shall be cured until the end of the time prescribed for curing.

3.7.4 Curing in accordance with sub-clause 5.13.1 & 5.13.2 above shall be continued for at least 10 days in the case of all concrete except concrete with rapid-hardening Portland Cement for which the period shall be at least 3 days. Alternatively, if tests are made of cubes kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive, strength has reached 70 percent of the minimum specified works cube strength. If one of the first four curing procedures of sub-clause 5.13.2 is used initially, it may be replaced by one of the other procedures of that sub-clause any time after the concrete is one day old provided the concrete is not permitted to become surface dry during the transition.

3.7.5 When the mean daily outdoor temperature is less than 5 degree C (41 deg. F) temperature of the concrete shall be maintained between 10 and 20 degrees C (50 to 68 deg. F) for the required curing period of sub-clause 5.13.4.

When necessary, arrangements for heating, covering insulation or housing t/ie. Concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions' are taken to prevent exposure of the concrete to exhaust gasses, which contain carbon dioxide.

3.7.6 During hot weather when necessary, provision for wind-brakes, shading for spraying, sprinkling, ponding or wet covering with a light coloured material shall be made in advance of placement. Such protective measures shall be taken as quickly as concrete hardening and finishing operation will allow.

3.7.7 Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 3 deg. C (37 deg. F) in anyone hour or 10 degree C (50 deg. F)in any 24 hour period.

3.7.8 During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibrations. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to over stress the concrete.

3.8 Works in Extreme Weather

3.8.1 Unless adequate protection is provided and approval is obtained from the Engineer, concrete shall not be placed during rain. Rainwater shall not be allowed to increase / ease the mixing water nor to damage the surface finish.

3.8.2 When the temperature of the surrounding air is expected to be below 5 deg. C during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 13 deg. C for sections less than 12 inch in any dimension nor 10 deg. C for any other sections.

When necessary, concrete material should be heated before mixing and carefully protected after placing, in general, heating or mixing water alone to about 60 deg. C may be suficient for this purpose. Dependence should not be placed on salt or other chemicals for the prevention of freezing. No frozen material or materials, containing ice shall be used. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 5.5 gallon/bag of cement.

If water or aggregate is heated above 38 deg. C the water shall be combined with the aggregate in the mixer before cement is added.

Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38 deg. C.

3.8.3 During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 32 deg. C. For massive concrete, this temp. should not exceed 21 degree C. When the temp. of the concrete exceeds 32 degree C, precautionary measures approved by the Engineer

shall be put into effect. When the temperature of the steel is greater than 50 deg. C, steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or flaked ice or well crushed ice of a size that will melt completely during mixing may be substituted for all part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered. Other precautions recommended by ACI Standard 305-72 shall also be adopted.

4. EST of Concrete Quality

4.1 The Contractor shall provide samples of concrete for testing at the Engineer's direction. Proper facilities shall be provided for making and curing the test specimens in accordance with PS 560 and PS 849. A competent person shall be employed by the Contractor whose first duty shall be to supervise all stages in the preparation and placing of the concrete. All Test specimens shall be made and site tests carried out under his direct supervision. .

4.2 Preliminary cube tests and works cube test shall be performed in accordance with PS 560 and PS 849 at the discretion of the Engineer. Works transverse tests shall be performed in accordance with sub-clauses 208 c and 610 d of CP 114. The standard of acceptance for preliminary and works tests shall be as given below.

4.3 The usual test for concrete with maximum size of aggregate up to 1-1/2 inch is the 6 inch cube tested in compression. Details of making and curing compression test cubes are given in PS 560, PS 849 and BS 1881 and details of the testing are given in Part 8 of BS 1881.

For all grades of concrete, preliminary cube strength test with the mixes and materials to be used shall be performed in accordance with PS 560, PS 849 and BS 1881 before the work is begun and subsequently whenever any change is to be made il1l the materials or in the proportions of materials to be used, or as required by the Engineer. The strengths shall comply with the standard of quality specified in accordance with. Table 1 for preliminary tests. The cost of such testing hall be borne by the Contractor.

4.4 Test sample shall be taken at the mixer or as directed by the Engineer. The test specimens shall be cured in accordance with PS 560, PS 849 and BS 1881.Records shall be kept of all test cubes identifying the mix used the section of work for which the concrete was used and the date poured. !

4.5 Five test cubes are to be tested for compressive strength as specified in BS 1881. These tests shall be carried out at site or in a laboratory approved by the Engineer. Two cubes shall be tested at the age of seven days and three at 28 days and the strengths determined are to comply with the standard of quality specified. The laboratory tests shall be carried out by an independent organization, such as Government Testing Laboratory or such other undertakings approved by the Engineer. The original test reports received from the above authorities should be submitted to the

Engineer.

4.6 For all grades of concrete, the appropriate strength requirement shall be considered to be satisfied if none of the strengths of the cubes is below the specified cube strength or if the average strength of the three cubes is hot less than the specified cube strength and the difference between the greatest and the least strength is not more than 20% of the average.

4.7 When the results of works cube tests show that the strength of any concrete is below the minimum specified, the Engineer may give instructions for the whole or part of the work concerned to be removed and replaced at the expense of the Contractor. The Contractor shall bear the cost of any other part of his, or any other contractor's work, which has to be removed and replaced as a result of the defective concrete. If any concrete is held to have failed, the Engineer may order the proportions of that class of concrete to be changed in order to provide the specified strength.

5. Finishing of Formed Surfaces

5.1 General

5.1.1 After removal of forms, the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Contract Documents.

5.1.2 When finishing is required to match a small sample furnished to the Contractor, the sample finish shall be reproduced on an area at least 100 Sq. ft. in an inconspicuous location designated by the Engineer before proceeding with the finish in the specified location.

5.1.3 Allowable deviations from plumb or level and from the alignment profile grades, and dimensions are specified in clause 9. Tolerances for concrete construction and defined as tolerances that are to be distinguished from irregularities in finish as described herein. The finish requirements for concrete surfaces shall be as generally specified in this clause and as indicated on the Drawings. Finishing of concrete surfaces shall be performed or, by workmen who are skilled in concrete finishes. The Contractor shall keep the Engineer advised as to when finishing of concrete will be performed. Unless inspection is waived in each -specific case, finishing of concrete shall be performed only in the presence of the Engineer. Concrete surfaces will be tested by the Engineer where necessary to determine whether surface irregularities are within the limits herein after specified. Surface irregularities are classified as abrupt or gradual.

Offsets caused by displaced or misplaced form sheeting or lining or sections, or otherwise defective form lumber will be considered as abrupt irregularities, and will be tested by direct measurements. All other irregularities will be considered as gradual irregularities, and will be tested by use of a template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template will be 6.5 ft. for testing of formed surfaces and 10ft. for testing of unformed surfaces.

5.2 As-cast Finishes

Unless 9therwise specified 9 indicated on the Drawings the classes of finish shall apply as follows:

5.2.1 Rough form finish:

No selected form facing materials Shall be specified for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding 1/4" in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

5.2.2 Fair face finish:

Fair face finish applies to concrete formed surfaces, the appearance of which is considered by the Engineer to be of special importance, such as surfaces of structures prominently exposed to public inspection. Surfaces of concrete structures requiring fair face finish is shown in the Drawings. Surface irregularities, measured as described in sub-clause 7.2.1, 'Rough form finish', shall not exceed 1/4 inch for gradual irregularities and 1/8 inch for abrupt irregularities, except that abrupt irregularities will not be permitted at construction joints. Abrupt irregularities at construction joints and elsewhere in excess of 1/8 inch and gradual irregularities in excess of 1/4 inch shall be reduced by grinding so as to conform to the specified limits. Abrupt irregularities at construction joints shall be ground on level of 1 to 20 ratio of height to length.

Unless otherwise approved, repair of imperfections in formed concrete shall be completed within 24 hours after removal of forms. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, temperated concrete-form-grade hardboard, metal, plastic paper, or other approved material capable of producing the desired fair face finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edge, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

5.2.3 Architectural Finish Concrete:

Architectural finish concreting formed surfaces as shown on the Drawings IS required by. The Engineer where the architectural appearance of surfaces of structures exposed to public view is of special consideration and importance. The Contractor shall use approved special material for formwork and design the forms in conformity with the specified architectural patterns, textures and finishes in order to obtain first class architectural finish on formed concrete surface without any defect, irregularities, blemishes, imperfections and encrustation's.

Samples:

Submit to the Engineer a minimum of two units or portions of units of each precast item required. Each pair of samples when accepted will describe the allowable limits between which variations can be acceptable.

Similar samples of in-situ concrete for approval by the Engineer submit two samples, 2 Sq. ft. of each type of exposed in-situ concrete. All in-situ samples will remain at the construction site.

Sample approvals of precast & in-situ concrete:

These samples will be reviewed and approved on the basis of colour, dimensional accuracy, and finish of surfaces and general appearance. The same requirements for sample approval will be required for both precast and in-situ concrete exposed surfaces.

Forms:

The contractor must maintain the forms unusually tight and braces to prevent movement, mal-alignment and bleeding that will result in sand streaks, honeycomb, fins, stain or unsightly appearance. / .

If wood forms are chosen to be used by the Contractor they shall be constructed of 3/4 inch minimum thickness plywood constructed in a fashion to allow many re-uses with all surfaces sealed with a polyurethane varnish.

Edges, surfaces and corners of forms shall be sealed to prevent loss of any matrix or unequal absorption of water. Corners of wood forms shall be filled with suitable compound and all contact surfaces sealed with a polyurethane varnish.

Re-use of forms shall be subject to approval by the Engineer.

Curing:

Curing shall be done in shade (out of direct sunlight) and shall be for a minimum period of 4 days.

Finishing Procedures:

"Finishing procedures for filling air void smooth finished concrete developed by a formed surface":

While the concrete surface is still damp (not more than three days after removal of forms), apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within any pits or blemishes in the parent concrete; avoid coating large areas of the finished surface. Before slurry has dried or changed colour, apply a dry (almost crumbly) grout comprised of one part cement, of the type and brand of cement used in the original concrete, to one and one-half parts clean masonry sand with f3 fineness modulus of approximately 2.25 and complying with the graduation requirements of the ASTM Specifications C 144. Mix proper amounts of white cement and colouring with the parent mortar to produce a satisfactory colour match with the

parent concrete after hardening. Use samples previously prepared.

Apply the finishing grout uniformly with damp (neither dripping wet nor dry) pads of coarse burlap approximately 6 inch square used as a float. Scrub the grout well into ' the pits to provide a dense mortar in all the imperfections to be filled. Allow the mortar to partially harden, from one to two hours, depending upon the weather. Avoid direct hot sunlight. If the air is hot and dry, keep the concrete surface damp during this period using a fine fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout from the small pits of holes, cut off all that can be removed with a trowel without delay; next allow the surface to dry thoroughly and rub it vigorously with clean, dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. Complete the entire cleaning and grouting operation for the grout to dry after it has been cut with the trowel, so it can be wiped off clean with the burlap.

On the day after the repair work, the concrete surfaces should again be wiped off clean with dry burlap to remove any inadvertent dust; leave no built-up surfaces on the parent surfaces. Employ, if possible, a used piece of burlap containing old hardened mortar to act as a mild abrasive. Use of fine abrasive stone if needed to remove any remaining built-up film without breaking through the surface film of the original concrete. Such scrubbing should be light and sufficient only to remove excess material without working up a lather of mortar or 'changing the texture of concrete.

Following the final b?l9.9ing or stoning operation, provide a thorough wash down with stiff bristle brushes 10 remove all extraneous materials and spray the concrete surface with a fine fog spray periodically to maintain a continually damp condition for at least three days after application of the pit repair grout.

Rust Stains:

All rust stains are to be removed employing the following procedure:

The rust stain shall be soaked for 10 minutes with a solution of 0.055 lb. of sodium citrate in 0.33 lb. water "(brushing the solution at short intervals is satisfactory). Then the surface is sprinkled with crystals of sodium hydrosulfite and covered with a paste of Fuller's Earth and water. On a vertical surface, the paste is applied with a trowel, with the crystals first sprinkled on the paste so they will be in direct contact with the stain. The paste is allowed to dry for 10 minutes then scraped off and the treatment repeated if necessary.

Repairing of Formed Surfaces:

It is the intention of Specification to require form mixture of concrete and workmanship so that concrete surfaces, when exposed, will require no patching. Any concrete which is not

formed as required and conforming to approved samples or for any reason is out of alignment or level or shows a defective surface, shall be removed from the job by the Contractor at his expense unless the Engineer grants permission to repair the defective area. Permission to patch any such area shall not be considered a waiver of the Engineer's right to require a complete removal of defective work if the repair does not, in his opinion, satisfactorily restore the quality and appearance of the surface. The Engineer shall be the sale judge of acceptability of appearance.

5.3 Finishes of Unformed Surfaces:

5.3.1 Monolithic Concrete Floor Finish

Where monolithic concrete floor finish is shown on the Drawings, placing shall proceed continuously for the full thickness of the course or RCC slab without change in concrete mix. Mixing water shall be the minimum required for proper placing, and will be as specified by the Engineer. After placing, floors, and other surfaces shall be floated with a wood float to a true surface and to elevation as shown on the Drawings. Where indicated on the Drawings, floor surfaces shall be steel trowel finished. Toweling shall be the minimum amount consistent with . maintaining a smooth dense surface, and shall not be done until the mortar has hardened sufficiently, to prevent excess fine material from being worked to the surface, and shall produce a dense uniform surface, free from blemishes and trowel marks.

Gradual surface irregularities shall not exceed 1/16 inch. The addition of water, dry cement, or dry cement mortar, to the surface of the concrete to facilitate finishing will not be permitted.

5.3.2 Equipment Foundations'

Unless otherwise specified, exposed, surfaces of equipment foundations shall be given steel trowel finish to produce a surface similar to the specified concrete floor finish.

6 Repair of Surface Defects

6.1 General

6.1.1 Any concrete failing to meet the specified strength or not formed as shown on drawings, concrete out of alignment, concrete with surfaces beyond required tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of the Engineer shall be removed at Contractor's cost. The Engineer may reject any defective concrete and order it to be cut out in part or in whole and replaced at the Contractor's expense. All ties and both less and all repairable defective areas shall be patched immediately after form removal.

6.2 Repair of Defective Areas

6.2.1 All honeycombed and other defective concrete shall be removed down to sound concrete. The area to be patched and an area at least 6 inch wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using c. mix of approximately 1 part cement to 1 part fine sand passing NO.25 BS Sieve and shall then be well brushed into the surface.

6.2.2 The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume. White Portland cement shall be substituted for a part of the gray Portland cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch.

6.2.3 The quantity handling of mixing water shall be no more than necessary for allowed and placing. The patching mortar shall be mixed in advance and of to stand with frequent manipulation with a trowel, without addition placing water, until it has reached the stiffest consistency that will permit

6.2.4 After surface water has evaporated from the area to be patched, the bon coat shall be well brushed into the surface. When the bond coat begins to loose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for 7 days. Metal tools shall not be used in finishing a patch in a formed wall, which will be exposed.

6.2.5 Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as cast surfaces shall not exceed 2 sq.ft. in each 1000 sq.ft. of as-cast suri'3ce. This is in addition to form tie patches, if the project design permits ties to fall within as-cast areas.

6.2.6 Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determined by trial to obtain a good colour match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

6.2.7 Patches in architectural concrete surfaces shall be cured for 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

6.3 Tie and Bolt Holes

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar. If architectural appearance

requires, these holes may be filled partially creating the desired round clear holes pattern on surfaces exposed to view.

6.4 Proprietary Materials

If permitted or required by the Engineer, proprietary compounds for adhesion or as patching ingredients may be used in lieu. of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations with prior approval of the Engineer.

Where tolerances are not stated in the specifications or drawings for any individual structure or feature thereof, maximum permissible deviations from established lines, grades and dimensions shall conform to the following. The Contractor is expected to set and maintain concrete forms so as to ensure complete work within tolerance limits. These allowable tolerances shall not relieve the Contractor of this responsibility for correct fitting of indicated materials. These tolerances are not cumulative.

6.5 Variation from the plumb (or the specified batter for inclined walls.)

6.5.1 In the lines and surfaces of columns, piers, walls and in arises: In any 10 feet of length or height In any storey or 20 feet length Maximum for the entire length or height. In any bay or 20 feet maximum 1/4 inch Maximum for the entire length or height ½ inch

6.5.2 Variation from the level or from the grades indicated on the drawings.

6.5.3 In floors, ceilings, beams soffits and in arises measured before removal of supporting shores.

In any 10 feet of length	1/4 inch
In any bay or in any 20 feet length	38 inch
Maximum for the entire length	3/4 inch

6.5.4 For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.

In any bay or 20 feet length	1/4 inch
Maximum for the entire length	1/2 inch

6.6 Variation of the linear building lines from established position in plan and related position of columns, walls and partitions.

In any bay or 20 feet of length Maximum for the entire length 1/2 inch 1 inch

6.7 Variation in the sizes and locations of sleeves, floor openings and wall openings. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs And walls.

Minus	¼ inch
Plus	½ inch 9.6 Footing

6.7.1 Variation in dimensions in plan Minus ½ inch

Plus (plus variation applied to concrete only, not to reinforcing

	bars or dowels).	2 inch
6.7.2	Misplacement or eccentricity	
	2 percent of the footing width in the direction of misplacement but not more than (applies to concrete only, not to reinforcing bars or dowels).	½ inch 2 inch
6.7.3	Thickness Decrease in thickness	5%
6.7.4	Increase in Specified thickness	No limit

6.8 Variation in Steps

6.8.1	In a flight of stairs	
	Rise	+1 / 8 inch-
	Tread	+1 / 4 inch-
6.8.2	In consecutive steps	
	Rise	+1 / 16 inch-
	Tread	+1 / 8 inch-

6.9 'Tolerances for Precast concrete construction'

Forms must be true to size and dimensions of concrete members shown on the plans and be so constructed that the dimensions of the finished products will be within the following limits at the time of placement of these units in the structure, unless otherwise noted' on structural-architectural drawings:

6.9.1	Overall dimensions of members	1/16 inch per 10 feet
6.9.2	Cross-sectional dimensions Sections less than 3 inch.	1/16 inch
	Sections over 3 inch and less than 18 inch.	1/8 inch 1/4 inch
	Sections over 18 inch.	1/8 inch
6.9.3	Deviations from straight line in long sections.	1/16 inch per 10 feet
	Not more than	+1/16 inch per 10 feet span
	Maximum differential between adjacent units in erected position	1/4 inch

7 Acceptance of Structure

7.1 General

7.1.1 Completed concrete work which meets all applicable requirements will be accepted subject to the other terms of the Contract Documents.

7.1.2 Completed concrete work which fails to meet one or more of the requirements and which has been repaired to bring it into

compliance will be accepted subject to the other terms of the Contract Documents.

7.1.3 Completed concrete work which fails to meet one or more of the requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that remaining work complies with the requirements.

7.2 Dimensional Tolerances

7.2.1 Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of clause 9 shall be considered potentially deficient in strength and subject to the provisions of sub clause

7.2.2 Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of clause 9 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished In such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this clause.10.2.3 Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or if misplaced items interfere with other construction.

7.2.3 Inaccurately formed concrete surfaces exceeding the limits of Clause 9 or of Clause 5.6 of Section 'Formwork' and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

7.3 Appearance

7.3.1 Architectural concrete with surface defects exceeding the limitations of Sub-clause 5.6 of Clause 5 of the Section, 'Formwork' shall be removed and replaced.

7.3.2 Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.

7.3.3 Concrete not exposed to view is not subject to rejection for defective appearance.

7.4 Strength of Structure

7.4.1 The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements" which control the strength of the structure, including but not necessarily limited to the following conditions. Concrete strength requirements not considered to be satisfied in accordance with Clause 6 hereof.

7.4.2 Reinforcing steel size, quality, strength, position or arrangement at variance with the requirements as listed under specification of 'Reinforcement' or in the Contract Documents. Concrete which differs from the required dimensions or location in such a manner as to reduce the strength. Curing less than that specified. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development. Mechanical injury, construction fires, accidents of premature removal of formwork likely to result in deficient strength. Poor workmanship likely to result in deficient strength.

Structural analysis and/or additional testing may be required when the strength of the structure IS considered potentially deficient.

Core tests may be required when the strength of the concrete in place is considered potentially deficient.

7.4.3 If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their result evaluated in accordance with British Standard BS 8110 or ACI Standard 318.

7.4.4 Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so directed by the Engineer or shall be replaced, at the Contractor's expense.

7.4.5 The Contractor shall pay all costs incurred in providing the additional testing and/or analysis required by this section.

7.4.6 The Employer will pay all costs of additional testing and/or analysis which is made at his request and which is not required by these Specifications, or by the Contract Documents.

8 Testing of Material

a) A site laboratory shall be established by the Contractor for all the required testing of concrete, aggregates and other materials etc. All tests shall preferably be done at site. Only the test which are not possible to be carried out in the site laboratory shall be referred to the laboratory approved by the Engineer. All testing charges thereof shall be borne by the Contractor.

For testing of reinforcement steel bars, the samples shall be referred to the laboratory approved by the Engineer at the cost of the Contractor.

b) Cement shall be tested as prescribed in -STM C -150.

c) Aggregates shall be tested as prescribed in British Standard BS 812 - 882. addition fine aggregate shall be tested for organic impurity in conformance with ASTM Standard CAO.

9 Measurement and Payment

9.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

9.1.1 Providing, fixing, striking, etc. of formwork.

9.1.2 Providing, placing and fixing of anchor bolts or any other embedded parts.

9.1.3 Providing and installing all type of joints in concrete structure, including expansion joints.

9.2 Plain and Reinforced Concrete

9.2.1 Measurement

Concrete shall be measured as executed but no deduction shall be made for the following: Volume of any steel embedded in the concrete.

Volume occupied by water pipes, conduits etc. not exceeding 10 square inches each in cross-sectional area.

Voids not exceeding 4 square inch in work given in square feet. If any void exceeds 4 square inch, total void shall be deducted.

Voids, which are not to be deducted as specified above, refer only to openings or ,vents which are wholly within the boundaries of measured areas. Openings or vents which are at the boundaries of measured areas shall always be subject to deductions irrespective of size.

Concrete work shall be classified and measured separately as listed under items of Bills of. Quantities. Junction between straight and curved works shall in all cases be deemed to be included with the work in which they occur.

Measurement of walls shall be taken between attached columns piers or pilaster. The thickness of attached columns, piers or pilaster shall be taken as the combined thickness of the wall and the columns, piers or pilaster.

Attached or isolated columns, piers, pilaster, and the like (except where caused by openings) having a length on plan not exceeding four times the thickness shall be classified as columns. Those having a length over four times the thickness and are caused by openings in wall shall be classified as walls.

Columns shall be measured from the top of footing/footing beams or floor surfaces to the underside of beams or slabs as the case maybe. Where the width of beams is less than the

width of columns, the extra width at the junction shall be included in the beams.

The depth of the beams shall be measured from bottom of the slab to the bottom of the beams except in case of inverted beams where it shall be measured from top of slab to the top of beam. The cross-section of the beam shall be the actual cross-section below or above the slab. .

Measurement of acceptably completed works of plain and reinforced cement concrete will be made on the basis of number of cubic feet concrete placed and compacted in position within the neat lines of the structure as shown on the Drawings or as directed by the Engineer.

9.2.2 Payment

Payment will be made for the acceptable measured quantity of plain and reinforced cement concrete on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.3 M16 Hilti System Dowels

9.3.1 Measurement

Measurement of acceptably completed works of drilling and fixing of anchoring dowels as per M16 Hilti's System HIT-HY150 injection adhesive with HAS rod will be made on the basis of number of dowels drilled and fixed in position as shown on the Drawings or as directed by the Engineer.

9.3.2 Payment

Payment will be made for the acceptable measured quantity of drilling and fixing of anchoring dowels as per M16 Hilti's System HIT-HY150 injection adhesive with HAS rod, on the basis of unit rate per number quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.4 For Mortar

9.4.1 Sand

Sand for mortar shall comply with the requirements for BS-1200. It shall be graded in accordance with the following table and the various sizes of particles shall be uniformly distributed. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the Engineer.

Sieve Size (No.)	Percent Passing by weight	
	Min.	Max.
#4	100	
#8	95	
#16	70	100
#30	40	75

#50	10	35
#100	2	15
#200		

Sand up to .0025 inch shall not be more than 8% by weight of the total.

9.4.2 Cement:

Cement shall be Sulphate Resistant conforming to BS-12.

9.4.3 Water:

Water shall be clean and free from any harmful impurity. Where the quality of the water is doubtful, it shall be tested in accordance with BS- 3148.

9.4.4 Additives:

Additives where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives shall in no way adversely affect the mortar strength or contain chemicals, which may be harmful to other building materials To add gypsum to cement is strictly forbidden.

9.4.5 Mortars and Grout:

Materials for mortar, sand binding agent and water, shall be mixed by volume or by weight for at least 3 minutes with the minimum amount of water to produce a correctly mixed mortar 'or grout of workable consistency in a mechanical batch mixer. For small jobs, hand mixing may be permitted, the ingredients being mixed with sufficient water to produce a correctly mixed workable mortar.

Mortar shall be as strong, but no stronger than the materials it bonds together:

Mortars shall be mixed in batches, which can be used within a period before the setting process commences. Once a mix begins drying off, it shall be rejected. No ingredients shall be added to it once the setting process has begun.

9.4.6 Reinforcement:

For reinforcement refer specification section no. 2200.

10 Concrete Block Making

10.1 The Solid and Hollow blocks shall be machine moulded. The block making machines shall be of the standard approved by the Engineer. They shall be operated according to the instructions laid down by the manufacturers.

10.2 The blocks shall be continuously water cured by sprinkling water for a minimum of 10 days and covered between sprinkling operations with

4 mils thick polyethylene sheeting. After 10 days water curing period the blocks shall be air-dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surfaces of the block will be allowed to dry.

10.3 Cured concrete blocks shall be stored of the ground, stacked on level platforms which allow air circulation under stacked units. Units shall be covered and protected against wetting Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work. .

10.4 The hollow blocks shall be manufactured as per pattern shown on the drawing. These block units shall be provided by the Contractor for use where required in building structures from approved type of materials. Units shall have uniformly fine smooth surfaces of uniform colour. These shall be free of any honey combing or other imperfections or deformations, all edges true and straight, and at right angles with each other and without any chipped or otherwise broken edges.

10.5 The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they were cast.

10.6 Reinforced cement concrete hollow block masonry shall be provided where shown on the drawings. Hollow block manufactured by moulding machine shall have well formed cavities, sharp and well defined edges and corners, smooth surfaces without any imperfections or deformations.

11 Properties of Blocks

11.1 All blocks shall be of the size and shape required to complete the work shown in the Drawings or as instructed by the Engineer.

11.2 The cement, sand and coarse aggregate shall be volume batched and their proportion may be adjusted so as to provide the concrete of the required strength when tested and shall be mixed in a concrete mixer in accordance with clause 5.4 of the section 'Plain and Reinforced Concrete'.

11.3 All blocks shall comply with ASTM C145 198,8 edition. The compressive strength of various solid and hollow block shall be as follows:

S. No	Type of Concrete Masonry ASTM 1988 Edition	Compressive Average of 3 Units	Strength Psi Individual Unit (MPa)	Location
1	Solid load bearing	1800 (12.4)	1500 (10.4)	Exposed to frost action
2	Masonry Unit	1200 (8.30)	1000 (6.90)	
3	(ASTM-C-145) Solid/Hollow non	600(4.14)	500 (3.45)	Not exposed to moisture & weather
4	load bearing Masonry units (ASTM-C-90) Hollow load bearing masonry	1000 (6.90)	800 (5.50)	Exposed to moisture & weather
5	(ASTM-C-90)	700 (4.80)	600 4.10	Not exposed to moisture &

11.4 The Contractor shall provide test certificates providing the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test certificates shall be provided as required by the Engineer, to ensure that all batches of blocks have the minimum specified crushing strength.

11.5 A laboratory approved by the Engineer shall carry out the test. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The Engineer will require to test samples of blocks periodically and the Contractor shall make necessary arrangements accordingly. The method of sampling for all tests shall be in accordance with.

11.6 All properties or specifications of blocks, not explained in these Specifications shall comply with the requirements of ASTM C145 1988 edition as directed by the Engineer.

12 Suction Rate

The Contractor shall, at his own cost, satisfy the Engineer that the suction rate of the block when determined in accordance with Appendix "A" of BS 3921 does not exceed 20 g/dm2/ min. or that the Contractor is able to adjust it so that it does not exceed this value on site.

13 Soluble Salt Content

For exposed block work, the contents by weight percent of soluble sulphate, calcium, magnesium, potassium ·and sodium radicals, shall not exceed 0.30, 0.10, 0.30, 0.03 andO.03, percent respectively when ascertained in accordance with BS 3921, at the cost of the Contractor.

14 Reinforcing and Anchors of Block Masonry

Unless otherwise stated reinforcing and anchors shall conform to under mentioned sizes:

14.1 Joint reinforcing shall be 1.32mm (0.05-inch) diameter mild steel wire. Mesh design, galvanized after fabrication. Steel wire woven into 12mm mesh 75rrym wide. Reinforcing bar anchors shall be 250mm dia. deformed bar minimum 10 inch long.

14.2 Two 6mm dia bar shall be provided at every fourth course for anchoring of block masonry to columns. Two # 10 bars at every fourth horizontal course shall be provided for anchoring masonry walls to plinth beam/floor beam, as shown on the drawings.

14.3 Dovetail anchors and slots (if used as an alternate anchorage) shall be not less than 18 gauge galvanized steel.

15 Erection

15.1 Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at centre of units in alternate courses below. Vertical joints shall be buttered in the entire height of blocks. Each course shall be bonded at corners and at intersections of walls and shall be properly bonded. Courses of block shall be kept plumb throughout and corner reveals shall be true and in plumb.

15.2 Standard width of mortar joints for both horizontal and vertical joints shall be 10mm (maximum). Mortar joints in walls shall have· full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools. Blocks terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joints shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Control expansion joints shall be kept free from mortar or other debris.

15.3 Unless otherwise shown on the drawings or specified by the Engineer, the spaces around doorframes and other material or built in items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with Class 'C' concrete.

15.4 Work required to be built in with masonry including doorframe anchors, wall plugs, and dovetail anchors and accessories shall be built in as the erection progresses.

15.5 The block work shall be carried up in a uniform manner and no portion shall be carried more than one meter above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled round each floor.

15.6 Sleeves, Chases, holes, sinking and mortices for other trades shall be correctly located and formed to the sizes as required by the relevant trades. Chiseling of completed walls or the formation of holes shall only be carried out.

15.7 Walls of blocks indicated, as being non-load bearing shall be constructed on the concrete floor slab unit after the floor formwork is struck and the concrete has obtained sufficient strength to support their weight Too thing into load-bearing walls shall not be permitted.

15.8 All bolts, anchors, ties, pipe sleeves, flushing metal attachments, lintels and the like required to be built into the work shall be correctly inserted and executed as the work proceeds.

15.9 Walls or partitions abutting concrete columns or walls shall be securely anchored and tied with metal anchors or ties at not more than 450mm vertical centres. Wall ties cast in with concrete shall be bent down after the removal of formwork and shall be securely jointed into the mortar beds of walling.

15.10 Care shall be taken during construction of cavity walls so as to avoid the filling up of cavity with mortar. G.1. flashing and weep holes shall be provided where ever specified on the drawings or as per the instructions of the Engineer. Wheep holes will be formed by oiled rods, removed after the mortar is set, at specified locations.

16 Scaffolding

Contractor shall provide safe scaffolding of adequate strength for use of 00rkmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damage to masonry from scaffolding or from any other object shall be repaired by the Contractor at his own cost.

17 Jointing

Jointing is the forming of joints as work proceeds. Joints shall be as follows:

17.1 Exterior exposed joints shall be tightly formed to a weather joint with the point of the trowel.

17.2 Interior exposed joints shall be tightly formed to a concave joint

17.3 Joints which are subsequently covered with plaster or other finish materials shall be struck flush.

18 Tolerances

All block work shall be erected plumb and true to line and level with the maximum variation in any storey height or any length of wall being one mm in one meter. The maximum tolerance in the length, height or width of any single masonry unit shall be! 3mm.

19 Damp Proof Course

Damp-proof course shall be laid on an even mortar bed, free from projections, which may puncture the material. Where the damp-proof course is to be stepped only flexible membrane shall be used.

All damp proof course, unless otherwise specified, shall consist of class 'C' cement concrete 50mm thick, mixed with 2.5 kg. of pudlo per bag of cement or other approved quality water proofing compound as per manufacturers specifications and shall be laid at required levels as per drawings and instructions of the Engineer. The D.P.C shall be tamped consolidated, leveled, edges and corners made to the requirements of concerned drawings including finishing and curing complete.

20 Solid Block Work Around Opening of Hollow Masonry

Around all openings in hollow block masonry, the Contractor shall provide solid block work c:f same thickness as that of hollow block masonry wall and of width as indicated on the Drawings .. Solid block shall be laid around openings in such a manner that these are bonded integrally with hollow block masonry.

21 Reinforced Hollow Block Masonry

Where specified on the Drawings, reinforced hollow block masonry shall be provided. Horizontal and vertical reinforcement shall be cold worked deformed bar. Two bars of No. 8 (8mm) diameter shall be provided at every third horizontal course at 600mm centers, while the vertical reinforcement shall be two bars of No. 12 (12mm) diameter at 800mm centers. Bars shall be anchored and held firmly vertical in respective beams and columns in the manner shown in shop Drawings. The reinforced hollow part of ',he block wall shall be solidly filled with Class 'D' concrete at intervals of one meter maximum height as the laying of block masonry work proceeds. The filled concrete shall be consolidated thoroughly by rodding to avoid formation of voids. Contractor shall submit shop drawings of anchoring and placing of reinforcement in hollow block masonry for approval of the Engineer.

22 Curing and Repairs

22.1 All block masonry shall be water cured and shall be kept wet for at least seven days, by an approved method, which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of the specifications for water used in the manufacture of blocks.

22.2 If, after the completion of any block masonry, the work is not in alignment or level, or does not, conform to the lines and grades shown on the Drawings •or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the Engineer grants permission in writing, to patch or replace the defective area.

23 Masonry Short of Height

In case of different thickness of slab in different areas or rooms or for any other reasons, whatsoever if chiseling of masonry is required, the Contractor shall do so at his own cost. Where for any reason whatsoever, the height of the wall is short of ceiling height the actual height shall be made good with Class 'C' nominal mix concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of wall masonry. Similarly where the lintel heights' are such that the Contractor has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate of masonry.

24 Measurement and Payment

24.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

24.1.1 Chiseling of masonry, wherever required

Providing and fixing all joints reinforcing bars dovetail anchors, Cement sand mortar used in laying blocks, curing of masonry works and making of weep holes, Wastage of material etc.

Providing and filling Class 'D' Concrete in the cavity of hollow block masonry.

Providing and laying damp proof courses including damp proof materials and GI sheet flashing within cavity wall.

24.2 Solid Block Masonry

24.2.1 Measurement:

Measurement for acceptably completed works of respective type of solid block masonry will be made' on the basis of number of cubic feet provided and installed in position as shown on the drawings or as directed by the Engineer. Each measurement shall be taken to the nearest W'. All opening$ left in the masonry wall shall be deducted.

24.2.2 Payment:

Payment will be made for acceptable measured quantity of respective type of solid block masonry work on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 10(a) BLOCK MASONRY

6.1 SCOPE

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all the operations in connection with masonry work, complete in strict accordance with the specifications herein and the applicable drawings subject to the terms and conditions of the contract.
The work under this section includes the block maosnry in foundations, walls and partitions both load bearing and non-load beraring.

6.2 MATERIALS

6.2.1 BLOCKS.

All blocks shall be sound, of well burnt clay, uniform in shape and size, when struck , the block should produce ringing sound. The block shall be free from flows, cracks, shipped corners, nodules of line, kankar, other blemishes and salt. When the block is soaked in water for one hour, it should not absorb more than one sixth of its own weight. Blocks of only one size shall be used in the works. Blocks from different kilns not having the same size and colour shall not be accepted. The minimum compressive strength of the blocks tested in accordance with B.S. 1257 shall be 1300 psi subject to the condition that average compressive strength of five blocks tested shall not be less than 1500 psi.

6.2.2 Cement

Cement shall be Ordinary Portland Cement as specified in respective section.

6.2.3 Aggregates

Aggregates used shall meet the requirements specified under respective concrete section. All the aggregates dry and properly screened from approved source, shall also be acceptable for block making.

6.2.4 Block Masonry Units

i) Concrete masonry blocks shall be made on the project site and shall be of the sizes required as per drawings and/or as directed by the Consultants and shall generally conform to the requirements of British Standard 2028, 1364:1968 until and unless specified or otherwise in the specifications.

ii) The block shall be solid as required and shall be carefully made so that they are true in line and face with square corners and free from all defects. The ends of the blocks, masonry, shall be double grooved or a directed by the Consultants.

iii) The blocks shall be cured by keeping moist continuously for a period of atleast ten (10) days and then shall be allowed to dry in shade for least twenty (20) days before used in masonry.

iv) All blocks shall have clean cut straight and true edges, smooth dense faces of uniform appearance without voids, honeycombs, projections and shall be free from cracks spalls, chips, rugged edges or other defects detrimental to their use.

v) Where blocks are to be plastered or rendered, the blocks surface shall have a coarse texture suitable for bonding the plaster as approved by the Engineer.

vi) All blocks shall be stacked at site in a quantity not exceeding 5,000 blocks in each stack. The stacking shall be done in such a manner as to avoid smearing of the blocks in the lowest part of the stack with clay. Blocks smeared with clay show very poor bond with mortar sand, therefore, any blocks thus affected be rejected out of hand without recourse. When transported to the site the blocks shall not be dumped from the vehicle, the blocks shall be manually unloaded and stacked as aforesaid.

6.2.5 CEMENT MORTAR FOR MASONRY

Proportion

Cement Mortar shall be composed of one part of Ordinary Portland Cement to 6 (six) parts of all block masonry walls. Hand mixing, when permitted by the Engineer shall be done on clean hard platform

as much as required for immediate use with only just sufficient water, to produce mortar of a proper consistency. If directed by the Engineer, the mixing shall be done by mechanical mixers. Sand shall b of an approved quality and shall pass 100% through 3/16 inch sieve.

SECTION – 10(b) BRICK MASONRY

1. Scope

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all the operations in connection with masonry work, complete in strict accordance with the specifications herein and the applicable drawings subject to the terms and conditions of the contract. The work under this section includes the brickwork in foundations, walls and partitions both load bearing and non-load bearing.

2. Materials

2.2.1 Bricks

All bricks shall be sound, of well burnt clay, uniform in shape and size, when struck, the brick should produce ringing sound. The brick shall be free from flows, cracks, and shipped corners, nodules of line, kankar, other blemishes and salt. When the brick is soaked in water for one hour, it should not absorb more than one sixth of its own weight. Bricks of only one size shall be used in the works. Bricks from different kilns not having the same size and colour shall not be accepted. The minimum compressive strength of the bricks tested in accordance with B.S. 1257 shall be 1300 psi subject to the condition that average compressive strength of five bricks tested shall not be less than 1500 psi.

2.2.2 Cement

Cement shall be Ordinary Portland Cement as specified in respective section.

2.2.3 Aggregates

Aggregates used shall meet the requirements specified under respective concrete section. All the aggregates dry and properly screened from approved source, shall also be acceptable for block making.

2.2.4 Brick Masonry Units

i) Concrete masonry blocks shall be made on the project site and shall be of the sizes required as per drawings and/or as directed by the Consultants and shall generally conform to the requirements of British Standard 2028, 1364:1968 until and unless specified or otherwise in the specifications.

ii) The brick shall be solid as required and shall be carefully made so that they are true in line and face with square corners and free from all defects. The ends of the bricks, masonry, shall be double grooved or a directed by the Consultants.

iii) The blocks shall be cured by keeping moist continuously for a period of at least ten (10) days and then shall be allowed to dry in shade for least twenty (20) days before used in masonry.

iv) All bricks shall have clean cut straight and true edges, smooth dense faces of uniform appearance without voids, honeycombs, projections and shall be free from cracks spalls, chips, rugged edges or other defects detrimental to their use.

v) Where bricks are to be plastered or rendered, the bricks surface shall have a coarse texture suitable for bonding the plaster as approved by the Engineer.

vi) All bricks shall be stacked at site in a quantity not exceeding 5,000 bricks in each stack. The stacking shall be done in such a manner as to avoid smearing of the bricks in the lowest part of the stack with clay. Bricks smeared with clay show very poor bond with mortar sand, therefore, any bricks thus affected be rejected out of hand without recourse. When transported to the site the bricks shall not be dumped from the vehicle, the bricks shall be manually unloaded and stacked as aforesaid.

SECTION – 11 CARPENTRY AND JOINERY

1. Scope

The work covered under this section of Specifications consists of providing all material, labour, plant, equipment, appliances and performing all operations in any floor and at any height. connected with the fabrication and erection of all woodwork, mill work, construction assembly, surface finish treatment and building in of all cabinet type items, supports etc. of wood or metal and incidentals, associated woodwork appurtenances, procuring and applying preservatives, installation of "Finish Hard Ware" in connection with finish woodwork as per details shown on the Drawings or as directed by the Engineer.

2. Materials

2.1 Timber

2.1.1 Hard Wood:

Hard wood shall comprise of Oak, beech, Walnut Mahogany, Teak, lroko and Sheesham.

2.1.2 Soft Wood:

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deodar (referred in the document as deodar), wood locally known as 'Partal' to be used in shutter core where specified.

2.1.3 General Characteristics:

All the timber shall be in accordance with the requirements of BSI No: 1186, 'Quality of Timber and Workmanship in Joinery.

The whole of the timber shall be from the heart of sound and fully grown tree, uniform in substance, straight first class quality properly seasoned, free from large or loose dead-knots, open shakes and excessive sapwood. The scantlings of all timbers shall be brig t: sound and square edged. The moisture content of timber shall not be more. than 10 (ten) percent in case of soft wood and 7 (seven) percent in case of hard wood.

2.1.4 Preservation of Wood:

Prior to installation of all finish wood works in their respective positions, preservatives shall be applied to safeguard the wood work against fungus, termite and bores.

The Preservatives shall be of the best available quality as approved by the Engineer. The method of application shall be strictly in accordance with the manufacturer's instructions. The treatment and application of all the preservatives shall comply with the requirements of BS-CP 98:1964.

2.1.5 Adhesive:

The adhesives shall conform to the requirements of BSI No. 745 "Animal Glues for Wood" manufactured by M/s Host shall be considered approved for this Project or as directed and approved by (he Engineer.

2.1.6 Nails and Screws:

All nails and screws shall comply with requirements of BSI NO. 1202 and BSI NO. 1210 respectively.

2.1.7 Ply Wood

The ply wood shall comply in all respects with BSI No. 1455:1963. All the ply wood shall only be obtained from KDC Board (Pvt.) Limited, Jhelum as approved by the Engineer.. All plywood shall be manufactured with phenol pharamaldihide or any other approved water proof adhesive but not with urea pharamaldihide.

Ply wood used for doors, and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other similar defects. The surfaces shall be free, smooth for painting or polishing.

2.1.8 High Density Fibre (MDF) Board

Medium density fibre board to be used on the project shall be LASANI of thicknesses as specified in the drawings. Board shall be manufactured with water proof resinous glues and shall be guaranteed by the manufacturer. All boards required for the exterior surfaces of cabinets shall be laminated with farmica in approved colour and texture in factory as specified elsewhere.

3. Samples

All samples of the material used for the work under this Section of Specification shall be approved by the Engineer and same type of material shall be used throughout the work. If the Engineer desires to get the material tested, this will be got done by the Contractor· at his own cost from a laboratory approved by the Engineer.

4. Fabrication

Unwrought' timber shall be used. Sawing shall be done with sufficient oversize margin to finally meet the requirements of specified sizes and dimensions of the finished work.

All framing shall be joined and glued properly as shown n on the Drawings or as directed by the Engineer. All joints shall be secured with sufficient number of nails. The Contractor shall perform all necessary mortising, tenoning, grooving, matching, tangoing, housing, rebating and all operations required for the correct jointing. The Contractor shall also provide all metal plates, screws, nails and other fixing material that may be ordered by the Engineer for the proper execution of the joinery work. Fabrication that develop defects due to bad workmanship or unsound materials not conforming to these specifications and the directions of the Engineer, shall be cut out and

replaced at Contractor's own expense before the expiry of the maintenance period.

5. Protection Of Materials

All materials and assembled units shall be protected from weather and stored in such a way as to prevent decay, warping and attack by fungus and termites.

6. Wooden Doors

6.1 Materials

6.1.1 First class Deodar wood as approved by the Engineer shall be used for door frames and door shutters except the core of shutters which shall be partial wood as specified and shown on drawings.

6.1.2 Architraves, beads, lippings shall be of Deodar wood of specified sizes and fixed as per details shown on Drawings.

6.2 Ground, Blocking & Nailing Strips

6.2.1 Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

Except as otherwise shown or specified, ground blocking and nailing strips shall be secured in place as follows:

6.2.2 To steel--- by means of 3/8" diameter bolts spaced not over 3 feet.

6.2.3 To brick wall ---- by the use of cut nails spaced not more than 1.5 feet apart and driven directly into the block. .

6.2.4 To poured concrete --- by means of 1/4" diameter galvanized expansion bolts spaced not more than 1.5 feet part or by any approved method.

6.3 Exterior and Interior Door Frames

All exterior and interior door frames shall be fabricated of wooden sections of first class deodar wood frame as shown on drawings.

All exposed surfaces of frames and architraves/beads shall be painted with synthetic matt finished enamel paint of approved shade as per the instructions of the Engineer.

The door frames shall be secured in place by means of 4 inches screws and matching Rawal plugs and built into the plastered masonry after the same has dried 4 number screws in each jamb and 2 number for upto 3.5 feet width and 3 number for upto 5 feet width of doors in the head shall be used.

6.4 Door Shutters

The shutters will be fixed to the frames with approved quality fittings as per hardware schedule.

6.5 Squareness Maximum diagonal difference 1/8" (between length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

Doors, shutters shall be fabricate in a workman like manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer.

Manufacturer's Qualifications:

The manufacturer of doors herein specified shall have been in business of manufacturing doors of type specified for minimum period of five years. The door shutters shall be built in sections, properly jointed and glued together.

The surfaces shall be prepared for painting or polishing. All door shutters shall be paneled, fabricated from first class deodar wood as shown on drawing . Fitting, Hanging and trimming All the doors shall be fitted, hung and trimmed as Here in after specified and as indicated on the Drawings.

Doors shall have a clearance of 1/8" at sides and top unless otherwise directed by the Engineer and shall have 3/16" clearance at bottom. Doors shall be hung and trimmed with hardware as specified. All the locks shall be installed at the same height and shall be located at height as directed by the Engineer. Where directed by the Engineer margin for carpet shall be incorporated in the door shutter.

6.6 Hardware

Hardware shall be of best quality local make extra heavy duty and first class finished material except door locks and door closures which shall be imported of Japanese origin as per attached hardware schedule. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials.

Completed doors shall be sound, rigid and free from defects and warp. All edges shall be aligned and smooth, joints shall be close fitting, hard wood doweled or mortised framed and of a strength to maintain frame and of strength to maintain the structural properties of the member connected. All adjoining faces and edges shall be flush and smooth. Edges shall be rectangular and solid.

6.7 Quality Assurance

6.7.1 Tolerances: Doors shall be fabricated to following tolerances Size: Plus or minus 1/16 in overall dimensions Maximum Warp: 1/8"

6.8 Submittal

6.8.1 Provide manufacturer's literature completely describing products.

6.8.2 Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.

6.8.3 Provide certificates stating that doors were constructed with timber of the Species specified having moisture content and meeting equilibrium and relative humidity requirements.

6.8.4 Submit samples of plywood for selection of colour and grain.

6.8.5 Procurement of materials shall be made only after the shop drawings and samples have been approved by the Engineer.

6.9 Product Delivery, Storage and Handling

6.9.1 Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

6.9.2 Keep products dry, stack products off ground on level platforms, fully protected from weather, including direct sunlight.

6.9.3 Identify type, size and location of each door before delivery in order to permit. installation at correct location.

6.10 Installation

6.10.1 Install doors at correct openings and assure smooth swing and proper closer with frames.

6.10.2 Install finish hardware in accordance with manufacturer directions.

6.10.3 Hardware shall be carefully and securely fitted. Upon handing over the work, hardware shall be demonstrated to operate freely. Keys shall be placed into a respective locks and upon acceptance of the work keys shall be tagged and delivered to the Engineering work at site.

7. Wooden Railing

Material for wooden hand railing in stairs shall be superior quality teak wood/ deodar wood & 1/2 inch dia mild steel pipes. It shall be fabricated and installed in accordance with the design shown on the drawings/details and as per the instructions of the Engineer. Sample of railing shall be fabricated & mock up samples installed at locations designated by the Engineer for approval, prior to s

Shop/detail drawing indicating the basic details at various locations including details at turnings shall be submitted by the Contractor for Engineer's approval. Hand railing shall be installed to line level and plumb. The surface of railing in stairs shall be prepared for polishing. The railing shall be polished/painted with clear lacquer and the steel surfaces shall be painted with matt finished enamel paint.

8. SS & Glass Railing

Material for hand railing in stairs shall be 3" dia stainless steel pipe handrail, 1" dia stainless steel balustrades, W' thick unbreakable Security glass and clamps including all fixing accessories complete in all respect as shown on the drawings, It shall be fabricated and installed in accordance with the design shown on the drawings/details and as per the instructions of the Engineer. Sample of railing shall be fabricated & mock up samples installed at locations designated by the Engineer for approval, prior to starting work at

site. Shop/detail drawing indicating the basic details at various locations inclu9ing details at turnings shall be submitted by the Contractor for Engineer's approval. Hand railing shall be installed to line level and plumb.

9. Defective Work

In the event of non-conformance to specification and drawings, the wood works shall be rejected by the Engineer and the Contractor shall remove and replace the rejected work by new work of same specifications.

10. Surface Preparation

The surfaces of all wood works shall be prepared in the (manner as directed by the Engineer for polishing or painting.

11. Mock-Up Sample

After approval of shop drawings and tests etc., the contract shall submit at his own cost one mock-up sample of each type of wood works complete with all fixing, fixtures accessories prior to the actual fabrication of the bulk.

The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

12. Measurement & Payment

12.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective/items of the Bills of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

12.1.1 Glazing where required and all finished hardware fittings in carpentry and joinery works, including locks, kick and push plate, architrave, beading, handles, locking arrangements etc.

12.1.2 Prime coat, painting with synthetic enamel paint/lacquer polish in carpentry and joinery works/hand railing.

12.1.3 Anti termite treatment to wood works and adhesives

12.1.4 SS / Steel balusters, steel base and steel strip for wooden railing.

12.1.5 Deodar wood blocking, shipping & base frame work in cabinets/hand railing.

12.1.6 SS Plate in the door bottom.

12.2 Wooden Door

12.1.1 Measurement

Measurement of acceptably completed works of all types of wooden doors will be made on the basis of net actual area in square feet fabricated and installed in position as shown on the Drawings or as directed by the Engineer. Net area will be measured in accordance with plastered masonry opening in between jambs and plastered head and bottom of shutter.

12.1.2 Payment

Payment will be made for acceptable measured quantity of all types of wooden doors on the basis of unit rate per square feet quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works including all hardware & fittings like locks, tower bolts, push plates etc. as per details mentioned in Volume III & IV of Tender & Contract Document related to the item.

SECTION – 12 ALUMINIUM WORKS

1. Scope

The work covered under this section of the specifications consists of providing all material, labour, equipment, performing all operations required for providing and installation of aluminium. doors, windows, ventilators & louvers including all related items such as sealants, gasket, netting, rollers, hinges, latches, fastenings, anchor bolts, door locks, locking devices and glass complete in strict accordance with this section of specifications, the applicable drawings and as scheduled. Any additional information required in this connection and not stated in these specifications, shall be obtained from the Engineer's Representative.

2. Applicable Standards

Latest editions of following ISO and British Standards are relevant to these Specifications wherever applicable.

2.1 ISO (International Organization for Standardization)

1804	Doors Door	Terminology
6442	Leaves	Measurement of defects of general flatness
6443	Door	
6444	Leaves Door Leaves	Measurement of dimensions and defects of squareness.
6613	Windows & Doors	Test of behaviour under humidity variations (successive uniform climates) wind resistance tests. Air permeability test.

2.2 BSI (British Standard Institution)

1227 Hinges

4873 Aluminum alloy windows.

3. General

3.1 Door, Windows, ventilators, louvers and other items to be provided shall be aluminium, of profile pattern and design shown on drawings and shop drawings manufactured by reputable manufacturer approved by the Engineer. The contractor shall provide manufacture literature completely describing the product instructions for installation and maintenance.

3.2 All the sections used for doors, windows, ventilators & louvers fly screens shall be of best quality aluminium products such as equal and unequal angles, channels, tubes, corrugated strips, mouldings etc., in accordance with International standards conforming to ASTM B 308 & B 221.

3.3 All doors, windows. Ventilators and louvers shall be of type and size indicated on drawings and shall conform to the requirements shown and specified herein.

3.4 Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each door, window, ventilator and louvers type at the maker's works or any laboratory specified by the Engineer for the material supplied by him to be tested in the presence of the Engineer's Inspector, to whom test certificates, proof sheets, etc. shall be furnished. The models shall be submitted to the Engineer for approval prior to testing. Nevertheless, neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer to reject, after delivery of materials found not in accordance with these specifications.

3.5 The contractor shall submit shop drawings conforming to design concept which shall show full construction details, quantities and locations, fastenings, stiffening members and attachments to adjacent construction and materials. Shop drawings and calculations shall be submitted at the proper time to allow for checking, revisions, and agreement and to permit manufacturer's product delivery and start of site work to suit the building programme. The Contractor shall submit representative samples of finished doors, windows, anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval.

After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of aluminium works complete with glazing, all components assembly method and required fittings and accessories prior to the actual fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

Fabricate and assemble all work in the shop of the approved manufacturer to reduce field fabrication to a minimum unless otherwise directed by the Engineer.

The glass shall conform to specification laid down under chapter 'Glazing' and shall free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in window members.

3.6 The structural shape of the Aluminium members shall be of uniform quality, colour temper, clean, round, commercially straight and free from injurious defects.

3.7 All doors, windows, ventilators and louvers shall be fabricated as a complete unit, fully airtight and watertight, including rubber gasket for glazing, hinges, stays, rollers, latch, locking arrangement, handles, etc anodized in specified colour, inclusive of glass sheet, necessary holes for fixing, door locks, door closures and window locking requirements, all as approved by the engineer.

Contractor shall, provide certificate signed by the manufacturer stating that each lot has been sampled, tested and respected and

has met the requirements in accordance with these specifications and the same shall be furnished to the Engineer.

3.8 The shop drawings shall clearly show that there shall be no penetration of rainwater from the exterior to the interior in case of severe wind and rainstorm. This has to be specially ensured in bill section.

4. Material

4.1 Frames/shutters

The frames of aluminium door, windows and ventilator shall be formed from rolled, strip or extruded aluminium. The thickness of sectional members shall be at least 1.6 mm. All outer / frame sections of open able / fixed windows. Ventilators and louvers curtain wall shall be 95 mm minimum in width. The Frames for doors and door/windows curtain wall shall be at least 97 mm in width.

4.2 As shown on the drawings, aluminium frames shall be provided as per international standard approved by the Consultant.

4.3 Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.

4.4 Gaskets shall be vinyl glazing channel gasket to commercial standard CS-230-60.

4.5 Hardware shall be manufacturer's standard hardware. Flush to match doors, windows, ventilators and louvers finish. Floor mounted concealed type double action/swing imported door closures shall be provided to all doors. Heavy duty in-matching finish stays shall be provided to all open able windows, ventilators and louvers. Stays shall be attached to the window frame so as could be replaced easily.

4.6 Joint sealant shall be approved elastomer.

4.7 All Aluminium sections shall be powder coated in accordance with the standards of Aluminium Association of USA. The anodisation shall be of not less than 70-90 microns. The anodic oxide surface shall be properly sealed.

4.8 For powder coated finish aluminium sections to be coated shall be mill finish. The sections shall be firstly degreased with a degreasing chemical to remove all/any stains. The sections will then be given a chromating coating and electro static powder coating in the desired colour with a powder-coating machine. After colour coating the sections will be baked at baking temperature of 220 degree Centigrade for 25 minutes.

4.9 All sliding/open able windows shall be sliding/open able wire/fly screen shutters in window matching finish with wire/fly screen of size so as not to permit the entry of flies and mosquitoes. The wire mesh shall be 30 SWG. 14 mesh (14 x 14 openings per square inch).

5. Design Requirement

The Contractor shall design the installation to meet or excel the following requirements,

5.1 Tolerances

The Contractor shall be responsible for agreeing to all dimensions with the Engineer before proceeding with the manufacture and for making provision to allow for building tolerances required by the Engineer. Contractor shall also take site measurements of the structure completed before manufacturing.

5.2 Thermal & Seismic Movements

The window and glazing assemblies are to be constructed and installed in the openings with sufficient tolerance and, where necessary, to provide for Joints incorporated in couplings, to provide for pansion and 'contraction as will be caused by the local seismic and climatic conditions and temperature changes, winter to summer - day to night without buckling, distortion of joints, or other harmful effects.

6. Workmanship

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workman like manner in accordance with the manufacturer's instruction and as specified herein. The Contractor shall be responsible for the protection of installed items from damage by other trades. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before the final acceptance.

The glass panes shall firmly be secured in the rebates with the rubber gasket. Ensure that the beads and grooves are clean, dry and unobstructed at the time of glazing. The complete unit shall be airtight and watertight on completion. No doors, windows and ventilator shall be considered complete until and unless the fingerprints and other stains and marks have been removed from the surface of glass and aluminium.

7. Product Delivery and Storage

7.1 Deliver doors, windows, ventilator and louvers in a manner preventing damage to units,

7.2 Applicable Standards

Latest editions of following British Standards are relevant to these Specifications wherever applicable.

Store materials off the ground under cover in a manner preventing deterioration or All embedded parts and anchor bolts shall be delivered to the site carefully and keeping the fabricated shape and configuration. All these parts shall be suitably marked for identification.

SECTION – 13 GLAZING

1. Scope

The work under this section of the Specifications consists of furnishing all labour, equipment, tools, appliances, scaffolding and providing in any floor and at any height glass, gaskets, sealants, compound and other materials required for performing all operations in connection with' the installation and setting of all types of glass and glazing complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of Specifications is covered with detailed Specifications as laid down herein.

2. Applicable Standards

Latest addition of following British Standards are relevant to these specifications where ever applicable:

2.1 BSI (British Standards Institution)

952	Glass for glazing
5051	Security glazing part I & II
CP.152	Glazing

3. General

3.1 Each type of glass shall have the manufacturer's label on each pane, and the labels shall remain on the glass until final cleaning.

3.2 Glazing sealant shall be as recommended by the manufacturer for the particular application.

3.3 Spacer shims distance (pieces) shall be plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on drawings between glass and rebates bead or cleat. Depth shall give not less than 1/4" cover of glazing sealant.

3.4 Contractor shall submit samples for each type of glass, minimum 4' x 4' in size with protective edges. Samples of glazing sealant minimum 0.1 liter of specified types shall be submitted.

3.5 Contractor shall submit 1 feet long sample c; each type of glazing gasket.

3.6 Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing gaskets, compounds sealants and accessories including description of required equipment and procedures and precautions to be observed.

4. Delivery Storage and Handling

4.1 Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.

Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.

Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

Examine each piece of glass and discard and replace glass with edge damage or face imperfection. All glazing shall be wind tight and fully water tight on completion.

Clean glazing channels and other framing members indicated to receive glass. Remove coatings which are not firmly bonded to the substrate, Remove lacquer from metal surfaces wherever elastomeric sealants are to be used. Apply primer and sealer to joint surfaces wherever recommended by the sealant manufacturer and as shown on the drawings.

Trim and clean excess glazing materials from surrounding surfaces immediately after installation and eliminate stains and discolorations.

Cure glazing sealants and compounds in compliance with manufacturer's instructions to obtain high early bond strength internal cohesive strength and surface durability.

While glazing operation is in progress great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be refixed at Contractor's expense.

No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass ad checked by the Engineer for water tightness.

5. Protection and Cleaning of Glazing

5.1 Remove all smears labels and excess glazing sealant, leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with the new glass at no additional expense to the Employer and replaced with new glass at no additional aged or broken glass shall be removed.

5.2 All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Consultant.

6. Measurement snd Payment

No payment shall be made for the works involved within the scope of this section specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost there of shall be deemed to be included in the quoted unit rate of the relevant item of the Bill of Quantities.

SECTION – 14 BITUMEN COATING

1. Scope

The work under this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations related to water proof treatment to foundations and basement structures complete in strict accordance with this section· of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. Submittal

2.1 Samples of all materials proposed for use under this section. shall be submitted to the Engineer for approval.

3. Materials

3.1 Bitumen 10/20 grade.

4. Delivery Storage and Handling

Materials shall be protected from damage during loading shipment delivery and storage Non staining materials shall be used for blocking and packing

5. Preparatory Work

5.1 All surfaces to be treated shall be dust free and dry. Application of finishes shall not start unless the preparatory work has been inspected and approved by' the Engineer.

6. Bitumen Coating/Painting In Foundation Sub-Structures, Under Floors

a) Bitumen Painting:

All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire brushing or as directed by the Engineer. The surface shall be primed with a coat or asphalt oil used at the rate of not less than 1.08 gallon /10 square meter. Two coats of hot bitumen paint shall be applied at the rate of 1.0 kg/ Sq.m. each coat. The first coat shall be allowed to dry for about 6 hours before applying the second coat. During operation of painting great care shall be taken to avoid air bubbles. The manufacturers shall be taken to avoid air bubbles. The manufacturer's instructions and Engineer's directions shall be followed.

7. Measurement and Payment

7.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of

Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

7.1.1 All preparatory work, scrapping, scratching, cleaning, cant strips, gravel strips, etc.

7.1.2 Coats of bitumen.

7.2 Bitumen Painting/Coating

7.2.1 Measurement

Measurement of acceptably completed works of bitumen painting/coating will be made on the basis of net actual area in square foot as shown on the Drawings or as directed by the Engineer.

7.2.2 Payment

Payment will be made for acceptable measured quantity of bitumen painting/coating on the basis of unit rate per square foot quoted in the Bills of Quantities. The unit rate shall include all cost of surface preparation and shall constitute full compensation for all the works related to the item.

SECTION – 15 CEMENT PLASTER

1. Scope

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height connection with providing and installation of cement plaster, and specified external rendering complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the contract.

2. General

2.1 Except as may be otherwise shown on surfaces specified, all plaster work, both internal and external shall be ordinary Portland Cement plaster of the required thickness as shown on the drawings.

2.2 Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sort$ of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that all such work is carried out by other contractors before starting of plaster work. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.

2.3 Sample of materials shall be submitted to the Engineer for his approval prior to use in the works.

3. Material

3.1 Cement for plaster shall be Ordinary Portland Cement (B.S 12 or P.S 232) or Sulphate resisting cement (B.S 4027 or P.S. 612) as specified 'and shall conform to requirements specified in the section "Plain and Reinforced Concrete".

3.2 Sand for plaster shall coy with the requirements of BS 1199, BS 1200 or the draft Pakistan Standard "Sand for Plaster" as directed by the Engineer.

3.3 Water for plaster shall conform to requirements specified in the section for "plain and reinforced concrete".

3.4 All materials and workmanship for plaster, not explained in these Specifications, Shall comply with the requirements of relevant BS CP 211 and CP 221 as directed by the Engineer.

4. Proportioning and Mixing

4.1 Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings, in the Bill of Quantities or as directed by the Engineer. Mixing shall be continuous until all ingredients are evenly distributed and thoroughly mixed.

4.2 Only limited water shall be added for proper workability and such quantity of ortar shall be prepared which can be consumed in thirty minutes after preparation. Preparation of mortar in bulk quantity for use during the entire day or for any other time more than that stipulated above is expressly prohibited. Retempering shall not be permitted and all mortar which has begun to stiffen shall be discarded.

4.3 Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer, as directed by the Engineer.

5. Preparation of Surface to be Plastered

5.1 Concrete surface to be plastered shall be cleaned to remove all grease, form oil and other surface impurities, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface of all-concrete ceilings, beams and columns shall be lightly hacked by approved means to give the required key for plastering.

5.2 All masonry surfaces to be plastered shall be cleaned to remove all matter, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface shall be washed with clean water and kept damp for 24 hours before further treatment. The surface thus prepared shall be treated uniformly with cement and sand slurry. The slurry to be used shall be one part cement to one part sand by volume with water added to make a stiff creamy mix. The slurry shall be applied with a stiff brush on surface, which has previously been well wetted. The surface so treated shall be left to cure for 3 days.

6. Application of Plaster

6.1 The plaster of thickness less than the specified thickness shall be rejected. If the plaster is to be more than 1/2" thick, it shall be done in two coats. The surface of first coat shall be made rough before the second coat is applied. The plaster shall not have wavy surface and shall be perfectly in plumb. The edges and corners shall represent a straight line. The plaster shall be kept wet continuously for at least ten (10) days. No extra payment shall be allowed for jambs, junctions, corners, edges, round surfaces or for more than one layer of plaster required due to any unevenness in the work done by the Contractor. The plasterwork is to cover all conduits, pipes etc fixed in the walls and ceiling. Wherever specified, metal lath shall be nailed firmly before plastering is commenced. The plaster surface shall be tested frequently with a 10 feet straight edge and plumb bob.

6.2 Plaster containing cracks, blisters, pits, dis coloration or any, defects shall not be acceptable. Any such plaster or loose plaster shall be removed & replaced with plaster in conformity with these specifications and as additionally directed by the Engineer. Contractor shall cut out and patch all defective work at his own cost. All damaged plaster shall be patched as directed by the Engineer. Patching plaster shall match appearance of and shall be finished level with adjoining plaster.

7. Metal Lath

Metal lathing shall be fabricated from sheet steel and shall be of uniform quality and free from flaws broken strands, cracks and corrosive pitting, shall be rectangular and true to shape and shall comply with BS-1369.

All lathing shall be galvanized. Where plastering material depends entirely on the lathing for its key, these shall be not less than two complete mesh openings per 1-1/8"in one direction and the width of the aperture shall not be less than 3/16".

Sheets shall not be less than 1.6 kg/sq.m when fabricated, using 0.7 mm thick steel sheet. Where used on smooth surfaces to form a key it sh~11 be not less than 1.2 kg/sq.mm when fabricated, using 0.5 mm thick steel sheet. Tying wire shall be 1.2 mm diameter galvanized annealed iron wire.

Sheets shall be welded to angle iron frame as shown on drawings. 8.

8. Angle and Beads

Angle beads, stop beads, depth gauge beads, edging profiles, plaster dividing profiles, interior angle profiles, plaster borders and the like shall all be manufactured from sheet steel and galvanized after fabrication, all beads shall be perforated at edges to ensure good adhesion of the plaster work. Thickness and dimensions shall suit particular locations and plaster thickness.

All angle beads, stop beads, depth gauge beads and the like are to be ffixed in accordance with the manufacturer's instructions, at all corners, stops, joints, etc. as per directions of Engineer In charge.

9. Internal / External Plaster

9.1 Where specified in the Drawings external surface shall have an average 20mm thick. plaster finish, consisting of a base coat of 1:4 cement sand mortar in Grey cement and the finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

9.2 Where specified in the Drawings all internal plaster shall have an average 12mm thick consisting of base coat of 1 :3l1:4 cement sand mortar in grey cement and finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

9.3 Stucco Plaster

Wherever specified in the drawings external stucco plaster shall consist 'of 1 :2, one part white cement & 2 parts approved shade of marble chips zero size mixed with approved pigment to achieve desired shade. Wherever shown on drawings, groves shall be provided with aluminum U/Y channels. The contractor shall prepare mockup samples of stucco plaster for the approval of Engineer. The plaster shall be applied with machines and the final rough surface/texture/shade shall be as per the approved sample, direction and approval of the Engineer-In charge.

10. Cleaning and Protection

10.1 Rubbish and debris shall be removed as necessary to make way for work of other trades and as directed by the Engineer. As each room or space is completed all rubbish, debris, scaffolding and tools should be removed to leave the room clean.

10.2 Prior to plastering all aluminum windows, finished metals should be covered by sheet of plastic or tarpaulin to protect it from damage.

10.3 Protect finished plaster from injury by any source. Contractor shall also protect walls, floors and work of other trades from Plastic materials.

11. Tolerances

Surfaces of plaster work shall be finished with a true plane to correct line and level with all angle and corners to a right angle unless otherwise specified and with walls and reveals plumb and square.

Maximum permitted tolerances shall not exceed 1/8" in 6 feet variation from plumb or level in any exposed line or surface and 1/16" variation between planes of abutting edges or ends.

12. Measurement and Payment

12.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective item of the Bill of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height.otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

12.1.1 Metal lath over reinforced concrete and masonry joint.

12.1.2 Joints, junctions, corners, beads, drip course edge, roundings, and aluminum UN channels in groves. Etc.

12.1.3 More than one layer due to any unevenness in the finished works and base coat plaster in stucco plaster including marble chips/colour pigments.

12.1.4 Cutting & patching of all defective works.

12.1.5 Surface preparation, cleaning and protection as specified.

12.1.6 Marble chips & pigments in stucco plaster.

12.1.7 Roughning of first coat of plaster before application of 2nd coat incase where overall required plaster thickness exceeds 1/2 inch.

12.2 Plain Plaster/Stucco plaster Measurement

Deductions shall not be made for ends of joints, beam posts, etc., and openings not exceeding 5 square feet each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings non for finishing the plaster around ends of joints, beams posts, etc.

In case of opening of area exceeding 5 square, feet each, deduction shall be made for the openings and also no addition shall be made for reveals jambs, soffits, sills, etc., of these openings.

Measurement of acceptably completed works of plaster will be made on the basis of number of square feet of the surface area plaster as shown on the Drawings, or as directed by the Engineer.

12.3 Payment

Payment will be made for acceptable measured quantity of plaster on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 16 MARBLE

1. Scope

The work under this section of specifications, consists of providing all material, labour, 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 sizes, 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 colour.

Submit three ranges samples 300mm x 300mm in size of each type of stone showing colour, grade, finishing and texture for approval of the Engineer.

3. 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's recommendations and as required to prevent staining,. scratching, etching or breakage.

4. Materials

4.1 General

Marble shall be compact, dense, metamorphic rock of lime stone origin obtained from quarries within Pakistan. It shall have a specific gravity of 2.7 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 colour 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 & risers 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 Consultant/Engineer.

Provide stone of specified thickness. Saw cut the back surfaces that are meant to be concealed in finished work.

Provide irregular shaped units, staircase units and skirting base units to the profiles of required shapes & sizes and polished exposed surfaces wherever specified.

4.2 Marble Stone Type

All marble stone types are to be selected and approved by the Engineer for quality, colour and texture.

Marble: Marble of approved type and colour of local origin, first class quality and high class finish acceptable to the Engineer.

4.3 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	: 1 part
Cement Sand Water	: 3 parts
	: Clean, fresh and free from deleterious substances

4.4 Adhesives, Grouts and Sealants

Proprietary adhesives, joint grouts and sealants of approved type as required and recommended by the manufacturer for specific application shall be used. The colour of the joint grout and the sealants shall match with the colour of stone.

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 tamps 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 well still 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 Marble Toilet Counters

Marble toilet counter tops of the specified size shall be installed in areas shown on Drawings with M.s. angle framing and fixing accessories in accordance with approved shop drawing. Joints shall be cement grouted with matching colour or with matching colour sealant.

5.3 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. Repoint defective and unsatisfactory joints to provide neat, uniform appearance.

6. Product Delivery, Storage and Handling

6.1 Material shall be delivered in original; unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.

6.2 Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.

6.3 Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

7. Job Site Conditions

7.1 Work which will be concealed by false ceilings shall be completed, tested, inspected and accepted before ceiling work is started.

7.2 False ceiling installation shall not begin until the area has been closed in, and temperature and humidity approximate occupancy conditions. Wet work shall be cured and dry before ceiling work is started.

7.3 Surface which will support the ceilings, and those to which the ceiling abut, shall be inspected and accepted for completeness and adequacy to receive the ceilings before the work begins.

8. Installation and Workmanship

False ceiling suspension system and panels shall be installed in accordance with the requirements of BSI-CP.290 and with the manufacturer's recommendations as approved by the Engineer.

8.1 Suspension System

The hangers as specified shall be evenly disposed as per drawings, details and place and position as indicated. The suspension system should be installed by . making holes direction in the roof and shall be made good as directed by the Engineer. Their lengths clear of roofing slab shall be as per shop drawing details.

The framing of the specified section and run at spacing as per shop drawings. The jointing of runners to hangers shall be as per approved shop drawing details. The extra framing if required shall be provided for light receptacles as per approved shop drawing details.

Wall hangers shall be positively and rigidly connected to the structure and to cross runners.

8.2 False Ceiling tiles.

Tiles shall be installed in the grid system after completion of installation of the suspension of lighting and air conditioning fixtures.

Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per shop drawings approved by the Engineer.

All panels shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

9. Fixtures

Light fixtures shall be installed as per approved pattern and supported in accordance with manufacturer's recommendations.

10. Finishing

After installation, dirty, soiled or discoloured surfaces shall be cleaned and left free from defects and ready to receive any painted finish if required.

The panels which are damaged or improperly installed shall be removed and replaced' by the Contractor at his cost.

11. Measurement and Payment

11.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

Aluminum approved suspension system including main channels, main tee/cross tee bars, wall moulding and edge trims, hanger strips and accessories hold down clips, Aluminum tiles / strips etc. complete for aluminum tile / strips ceiling.

11.2 False Ceiling

11.2.1 Measurement

Measurement of acceptably completed works of respective types of false ceiling will be made on the basis of net actual area in square feet of false ceiling provided and installed in position as shown on the Drawings or as directed by the Consultant/Engineer.

11.2.2 Payment

Payment will be made for acceptable measured quantity of respective type of false ceiling on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 18 FLOOR AND WALL FINISHES

1. Scope

The work under this section of the Specification consists of furnishing all plant. labour, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the installation of cement concrete floors and floor finishes including bases, skirting and external surface treatments, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. Aterial

2.1 Cement

Cement shall be ordinary Portland cement conforming to B.S. 12 or PS 232.

2.2 Sand

All fine sand shall be obtained from sources approved by the Engineer. The grading shall conform to B.S 882 Grading Zone 1 and 2 of which the gradation limits are as follows:

Percentage (by weight) passing

B.S. Sieve	Grading Zone 1	Grading Zone 2
3/8" (9.53 mm)	100	100
3/16" (4.765 mm)	90-100	90-100
No. 7	60-95	75-100
No. 14	30-70	55-90
No. 25	15-34	35-59
No. 52	5-20	0-10
No. 100	0-10	

2.3 Coarse Aggregate

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BSS NO.882 and shall be graded as follows:

B.S. Sieve	% Passing by weight
1" (25.40 mm)	100
3/4" (19.05 mm)	90-100
3/8" (9.53 mm)	20-55
3/16"(4.765 mm)	0-10

The aggregate shall be stored on properly constructed paving or as directed by the Engineer.

There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site with-out delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the Contractor.

2.4 Stone Ballast

Stone ballast to be used as soling shall comprise of strong, hard, durable stone of approved size. The stone shall be obtained from approved quarry and shall be sound, free from laminations and weak cleavages and shall conform to specifications of "Stone Soling".

2.5 Water

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes:

2.6 Ceramic/Porcelain tiles

Ceramic tiles shall be imported, premium quality, plain white/ coloured or printed. Porcelain tiles shall be imported Italian or Spanish or Granitto. The tiles shall be of sizes as specified on the drawings and shall conform. to BS 1281 as per samples.

2.7 Cleaning Compound

The compound used for all cleaning of terrazzo shall be an approved neutral chemical cleaner free from acid and alkali or any other material that will affect the colour or otherwise damage the terrazzo and shall not affect the conductivity of terrazzo floors.

2.8 PVC Vinyl Tiles

PVC vinyl tiles shall be imported best quality of size 300mm X 300mm Colour and shade shall be as per sample to be submitted by the Contractor and approved by the Engineer.

2.9 Division Strips

Division strips shall be of marble as approved by the Engineer. Standard division strips for floor finishes shall be not less than 5mm (3/16") in thickness and shall not be less than 1-3/4" in depth.

2.10 Marble Chips

Marble chips shall have an abrasive hardness of not less than 16, as determined by the test of wear resistance in National Bureau of Standards Reports MBS 98. Size shall vary from No. zero to 8.

2.11 Preservative Material

Preservative treatment for terrazzo floor shall produce a water-proof finish which will not be impaired by immersion in water at room temperature for a period of 2-1/2 hours, approximately 18 hours after the floor is finished by buffing, as specified. The preservative material shall not discolour the terrazzo nor leave a tacky or sticky finished film on the surface after buffing.

3. Cement Concrete Flooring

The materials for C.C flooring shall be same as already specified under clause 3, "Materials".

3.1 Composition of Concrete

Concrete shall be composed of Portland Cement, sand, coarse, aggregate and water, all well mixed and brought to the proper consistency. The Contractor shall mix the ingredients as indicated on the Drawings. The proportions of the various ingredients shall be determined from time to time during the progress of the work and tests shall be made of samples of the aggregates and the resulting concrete. The mix proportions and appropriate water-cement ratio will be determined on the basis of the production of concrete having required workability, density, impermeability, durability and required strength.

3.2 Mixing Concrete

The concrete ingredients shall be mixed in a batch mixer for not less than 1-1/2 minutes after all ingredients, except the full amount of water, are in the mixer. The Engineer reserves the right to increase the mixing time when the charging and mixing operations fail to produce a concrete batch in which the ingredients are uniformly distributed and the consistency is not uniform. The concrete shall be uniform in composition and consistency from batch to batch except when changes in composition or consistency are required. Water shall be added prior to, during and following the mixer charge. Excessive over-mixing requiring addition of water to preserve the required concrete consistency will not be permitted. The concrete ingredients shall be mixed by volumetric measurement in purpose made boxes approved by the Engineer.

3.3 Construction

The base course of the floor shall comprise of stone ballast of 2 inches (approx: 50 mm) mesh size. The base course shall be thoroughly compacted by suitable power rammers to the total consolidated

thickness as shown on the Drawings and as approved by the Engineer. The interstices shall be filled with smaller size stones. The base course shall be blinded with sand and the whole surface watered. Over the well compacted base course, a layer of concrete of the required grade and thickness shall be laid, in panels of the sizes as indicated on the Drawing and as approved by the Engineer.

After the C.C bed has been cured, as directed by the Consultant/Engineer, it shall be roughened and well watered before floor finishing is laid. The floor finish shall comprise of cement concrete of required grade and shall be laid in panels to the required thickness as shown on the Drawings or as directed by the Engineer. The concrete after laying will be thoroughly rammed and mortar worked up to the top and smoothed with a steel trowel. The edge of each section into which the floor is divided should be defined by wooden screeds of the approved width and of a depth equal to the depth of the floor concrete.

Freshly placed concrete floor and completed floor portions as finished shall be protected to prevent loss of water by covering with damp hessian, water proof paper, damp sand or other approved material, and shall be kept constantly damp for a period of four days or longer after concreting as directed by the Consultant/Engineer. The concrete shall be allowed to dry out slowly over a period of three days after wet curing is completed.

The expansion joints shall be filled in with hot bitumen, of the approved grade, as directed by the engineer.

4. Terrazzo Flooring

4.1 Mix

The terrazzo mixes shall be composed by weight as follows:

Plain terrazzo for all floors and bases indicated as terrazzo and not otherwise specified, shall be composed of one part cement, white or grey, and 2 parts of marble chips of the sizes and colours hereinafter specified.

4.2 Preparation for Terrazzo

The grade and thickness of concrete as shown on the Drawings shall be laid as under bed to receive terrazzo. The surface of the bed shall be roughened for bounding with the terrazzo finish. If the surface is too smooth it shall be roughened with a toothed chisel and, prior to laying the terrazzo the bed shall be cleaned of all dirt, oil grease and extra loose material.

4.3 Division Strips

Terrazzo floors and bases shall be divided up by marble strips of specified thickness and depth. The division strips between field work and borders shall have exposed tops in full width of the strips. The division strips shall be set immediately after the spreading of the under bed, the strips being partially embedded therein, securely anchored to the subfloor and grouted solid.

All division strips shall be set, straight to lines and to the proper level to ensure that the tops of the strips will show uniformly after grinding and smoothening operations are completed and joints and intersections shall be fitted tight. Strips shall be braced to prevent bulging during the placing of terrazzo.

Unless otherwise shown on the drawings, the divisions in field work of large areas shall not exceed 4 feet x 4 feet and in small areas shall not exceed 2 feet x 2 feet.

Edging strips shall be placed at doorways between terrazzo and other types of flooring and along the edges of all terrazzo bases or borders and adjoining other types of floor finishes or floor covering. The edging strips at doorways shall be placed in line with the step face of doors. All edging strips shall be anchored and grouted solid in the under bed or to the concrete sub-floor and braced to prevent bulging as specified for division strip.

4.4 Laying Terrazzo

4.4.1 The sub-surface shall be swept clean, thoroughly moistened, but not saturated, and slushed with a coating of neat cement grout approximately 1/8" in thickness. The under bed consisting of class 'C' cement concrete screed shall be spread and brought to a level not less than 3/4" below the finished floor level. The dividing strips shall be installed in the green under bed. The terrazzo mix shall be spread, tamped and rolled into a compact mass not less than 3/4" thick. After rolling additional aggregate mix shall be sprinkled over the surface to fill up all depressions, to take up excess moisture and to permit the terrazzo to be trowelled to a level, dense and even surface, slightly above the finish line of floor. This level, shall allow for the surface grinding necessary to expose the specified area of aggregate, and to produce smooth, level floors free of waves and depressions.

4.4.2 Seasoning

The completed terrazzo shall be allowed to season for 6 days during which time it shall be kept moist by (1) covering with approximately 1" thickness of sand; or (2) covering with building paper or mats; or (3) sprinkling with water at every 10 hour interval.

4.4.3 Surface

Following the curing period, the terrazzo shall be machine ground to a true, even surface using a No. 24 grit followed by a No. 80 grit or finer abrasive stone. After the first grinding, the floors shall be thoroughly grouted with the same cement and colour composition as specified for the matrix of the terrazzo mix. The grout shall be of the consistency of thick cream, and shall be brushed over the floor to eliminate all pits and thoroughly fill the surface for final grinding.

4.4.4 Finishing

Not less than 72 hours after application, the grouting coat shall be removed by grinding. In the later stages of grinding, the grit stones or other abrasive used in the grinding machine shall be of a grain or fineness that will give the surface smooth finish. Small areas, inaccessible portions and corners which cannot be reached by the grinding machine shall be ground and rubbed by hand.

4.4.5 Protection

The walls and all surfaces of the finished work 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 material approved by the Engineer until completion of the work of all other trades.

4.4.6 Cleaning and Coating

Prior to placing the protective covering, the terrazzo floor shall be approved by the Engineer. After the work of all other trades has been completed and the protective covering removed, all terrazzo work shall be washed with cleaning compound, mixed with warm water and using a fine abrasive where necessary to remove any stains or cement' smears. The terrazzo' shall be allowed to dry thoroughly and shall be given a sealing application of preservative material. The sealing material shall be applied in accordance with the manufacturer's directions, leaving all terrazzo work in clean condition as approved by the Engineer.

4.4.7 Dado/Skirting

The ingredients of dado/skirting shall be one part of cement and two parts of marble chips varying from Nos. zero to 2. Striking shall be laid over a base of plaster of specified thickness. The thickness of dado/skirting layer shall be as specified. The surface shall be grinded and polished to the satisfaction of the Engineer.

5. Installation of Tile Flooring

When setting out the tiles, care shall be taken to establish the correct elevation for the floor. A gauge rod shall be used, indicating the overall measurement of a given number of tiles with specified joint width to reduce cutting.

After the floor has been machine finished, it should be covered with white, non-staining sand or rags to protect it while other work is being done. After removal, the floor shall be thoroughly scrubbed.

5.1 General

The base shall be prepared by laying cement concrete of specified grade and of thickness as shown on the drawings, or specified in the Bill of Quantities.

The curing period of the setting bed shall be as directed by the Engineer. As large an area of setting bed shall be spread at one time as can be covered with tiles before the mortar has set. Surplus mortar shall be removed. The thickness of setting bed in any space shall not be less than 1/2".

Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust, oil and other objectionable matters. Tiles shall be laid out from the centre line of each space in an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles as directed by the engineer.

Joints between the tiles shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges.

5.2 Ceramic/Porcelain Tiles

The ceramic/porcelain tiles shall be laid to the required lines, levels and grades over a setting bed of cement sand mortar comprising of one part of cement and 4 parts of sand by volume and the joints filled with neat white or grey cement including vertical and horizontal covers. The tile floor shall be kept wet for at least 72 hours and no traffic should be allowed on the tiles during curing period.

6. Measurement and Payment

6.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities.

The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

6.1.1 Loss and wastage of material due to consolidation, erosion and settlement.

6.1.2 All type of joints (expansion, contraction and construction joint etc.).

6.1.3 Class 'C' cement concrete screed base and 1:4 cement sand mortar under floor.

6.1.4 Rough plaster base under skirting / dado.

6.1.5 Finishing/grinding, washing & polishing works of ceramic, concrete, terrazzo tile, terrazzo floors and marble tiles.

6.1.6 Marble strips in terrazzo floors

6.1.7 1 :2 and 1:4 cement sand rough cast plaster.

6.1.8 Sand cushion under concrete pavers

6.1.9 Adhesives used in the laying of PVC flooring.

6.1.10 Bedding / Jointing Material of Envicrete jali

6.1.11 Pigmented grouting

6.1.12 Cleaning of tiles after installation.

6.1.13 Bull-nozing, chamfering of edges of marble tops including base mortar and making holes for wash basin including all necessary fixing accessories.

6.2 Cement Concrete Floor

6.2.1 Measurement

Measurement of acceptably completed works of cement concrete floor steel trowelled finish will be made on the basis of net actual area in square feet laid in position as shown on the Drawings or as directed by the Engineer.

6.2.2 Payment

Payment will be made for acceptable measured quantity of cement concrete floor steel trowelled finish on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

6.3 Ceramic/Porcelain Tile Floor

6.3.1 Measurement

Measurement of acceptably completed works of ceramic/porcelain tile in floor will be made on the basis of net actual area in square feet-of floor laid in position as shown on the drawing or as directed by the Engineer.

6.3.2 Payment

Payment will be made for acceptable measured quantity of ceramic/porcelain tile floor on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

6.4 Ceramic/Porcelain Tile Dado/Skirting

6.4.1 Measurement

Measurement to acceptably completed works of ceramic/Porcelain tile in dado/skirting will" be made on. the basis of net actual area in square feet of dado/ skirting laid in position as shown on the Drawing or as directed by the Consultant/Engineer.

6.4.2 Payment

Payment will be made for acceptable measured quantity of ceramic/porcelain tile in dado/ skirting on the basis of unit rate per square feet quoted in the Bills of Quantities. The unit rate

shall include all cost of cement, sand, mortar and shall constitute full compensation for all the works related to the items.

6.5 Terrazzo Flooring/Skirting

6.5.1 Measurement

Measurement of acceptably completed works of terrazzo flooring/skirting will be made on the basis of net actual area in square feet laid in position as shown on the Drawings or as directed by the Engineer.

6.5.2 Payment

Payment will be made for acceptable measured quantity of terrazzo flooring/skirting on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

6.6 PVC Vinyl Tile

6.6.1 Measurement

Measurement of acceptably completed works of PVC vinyl tile flooring will be made on the basis of net actual area in square feet laid in position as shown on the Drawings or as directed by the Engineer.

6.6.2 Payment

Payment will be made for acceptable measured quantity of PVC vinyl tile flooring on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 19 PAINTING

1. Scope

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in any floor and at any height in connection with surface preparation, mixing, painting concrete works, gates, frames, walls, ceilings and all . such surfaces as shown on the 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. Applicable Standards

Latest editions of following British Standards are relevant to these specifications wherever applicable.

2.1 BSI (British Standards Institution)

245 Specification for mineral solvents (white spirits and related hydrocarbon solvents) for paints and other purposes.

2521 Lead - based-priming paint for wood work .

2523 Lead based priming paint for iron and steel.

2569 Sprayed metal coatings.

4800 Paint colours for building purposes. Painting of building.CP2

3. Cleaning and preparation of metal surfaces

3.1 Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work.

3.2 The Contractor shall repair at his own 'expense all damaged" or defective areas of shop-painted metal and structural steel work. Metal surfaces against, which concrete is to be placed will be furnished shop-painted and shall be leaned prior to being embedded in concrete.

3.3 Except as otherwise specified all concrete and plastered surfaces are to be painted.

3.4 The Engineer will furnish a schedule of colours for each area and surface. All colours shall be mixed in accordance with the manufacturer's instructions.

3.5 Colours of priming coat (and body coat) where specified, shall be lighter than those of finish coat. The Engineer shall have unlimited choice of colours.

Samples of all colours, and finishes shall be prepared in advance of requirement so as not to delay work and shall be submitted to

the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the Employer. Samples of each type of paint shall be on separate 12" x 12" x 1/8" tempered hard board panels. Manufacturer's colour chart shall be submitted for colour specifications and selection.

4. Materials

4.1 All materials shall be acceptable proven first grade products and shall meet or exceed the minimum standards of reputable manufacturers as approved by the Engineer.

4.2 Colours shall be pure, non-fading pigments, mildew-proof sun-proof, finely ground in approved medium. Colours used on-plaster and concrete surfaces shall be lime proof. All materials shall be subject to the Engineer's approval.

4.3 All synthetic enamel paints and primers for structural steel works, metal work and wood works will be the best available of its type and shall be approved by the Engineer prior to its procurement.

4.4 Approved quality Weather Shield Weather Coat paint shall be used for painting the exteriors of the structures or other surfaces where specified on the drawings as directed by the Engineer.

4.5 The plastic emulsion paint, vinyl emulsion paint or similar as approved by the Engineer shall be used for interior surfaces.

4.6 All material for Bitumen painting shall consist of Bitumen grade 10/20. It shall be used for foundations or wherever recommended by the Engineer.

4.7 Only paints manufactured by ICI, Berger or approved equivalent shall be used in this Project. All material shall be delivered to site in their original unbroken containers or packages & bear the manufacturer's name, label, brand & formula & will be mixed and applied in accordance with his directions.

5. Delivery Storage And Container Sizes

Paints shall be delivered to the site in sealed containers, which plainly show the type of paint, colour (formula or specifications number) batch number, quantity, date of manufacture, name of manufacturer and instructions for use. Pigmented paints shall be supplied in containers not larger than 20 liters. All materials shall be stored under cover in a clean storage space, which should be accessible at all times to the Engineer. If storage is allowed inside the building, floors shall be kept clean and free from paint spillage.

6. Surface Preparation

6.1 All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be painted, polished and white washed by the use of a solvent and clean

wiping material. Following the solvent cleaning, the surfaces shall be cleaned by scrapping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.

6.2 In the event the surfaces become otherwise contaminated in the interval between cleaning and painting, recleaning will be done by the Contractor at no additional cost.

6.3 Surfaces of stainless steel, aluminum, bronze, and machined surfaces adjacent to metal work being cleaned or painted shall be protected by effective masking or other suitable means, during the cleaning and painting operations.

6.4 All the surfaces to be painted with approved quality paint shall be free from dust, dirt, fungus, lichen, algae etc. Oil paint, varnish and lime wash should always be removed by scraping and washing.

6.5 All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire-brushing or as directed by the Engineer. The surface shall be primed with a coat of asphalt oil used at the rate of not less than 0.50 pound per square foot.No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

7. Application

7.1 All paint and coating materials shall be in a thoroughly mixed condition at the time of application. All work shall be done in a workman like manner, leaving the finished surface free from drips, ridges, waves, laps, and brush marks. All paints shall be applied under dry and dust free conditions. Unless approved by the Engineer paint shall not be applied when the temperature of the metal or of the surrounding air is below 7 degrees centigrade. Surfaces shall be free from moisture at the time of painting.

All primary paint shall be applied by brushing. The first coat of paint shall be applied immediately after cleaning. When paint is applied by spraying, suitable measures shall be taken to prevent segregation of the paint in the container during painting operation.

Effective means shall be adopted for removing all free oil and moisture from the air supply lines of the spraying equipment. Each coat of paint shall be allowed to dry or harden thoroughly before the succeeding coat is applied. Surfaces to be painted that will be inaccessible after installation shall be completely painted prior to installation.

Coats of Weather Shield Weather Coat paint shall be applied in accordance with the manufacturer's instructions or as directed by the Engineer.

Only as much material should be mixed as can be used up in one hour. Over thinning will not be permitted. After the first coat

the surfaces will be soaked evenly four or five times and the second coat shall be applied after leaving for at least overnight.

7.2 Where shown on Drawings all exterior 1.1ishes shall be painted with Weather Shield/weather coat paint in approved colours as per manufacturer's specifications. The number of coats shall be as shown on the drawings or as directed by the Engineer.

7.3 All wooden doors shall be painted with approved synthetic enamel paint as per manufacturer's recommendation and instructions or after approval of the Engineer.

7.4 Plastic emulsion paint vinyl emulsion paint or matt enamel paint of the approved make and shade shall be applied to surfaces as shown on Drawings as per manufacturer's instructions. The numb7er of coat shall be as indicated on the Drawings or as directed by the Engineer.

7.5 Two coats of hot bitumen paint shall be applied to exposed concrete surfaces in contact with earth. The first coat shall be allowed to dry for about six hours before applying the second coat. During the operation of painting great care should be taken to avoid air bubbles. The manufacturers instructions and Engineer's directions shall be complied with.

8. Job Conditions

8.1 Observe manufacturer's recommended minimum and maximum temperature but do not apply paint or finish to any surface unless ambient temperature is 10 degree C or above and less than 43 degree C. No painting shall be done above 90% relative humidity.

8.2 Place drop cloths to adequately protect all finished work.

8.3 Remove and replace all items of finish hardware, device plates, accessories, lighting fixtures or other removable items.

8.4 In no case shall any finish hardware or other finished item that is already fitted into place be painted, unless otherwise specified.

9. Quality Assurance

All paint for anyone surface shall be top quality, of one manufacturer and approved by the Engineer. Deep tone accent colours shall be used and the unavailability of final coat colours may be the basis for rejecting materials for anyone surface.

10. Schedule of Measurement Of Paint Area

10.1 Irrespective of prime coats and number of paint coats applied to exposed painting surface area of column, walls, projections, ceilings, false ceilings and other surfaces (Except gates, doors windows and ventilators) shall be measured as per actual paint· surface area for single time only and paid in accordance with quoted rate of Bill of Quantities.

11. Measurement And Payment

11.1 General

Except otherwise specified herein or elsewhere in Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of Bill of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

11.1.1 Preparatory works, including .preparatory materials, scraping, scratching, sand blasting, c1earjng, prime coating, priming, protection of finished works etc.

11.1.2 Polishing works, including preparatory materials, scraping, cleaning, sanding etc/

11.1.3 Painting work on steel & wooden surfaces.

11.1.4 Before application of paint on existing surface the old paint surface shall be removed existing paint filing of cracks, surface preparation and application of primer coat, if any.

11.2 Measurement

11.2.1 Measurement of acceptably completed respective type of painting works will be made on the basis of net actual areas in square feet of the surface painted as shown on the Drawings or as directed by the Engineer.

11.2.2 Payment will be made for acceptable measured quantity of respective type of painting on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 20 TEXTURED I GRAFFITO WALL COATING

1. Scope

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in connection with surface preparation, mixing, and application of graffito wall coating as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specifications is covered with detailed specifications as laid down herein.

2. General

2.1 Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work.

2.2 The Engineer will furnish a schedule of colours for each area and surface. All colours shall be mixed in accordance with the manufacturer's instructions.

2.3 Samples of all colours/coating, stains and finishes shall be prepared in advance of requirement so as not to delay work and shall be submitted to the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the Employer. Samples of each type of . coating shall be on separate 300 x 300 x 3 mm tempered hard based panels. Manufacturer's colour chart shall be submitted for colour specifications.

3. Material

3.1 Material shall be acceptable, proven, top-grade products and shall meet or exceed the minimum standards of reputable manufacturers as approved by the Engineer.

3.2 The material for textured graffito coating shall be variable granular material and shall composed of Acrylic Copolymer Emulsions spherodial quartz various additives, metallic oxides, inerts of different granulemetries colouring agent, antibacterial and antibacterial agents.

3.3 All materials shall be delivered to site in their original unbroken containers or packages and bear the manufacturer's name, label, brand and formula and will be mixed and applied in accordance with his directions.

4. Surface Preparation

4.1 All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be coated. Following the solvent cleaning, the surfaces shall be cleaned by scraping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.

In the event the surfaces become otherwise contaminated in the interval between cleaning and costing, recleaning will be done by the Contractor at no additional cost.

No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

The grafito coating material should be applied with stainless steel trowel and finished with plastic trowel in thickness as per manufacturer's specification. To get straight texture plastic trowel should be moved vertically and the trowel is to be rotated to obtain swirl texture.

5. Measurement And Payment

5.1 General

Except otherwise specified herein or elsewhere in Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of Bills of Quantities.

5.1.1 Preparatory works, including preparatory materials, scraping, scratching, sand paper rubbing, cleaning, protection of finished works etc.

5.1.2 Providing and applying rough plaster base Corner, pattas, rounding&, arches, borders, grooves etc.

5.2 Measurement

Measurement of acceptably completed works of graffito coating to specified surfaces will be made on the basis of actual area in square foot of the surface coated as shown on the Drawing or as directed by the Engineer.

Payment

Payment will be made for acceptable measured quantity of coating to specified surfaces on the basis of unit rate per square foot quoted in the Bill of Quantities & shall constitute full compensation for. all the works related to the item

SECTION – 21 LIST OF APPROVED MANUFACTURES AND MAKE

CIVIL WORKS

• ORDINARY PORTLAND CEMENT	Falcon Cement, Lucky Cement, DG Khan Cement.
• SULPHATE RESISTANT CEMENT	Falcon Cement, Lucky Cement, DG Khan Cement.
• STEEL	Amreli Steel & Razzak Steel.
• SAND	Bolari Sand.
• CRUSH AGGREGATES	Good Quality Crush from Kot Banglu Origin Origin or as approved by Consultant.
• TERMITE PROOFING WORK	Bi Flex FMC / or as Approved By Consultant.
• ALUMINIUM DOORS/WINDOWS	Pakistan Cables
• DOUBLE TEE RCC ROOF PANEL	M/s. Izhar Concrete Pvt Ltd, Izhar Group of Companies.
• GLAZED TILES	Master Tiles, Shabbir Tiles,
• PORCELAIN TILES	Imported of approved manufacturer (Nano Polish) approved by Consultant.
• INDUSTRIAL TILES	National Tiles, EMCO Tiles or as approved by Consultant.
• BOND FOR TILES	STILE BOND
• PAINT WEATHER SHIELD, SPD DISTEMPER, SYNTHETIC ENAMEL PAINT, MATT FINISH PAINT.	ICI /Berger / JOTUN

• PAINTS / PRIMER & PUTTY	ICI Pakistan Ltd, Berger Paints Pakistan Ltd.
• ALUMUNIUM EXPANSION, JOINT COVER.STRIP FOR FLOORS/WALLS ETC	Balco, M/s. Chemi Tech. or As Approved By Consultant.
• HARDWARE & HANDLES	Bonco Brand.
• GLASS	Tinted Glass imported as approved or Ghani Glass as directed by Consultant.
• TEMPERED GLASS	Pakistan Safety Glass.
• LOOKING MIRROR	Imported Belgium Glass or As Approved By Consultant.
• VENITIAN BLINDS	Protector, MI Décor.
• FIBER GLASS SHEET (Hollow / Solid)	Toughlite Brand.
• GALVANISED IRON (GI) PIPE	M/s. I.I.L. or As Approved By Consultant.
• RCC PIPE	M/s. RAZIA Brand or As Approved By Consultant.
• UPVC PIPE	Dadex, Pak Arab, AGM.,EURO GULF Pipes
• JUMBOLON	M/s. Diamond Foam.
• CONSTRUCTION CHEMICALS	M/s. FOSROC , Mitchels & Co.
• STEEL GROUTING	M/s. Fischer , M/s. Hilti
• ALUMINIUM COMPOSITE PANEL (ACP) SHEETS	M/s. Dadex, M/s. Aluco MASTER
• ALUMINIUM SUSPENDED FALSE CEILING	DFB brand
• BITUMEN / ASPHALT	National Refinery/ Pak Hy Oils.

• BITUMINOUS MEMBRANE	Pak Hy Oils.
• MANHOLE COVER	C.M.P. or As Approved By Consultant.
• UPVC DOORS	M/s. Framez, / M/s. Auvitronics Pvt. Ltd.
• CONCRETE KERB BLOCKS	M/s. Envicrete, M/s. Izhar Crete, M/s. Magna Crete, M/s. Prime Crete.
• CONCRETE HOLLOW BLOCKS / SPLIT BLOCKS	M/s. Envicrete, or equivalent approved by Consultant.
• GRANITE / MARBLES	Marina Marble, POPULAR Marble or equivalent approved by Consultant.
• CONCRETE BLOCKS	M/s. Envicrete / M/s. Bes Block Hub or equivalent approved by Consultant.
• CONCRETE PAVERS	M/s. Envicrete, M/s. Izhar Crete, M/s. Magna Crete, M/s. Prime Crete.

_____ _____

Contractor. **Engineer In-charge.**

TABLES OF CONTENTS

ELECTRICAL WORKS

SECTION – A

TECHNICAL SPECIFICATIONS

The specification describes the requirements for the supply and installations of electrical/ low current systems.

1. SCOPE OF WORK

The works under these specifications includes providing of all materials & equipments and performing the work necessary for completion of work as shown on the drawings, specified in specification & bill of quantities. The work also include to obtain clearances, certificates etc. from the relevant authorities and also to give the required notices to local electrical authorities and assist the owner in getting electrical connections. The work shall by include but not limited to the following:

a) Electrical Works

i.	Low Voltage Switchgear	(Section - B)
ii.	Low Voltage Cable and Wires	(Section – C)
iii.	Conduits and Pipes	(Section – D)
iv.	Wiring Accessories	(Section – E)
v.	Light Fixtures	(Section – F)
vi.	Earthing System	(Section - G)
vii.	Standby Generator	(Section - H)
viii.	Lightning Protection System	(Section – I)
ix.	Power Transformer	(Section – J)
x.	Underground Trench & pipes	(Section – K)
xi.	Cable Tray System	(Section – L)

b) Low Current Systems

i.	Voice & Data Communication Systems	(Section – M)
ii.	Addressable Fire Alarm System	(Section – N)
iii.	Conventional Fire Alarm System	(Section –O)
iv.	CCTV System	(Section – P)
v.	Public Address/Sound System	(Section - Q)

vi.	Nurse Call System	(Section – R)
vii.	Security Access System- Velocity System	(Section – S)

2. MATERIALS ORIGIN

a) All material and equipment supplied by the Contractor shall be new and shall be in accordance with the details described in BOQ and/or shown on drawings. If the contractor desires to use different materials other than specified, he shall obtain the approval from consultant in writing before using the materials.

b) The Contractor shall also be responsible to supply any other equipment not mentioned in specifications but which is necessary for completion of works, it shall be provided by the Contractor as part of the Contract.

c) Material shall be in accordance with high standard specifications. The contractor shall submit the samples of materials with complete specifications etc for the approval of consultants, before ordering or installation of materials. Approval of materials/installations shall not relieve the contractor of any of his obligations or liabilities under the contract. The Consultants/Owners or Representatives reserve the right to inspect the materials in store or in installed at site and to reject any material not complying with specifications without any extra cost.

d) When choice of manufacturers is allowed for any material/equipment, the contractor shall obtain the whole quantity required to complete the job from one manufacturer otherwise he shall provide evidence to the consultant for non-availability of material/equipment in market.

3. RULES, REGULATION AND STANDARDS

The entire electrical installation / work shall be carried out by licensed electrical contractor, issued by Electric Inspector. The work shall be carried out by qualified & experienced workers having permits/certificates issued by Electric Inspector to undertake such a job. The contractor’s license number and supervisors competency certificate shall be submit before commencement of work.

All works shall be carried out in accordance with the latest edition of the Regulations of Electrical Equipment of Buildings issued by the Institute of Electrical Engineers - London, the Contract documents, the Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these specifications and any other rules and regulations shall be brought to the notice of Owner or his representative, and his decision shall be final and conclusive.

The Contractor shall be responsible to complete all the formalities/requirements and get the installations passed by the Electric Inspector and submit the test certificates to Owner/Electric Company without any extra cost.

All installations/equipment and materials shall conform to the following standards:

a) International Electro-technical Commission (IEC)
b) British Standards (BS)
c) National Electric Code (NEC)
d) National Standards
e) Any other international standards

In the event of conflict between the standards, the most stringent shall prevail.

Whenever any electrical equipment is to be installed, which does not hold national standards, the Contractor shall take into account the specific standards chosen by the Owner and make sure that the equipment he has to install, meets any one of the above mentioned standards.

4. INSTALLATION AND SERVICE CONDITIONS

4.1 Site Conditions

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material / equipment:

a. Maximum outdoor ambient temperature : 45^0

b.	Minimum Indoor ambient temperature	:	15^0
c.	Maximum relative humidity	:	90 %
d.	Minimum relative humidity	:	26 %

4.2 Service Conditions

4.3 Equipment shall be designed and built for continuous service with a minimum of supervision and maintenance.

5. MAIN ELECTRICAL CHARACTERISTICS

5.1 Power Supply System

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate and function satisfactorily with the following minimum requirements without any de-rating:

- Voltage	400V $\pm$ 10%
- Phase	3phase, 4 wires system
- Frequency	50 Hz. $\pm$2 Hz.

5.2 Degree of Protection of Enclosures

For indoors, IP31 minimum degree of ingress protection of the enclosures against contact with line or moving parts and against ingress of solid foreign bodies or liquids, shall be selected, in accordance with IEC 60529.

6. GUARANTEE

a) The Contractor shall furnish written grantee that the material & installations meet with this specification and the electrical systems are free from all grounds and all defective workmanship and materials and will remain so far a period of one year after handover of project. Any defect appearing within one year, shall be rectified by the contractor at his own

cost.

b) The contractor shall indemnify and save harmless the owner and consultant from and against all liabilities for damages arising from injuries to persons or property occasioned by any act or commission of the worker/sub-contractor/contractor including any or all expenses, legal or otherwise, which may be incurred, any and all expenses, legal or otherwise by the owner in the defense of any claim, action or suit

7. SPECIFICATIONS & DRAWINGS AT SITE

The Contractor shall have for ready access and refer a complete set of drawings/design, BOQ specification at site. He shall incorporate all changes, additions/ alterations made at site during installations and shall prepare a set of drawings indicating the work as actually and finally installed.

8. DISCREPANCIES IN TENDER DOCUMENTS AND DRAWINGS

The Contractor shall carefully examine the documents and drawings and if he finds any discrepancies or omissions from the specifications, bill of quantities or drawings, or is in doubt as to the meaning, he shall consult with the consultants before starting the work. If such defective or modified work is carried out by the Contractor, he shall rectify the same at his own cost.

9. MEASUREMENT OF WORKS

The quantities set out in the bill of quantities are estimated quantities and they shall not be taken as actual and correct quantities of work to be executed by the Contractor. The Contractor shall carry out actual measurement of works at site and prepare bill accordingly

10. INSTALLATIONS/PROTECTIONS/CO-OPERATION

A. The locations, routings, installation heights, and other details etc. for installations are shown on the drawings. If any information is not stated on the drawings or wherever modifications are required the Contractor shall obtain prior instructions from the Owner or consultants.

B. The contractor shall protect his own work from damage and he shall likewise protect adjoining works of other trades during or after installations.

C. The contractor shall co-operate and work as a team with all other contractors during the installation.

11. DRAWINGS AND WORKMANSHIP

The Contractor shall provide dimensional outline drawings, arrangement drawings and technical data to fit with architectural details as per instructions given to him.

a. The plans are drawn on the basis of architectural drawings. The plans are diagrammatical and do not necessarily show all details to fit the building conditions. The location of outlets, fittings, fixtures & equipments are approximate and may be accommodate to site conditions.
b. No major change shall be made without the approval of consultant. The contractor shall examine all approved shop drawings of other trades in detail and he shall frequently consult to ascertain any change that may have been made.
c. The work shall be executed in the best and most thorough manner under the direction of consultants. The consultants reserved the rights to reject any installation/material, which is not in accordance with the drawings & specifications.

12. IDENTIFICATION

a. For each of the equipment, identification label shall be fitted in front of the casing. The label shall have block letter 7mm high, black on white back ground of trifoliate and fixed with screws.
b. All DB's shall be provided with detail circuit sheet fixed inside the front cover indicating the function and circuit numbers. Spare circuit space shall be left blank.
c. On AC system the phase sequence shall be maintained in the order of Red, Yellow and Blue from top to bottom and/or left to right. Neutral and earthing wires to be connected on respective link or bus-bars.
d. Where 400 volts or above exists the equipment shall be marked "DANGER 400V" engraved in front of the equipment with the requirements of electricity rules and according to

engineering practice.

13. SWITCHGEAR TESTS

All switchgear installed by the Contractor etc shall be fully tested at the manufacturer's place to meet the requirements of appropriate standards without any extra cost.

The Contractor shall inform the Engineer in writing about the date and time of test at least 3 days in advance. The witnessing of test by the Owner or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment and for furnishing the guarantees. All test results in the form of certificate/record certificates, signed by all the witnesses, shall be submitted to the Engineer 3 days before delivery to the site.

14. STORAGE

The Contractor shall store the equipment in dry warehouse and protect from damages. Fragile components shall be stored on shelves in their original packing, marked with identification labels.

The Contractor shall handle, store and fix each of the equipment as per the manufacturer's recommendations. He shall inform the Engineer if these conflicts with any other specified requirement and submit copies of manufacturer's recommendations to the Engineer if required.

15. LABOR AND STAFF

The Contractor shall provide all labor materials, tools and equipments for installation and testing of work as detailed below:

- Skilled and unskilled labor required for performing the works as per specifications and drawings.
- Experienced supervising staff with requisite expertise to ensure quality of work in time.
- Administrative staff to ensure smooths functioning of site activities.
- Construction equipment, measuring tools, apparatus and working tools in good working conditions.

The Contractor shall be responsible for the performance of any sub-contractors, worker and manufacturer at his own cost and risk.

16. SMALL INSTALLATION MATERIAL

The Contractor shall supply and install all small installation and consumable materials such as nuts, screws, anchor, bits, bolts, washers, shims, angles, leveling materials, insulation tape, solder, PVC strap-on or heat shrinkable type cable tags, cable ties, bushes, sealing compound, lugs etc, required to complete the job without any extra cost.

17. INSTALLATION INSTRUCTIONS - GENERAL

The Contractor shall set out the works himself as per specifications and drawings and shall properly install the equipment on specified foundation / location as per manufacturer's instructions. Any defective or faulty operation of equipment the Contractor shall change/repair the same at his own cost.

18. ASSOCIATED CIVIL WORKS

The Contractor shall be carried out associated civil works under the direction of the Engineer.

The Contractor shall prepare drawings giving details of all associated civil works without any extra cost.

The following work to be carried out by the Contractor during installations:

a. The cutting and forming of holes or conduits/pipe fixings in walls, floors, ceilings, partitions, roofs, etc., and bringing back the finish to the position that it was before.

b. Formation of concrete bases or foundation pads.

c. Excavation forming for underground services of ducts and courses and then covers it.

d. Excavation for and lying of cables or pipes etc.

e. The painting of all pipes, tube and conduits etc. after fixing unless specified to the contrary.

f. Sleeves through floors/walls, flush with walls/ceilings or finished floors of a size to accommodate the raceways.

All required holes through walls, floors and beams for pipes and ducts will be left out by the Contractor during the process of building and he should workout in advance the position of holes channels etc to the civil contractor where it's not possible for cutting or chipping etc.

Cutting, fitting, repairing, patching of plaster and finishing of carpentry work shall be done by skilled workers in their respective trades, when cutting is required it shall be done in such a manner as not to weaken structure, partitions or floors. The holes required to be drilled without breaking out around the holes. Where patching is necessary in finished areas of building, the Engineer shall determine the extent of such patching or refinishing.

19. TESTING

Upon completion of installations, the Contractor shall perform all static, semi-dynamic (by simulation), and dynamic field testing on all the equipment and systems.

All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with specifications. The Contractor shall submit for

Engineer's approval complete details of tests to be performed describing the test procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc., and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of the Contractor. The Contractor shall record all test values and submit the same to the consultants.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship, or as any obligations of Contract.

In addition to installation testing, the Contractor is to carry out operation testing of all sections to ensure that the entire installation is sound, complete and safe and will function properly and as intended.

The acceptance shall be made by the Owner.

The Contractor shall formally engage his direct responsibilities to the Owner or his representative, and likewise, shall assume all responsibility for work performed by sub-contractors and materials he has supplied and installed.

19.1 Insulation Resistance Test

Insulation resistance test shall be made on electrical equipment and wiring by using a meager of 1000 volts for circuits between 250 and 500 volts. The insulation resistance of distribution boards, cables, etc., shall be as per IEC, IEEE, BSS and Pakistan Electricity Rules.

The distribution boards shall be tested before wire connections. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit is less than specified values, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the readings shall be taken and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required.

19.2 Earth Resistance Test

Earth resistance tests shall be made by contractor on the earthing system, separating and reconnecting each earth connection as may be required by the Engineer. If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the E.C.C. together with the resistance of the earthing lead measured from the connection with earth electrode to any other position in the completed installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earthing sets are installed, the earth resistance test between two sets shall be measured by means of Resistance Bridge Instrument. The earth resistance between two sets shall not exceed one ohm.

19.3 Phase sequence test

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for correct rotation of all motors and entire installation before final connection to supply line.

Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses disconnect switches, number of interlocks, indicating lights and alarms shall be in accordance with approved manufacturer drawings. Name plates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment.

19.4 Low Current Systems Tests

The testing of Low Current systems shall be carried out as per procedures or recommended by the manufacturer/supplier.

19.5 Complete Tests

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer, the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

20. ELECTRICAL CONNECTION

Electrical connection shall be provided by Electric Supply Company but necessary but necessary arrangement coordination to be done by the Contractor. The temporary arrangements (including materials and labor) for installation/testing purpose to be made by the contractor without any extra cost.

21. DRAWINGS, SAMPLES AND MANUALS

1. The contractor shall prepare shop drawings showing all routes, switches, sockets, DBs and junction/pull boxes locations etc. and submit to the consultant for approval before starting the work without any extra cost.
   a. Single line diagram indicating all cables, with sizes and types, and rating of circuit breakers, fuses, etc.

b. Lighting, power, telephone, fire alarm, nurse call, public address, CCTV, queue management and data/voice systems, as applicable.

c. Control and Data/Voice wiring diagrams for the equipments installed by the Electrical Contractor

2. All changes/additions/alterations shall be carefully recorded during the work and the Contractor shall prepare as built drawings. On approval of drawings the Contractor shall provide two set of drawings to the consultant and owner before final payments.

The Contractor shall submit for approval of the manufacturer's instructions for installation, testing, commissioning, operation and maintenance manuals of the equipment before installation. Upon acceptance, the Contractor shall supply a copy to the Owner. The contractor shall also submit for approval the samples of materials to be used in the project, before starting the installations and approved list of materials/equipments to be handed over to owner.

22. WORK COMPLETION

The Contractor shall further repair/replace all defective works on completion and leave all installations in perfect working order up to the satisfaction of the Owner and consultant. The contractor shall meet all the requirements/instructions given in specifications.

The contractor shall complete each and every work as described and included in these specifications and BOQ as per owner's/consultant's instructions.

23. PAYMENT

Running payments shall be made to the contractors at an interval not less than 15 days at a time. Contractors shall submit running bills to the consultant for verification. After due verification, the owner shall paid the bills to the contractor after deducting applicable taxes.

SECTION - B

LOW VOLTAGE SWITCHGEAR

1. GENERAL

1.1 Purpose

This section describes the minimum requirement for the design, construction and performance of factory assembled LV switchboard.

1.2 Scope of Work

The job consists of supply, installation, testing, connecting and commissioning of switchboards as specified in BOQ or shown on the Drawings.

1.3 Installation

Switchboard shall be installed indoor. The equipment shall be capable of operation under the prevailing ambient conditions without any deleterious effect of any kind. Switchboard shall be suitable for continuous operation at full load rating under combined variation of both voltage and frequency.

2. MAIN ELECTRICAL CHARACTERISTICS

2.1 Power Supply System

Main characteristics of power supply system applicable to all switchboards are:

- Voltage 400 V $\pm$ 10%

- Phase 3 phase, 4 Wires.
- Frequency 50 Hz. ± 2 Hz.
- Neutral system firmly grounded.

Main characteristics of auxiliary supply system are:

- Control / Command system 24 VDC.
- Space heater system 230 VAC.

2.2 Ratings

The equipment shall be capable of carrying the specified current continuously 24 hours per day, without exceeding the permitted temperature.

The current ratings must be guaranteed at the specified design temperature. Equipment shall be fully rated and constructed for withstanding, making and breaking the specified short circuit duty.

Pins of auxiliary circuits shall be sized for a rated circuit of minimum 10 Amp.

3. ENCLOSURES

The Switchboard shall be prefabricated metal clad cubicle(s), floor standing type, totally enclosed, dust tight and vermin proof and front access only. It shall complete in all respects with material and accessories, factory assembled, tested and finished all according to the specifications and to normal requirements. For indoor installations the international classification shall be IP42.

a) The short service breaking capacity, ICs at 400 VAC, conforming to IEC 60947-2 unless otherwise stated on the drawings.
b) To provide with adequate clearance from live parts so that flash over cannot be caused by switching, vermin, pests, etc.
c) All components shall be rated for insulation class 600-volt minimum.
d) It shall be designed for flush mounting of all instruments on the front side only.
e) All incoming or outgoing connections from top or bottom shall be

completed. The components mounted so as to facilitate ease of maintenance from the front. Common lamp test facility for all lamps.

f) The wiring diagram on the inside of door. Be labeled with name plate on the front side of door.

g) To provide 25% space for extension in future.

3.1 Cable Accessibility

Switchboard shall preferably be arranged for bottom cable entries. Adequate space must be provided for cable entries and termination. It shall be possible to work easily and safely on cable of a main or control outgoing circuit in OFF position with the remainder of the board alive.

Adequate system shall be provided for installation and clamping of cables inside the cable compartment. Position of terminals and cables shall allow use of clamp ammeter.

Power and Control cable termination shall avoid obstruction to other cable termination and provide easy access for terminating cables. Cable supports shall be provided to avoid undue strain on cable termination. Easily accessible locations shall be reserved in the compartment for measuring transformers.

3.2 Heaters

Space heaters shall be provided for prevention of moisture in each cubicle. Heaters shall be wired together and shall be automatically controlled to avoid over heating the equipment. Heater shall be suitable for operation on 230 VAC supply from an external source (to be provide in main Distribution Board)

3.3 Name plates

On the front side, a name plate shall be provided at the top to indicate the name of manufacturer, system voltage and frequency and the current carrying capacity of switchboard.

Each breaker shall have a circuit identification label fitted below the breaker aperture or as suitable.

Drawing indicating the branch circuit names, breaker elements, cable sizes and connecting services shall be placed in a clear plastic pocket provided at the back of the front access.

Labels described shall have block letters 7 mm high on a white back ground, to be made from trifoliate and be fixed with screws.

Each incoming and outgoing circuit shall also be labeled with name plate 75 mm x 15 mm, as described above on the front side of door.

4. CONSTRUCTION

4.1 The switchboard shall be fabricated, welded; grinded, finished with angle iron frame work and clad with 2MM MS sheet, to form a rigid, free standing, flush mounting fronted assembly.

It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories. Each compartment shall be fully partitioned from its neighbor both horizontally and vertically, allowing safe cable routing / termination without shutting the switchboard down.

All live parts within cubicles, compartments or modules, which have to accessible during normal maintenance operations, shall be adequately protected and / or buried to ensure protection of works and to avoid accidental contact. Barriers may be rigid, transparent, insulating material fitted with warning labels.

The doors shall be provided with hinges on the left-hand side and locking handles on the right hand side for fastening the door. The front assembly shall be fastened to the enclosure by means of self locating fasteners for quick and easy fixing.

All holes, cutouts shall be tool or jib manufactured and free from burrs and rough edges. All structural components shall be of standardized design to provide complete uniformity and inter change ability of common parts. Removable gland plated shall be provided at top and / or bottom as required.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable clamps respectively for PVL/PVC and SWA cables shall be provided.

The cabling inside the Switchboard shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the switchboard shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of color RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

4.2 Bus Bars

Bus bars and droppers supported on non - hygroscopic material are to be high conductivity electrolytic tinned copper, completely isolated and mechanically braced and rated to withstand the specified short circuit currents for one second duration.

Bus bars and droppers shall be housed in a separate compartment and shall be clearly marked with Red, Yellow and Blue colors. Bus bars shall be provided for three phases, neutral and multi - terminal earth. The temperature rise shall not exceed 50 degree centigrade at rated current. Neutral bus assembly shall consist of outgoing screw terminals with one terminal for every MCCB / MCB.

Removable metal covers on the bus bar chamber shall be provided with suitably sized labels at regular intervals, fixed with self tapping screws and warning of live metal work.

All bus bars connectors shall be tinned plated connections and joints. Horizontal bus bars shall be of the same current rating throughout their length.

4.3 Earthling

A copper earth bar of suitable section for the specified fault level shall extend the entire length of the Switchboard. Provisions shall be made for possible future extensions at both ends.

Earthing facilities shall be provided on each incoming and outgoing unit to permit earthing of the connections.

All metallic non-current carrying parts of the Switchboard shall be bonded together and connected to the Switchboard's earth bar.

Each circuit wiring shall be green / yellow color. Earthing mass continuity between withdraw able parts and fixed frame shall be correctly ensured whatever withdraw able part position.

Provision shall be made adjacent to cable termination for earthing cable armor to the earth bus bar.

Earthing switch shall be provided wherever mandatory as per rules and regulations / codes and standards and shall be manually operated. An interlocking system shall provide the following locking and safety functions:

- Impossibility of closing the earth switch if the switching device is closed.
- Visual check of earthing switch positions to be possible.
- Possibility of locking the earthing switch operating handle in open and closed position.
- The earthing of the bus bar shall be done manually by the operator without provision of general earthing system.

5. DISTRIBUTION BOARDS

The enclosure of the LV Distribution Board shall be fabricated from electro-galvanized / zinc coated sheet steel.

The LV Distribution Board shall be fabricated with 1.6mm sheet steel recess or surface mounting. All components shall be installed on a component mounting plate inside the enclosure and protected from the front with screwed sheet steel safety plate. The door shall be fully gasket with hinges on the left hand side and locking handle on the right hand side for fastening the door. The locking handle should be detachable. The dead / front assembly shall be fastened to the enclosure by means of self - locating fasteners for quick and easy fixing.

The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box of same material & finish shall be provided for accommodating the cables and conduits.

An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of Distribution Boards at two points. Flexible copper strip shall be provided for earthing of the door.

Neutral bus assembly shall consist of outgoing screw terminals with one terminal for each MCB. All holes, cutouts, etc., shall be tool or jib manufactured and free from burrs and rough edges. Removable gland plates shall be provided at top/bottom, as required.

The cabling inside the distribution board shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC pipe. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of components etc.

All metal work of the distribution board shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of color RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

6. COMPONENTS

The switchboards shall be provided with all components as specified or shown on the Drawings and as necessary for the satisfactory operation of the Switchboard and electrical system. Typical specifications are given here under:

6.1 Circuit Breakers

The circuit breakers shall be panel mounted, compact modular design, trip shall be standard and shall have built in overload and short circuit protection. The breakers shall have high performance, multifunctional type under modern design concept. The breakers should confirm international standards.

The breakers shall have inverse time limit characteristic, instantaneous magnetic trip element for short circuit and thermal overload protection.

a) Molded Case Circuit Breakers (MCCB)

The MCCB shall be three pole 400 / 500 volts rating. The breakers shall have both time delay over current and instantaneous short circuit protection.

The MCCB’s shall be installed such that their switching levers are accessible through the dead front plate for operation. Circuit numbers / designation on all circuits shall be clearly marked to facilitate connection and maintenance.

The breakers shall have quick make - quick break toggle mechanism with positive 'ON', 'OFF' color indication and intermediate ' Tripped ' positions.

Trip mechanism shall be trip free on overload or short circuit ensuring that the breaker will not close / remain close even if the close command is given while the circuit breaker has tripped due to short circuit or continuing overload.

b) Miniature Circuit Breaker (MCB)

The MCB’s with current rating from 1 to 125 Amps shall be conforming to BS EN 60-898 or IEC 60947-2. The circuit breakers shall be suitable for DIN-rail mounting, maintenance-free and fully tropicalised.

The MCB's shall be designed for horizontal or vertical mounting, or reverse feeding, without any adverse effect on electrical performance.

The operating mechanism shall be quick make, quick break type, trip free, with all poles opening and closing simultaneously (except for the neutral pole, which if required shall be of the advance-closing and late-opening type). The operating toggle shall clearly indicate the ON and OFF color indications.

The individual operating mechanism of each pole of a multiple MCB shall be directly linked within the MCB casing and not by the operating handle.

Each pole of the MCB's shall be provided with bimetallic thermal element for overload protection and a magnetic element for short circuit protection.

c) Earth Leakage Circuit Breakers (ELCB)

ELCB's shall be four pole, current operated type with tripping current of 0.3A and tripping time not more than 0. I seconds.

6.2 Transformers/Meters etc.

a) Current Transformers

Current transformers shall comply with the requirements of IEC 60185 (or equivalent).

Current Transformers shall be polyester resin insulated, ring type, air cooled having transformation ratio as indicated on the drawings. The current Transformers shall be of suitable burden having accuracy class 1.0. The Current Transformers shall have rated secondary current 5A / IA as required.

Current Transformers shall mechanically and thermally withstand the specified short circuit capacity. Test terminal blocks shall be provided for current Transformer secondary circuits having short circuiting provisions to allow portable apparatus to be connected.

b) Voltage Transformers

Voltage transformers shall comply with the requirements of IEC 60186 (or equivalent) and shall be of accuracy class 1.0.

Voltage Transformers shall be equipped with primary fuses with an interrupting capacity of the incoming circuit breakers. Test terminal block shall be provided for each Voltage Transformer system.

c) Ammeters and Voltmeters

Indicating instruments shall be semi-flush Switchboard type, moving Iron, spring controlled with standard scale having white background and black graduations and markings. The front dimensions shall be 144 x 144 mm for instruments on incoming side and 96 x 96 mm on all outgoing circuits.

Indicating instruments shall be 1.0 class percent of full scale basic accuracy class in accordance with IEC 60051.

The ammeter shall be suitable for connection to 5 Amp. Secondary of current transformer or directly through shunt as shown on the drawings. The instruments shall have measuring range indicated on the drawings. A red mark shall be provided at the working voltage on the scale of all voltmeters.

d) Selector Switches

Ammeter and voltmeter selector switches shall be complete with front plate, grip handle, R-Y-B and OFF position for ammeter and RY-YB-BR-RN and OFF positions for voltmeters.

The selector switches for controls shall be rotary cam type and shall be provided complete with knob and front plate, showing all positions as required.

e) Push Buttons

The push buttons shall be momentary make / break contact type (normally open / normally close) and suitable for flush mounting. The push button for ON and OFF switching shall be red and green respectively.

f) HRC Fuses

HRC Fuses shall be provided complete with fuse bases, fuse, etc. The fuses shall have a fusing factor as specified for class Ql in accordance with BS 88.

g) Pilot Lamps

Switchboard shall be provided with phase indicating pilot lamps. The lamps shall be rated for 250 volts supply and suitable for flush mounting. The front of the lamps shall have colored rosettes for identification of phases.

h) Line up Terminals

Line up terminals wherever provided for Control or Power circuits shall be suitable for voltage and size of conductors as indicated on drawings. The Line up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

i) Secondary Wiring

All wiring shall be copper conductor, thermoplastic insulated, at least 1.5 sq. mm flexible, neatly arranged and clipped in groups.

Each conductor and its termination are to be identified and marked with numbered ferrules. All live terminals are to be shrouded.

Secondary wiring for Current Transformers shall be carried out with not less than 2.5 sq. mm. Terminals shall be specially marked to avoid opening of the circuit by accident.

7. POWER FACTOR IMPROVEMENT PLAN (PFI)

The power factor improvement plant shall be used for improving the power factor of the system. The plant shall be automatic cum manual.

The PFI plant shall be aligned with main LT switch board and it shall be a part of that LT switchboard as shown on the drawing. The capacitors shall be suitable for three phases, 415 volts 50 Hz system and shall be self cooled, designed for indoor use in tropical climate for maximum ambient temperature of 45 degrees centigrade and relative humidity 90%. The capacitors shall be in the form of banks divided for 12 stages, 6 stages and 4 stages. Each capacitor bank unit shall be 12.5/25 and 50 KVAR. The total KVAR capacity shall be as indicated on the drawings. Each capacitor unit shall be complete with discharge resistors and internal fuses and shall be connected with control panel with proper size of single core PVC insulated cables.

The panels shall be supplied complete with a set of 3-phase, full capacity, isolated tinned copper bus bars, interconnections, risers, designation labels, cable sockets, holding down bolts, wiring with cleats and ferrules, earthing sockets and studs, etc. Each control panel shall comprise.

1 No. Multi stage power factor correction relay for automatic/manual control.

1 No. 3-phase, 4 wire, 415 volts, unbalanced load power factor indicator.

1 No. Auto-off-Manual selector switch

1 No. Current transformers with 5 amps secondary current having suitable output burden and accuracy.

3 Nos. Instrument protection fuses.

Following equipment shall be provided for every 250 KVAR capacitor bank:

1 No. 630 amps, triple pole 415 volts air break contractor with auxiliary contacts (2 N.0+2 NC) Contractor shall be suitable for AC 3 duty.

1 Set of 2 Nos 630 Amps H RC back-up fuses with base and carrier.

1 Set of ON and OFF push buttons.

1 No. Red lamp for “ON” indication to the contactor.

Requirement of Capacitor Banks

According to IEC-83 1 -1 and 831-2.

Fully insulated terminals to be shielded by a cover.

Dielectric: Plastic poly-propylene, impregnated.

Electrodes: Aluminum coating vacuum metalized.

Safety features: Self healing. Over pressure tear-off fuse.

Withstand switching operations safely.

Maximum in rush current 200 times rated current.

Loading capacity: 1.1 times rated voltage. 1.3 times rated current at delta max.

Overloading capacity 1.5 times rated output at delta max.

Acceptable tolerances - 5/+ 10% of rated output at rated frequency.

Static life expectancy > 100,000 operating hours.

Test Specifications: Terminal versus terminal with an AC voltage 2.15 times rated voltage for 10 seconds duration. Terminals to casing with an AC voltage of 3 KV for 10 seconds duration.

8. INSTALLATION

The LV Switchboard shall be installed at location shown on the drawing. The Contractor shall coordinate with civil & allied works for providing any openings, holes, etc. to avoid any breakage. In case the provisions in civil works for the installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own cost and to the satisfaction of the Engineer. The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.

All installation material for physically erecting the switchboard, such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The Switchboard shall be installed upright and in level and shall be firmly and rigidly bolted to the floor and concrete supports.

The switchboard shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking provided by the manufacturer for safe transportation shall be released only after the switchboard is erected in position.

The incoming and outgoing cables shall be connected as recommended by cable manufacturer. The cable armor shall be connected effectively to ground.

The Switchboard enclosure shall be connected to earth terminal. The Switchboard shall be tested before energizing in the presence of the Engineer.

SECTION - C

LOW VOLTAGE CABLES AND WIRES

1. SCOPE OF WORK

The work under this scope consists of supply installation, testing, connecting and commissioning of all material and services of low voltage cables and wires and the accessories as specified herein or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with project Engineer and coordinate at site with other trades for exact route, location and positions of electrical cables and equipments etc.

2. GENERAL

All multi-core and single core wires for light circuits, socket outlets and circuits operating up to 250 volts shall be 300 / 500 volts grade. All single core sheathed cables shall be of 450 / 750 volt grade. Power cables for main feeders, main to sub-main feeders, power equipment, etc., armored or unarmored shall be of 600 / 1000 volts grade. Armoring of cables shall be done with appropriate size galvanized steel wire as per codes.

The conductors shall be stranded or solid, high conductivity, soft annealed copper. Conductor of single core cables shall be circular, whereas of multi-core cables may be circular or shaped according to standard practices and codes. The PVC insulation shall be extruded with a PVC compound having good flexibility, resistance to aging and ability to withstand the ambient temperatures. Cable should be capable of running 125% of full load current without any damage.

3. STANDARDS

All Cables & Wires shall be manufactured to confirm the following standards as given below:

BS 6004 / 6346 PVC insulated cables for lighting and power.

BS 6746	PVC insulation for electrical cables.
BS 6360	Copper conductors
BS 6500	Insulated flexible cords.

4. MATERIAL

4.1 General

The power, lighting and control cables shall be furnished and installed in accordance with the routes and requirements shown on the drawings. The single core cables shall be delivered as complete coils with wrapping & seal intact.

All cables shall have phase identification colors on insulation of each core. The color code for three phase circuits shall be red, yellow and blue for phases, and green for earthing.

Single phase circuits shall have insulation of red color for phase / line, black color for neutral and green color for earth conductor.

All DC circuits shall have insulation of red color for positive, black color for negative and green for earth conductor.

The ends of each length of multi-core armored or unarmored cables shall be properly marked for clock-wise and anti clock-wise sequence of core colors.

4.2 Cables for Conduit Wiring

All cables / wiring in concealed or surface mounted PVC or MS conduits shall be single core PVC insulated of specified grade and size, unless specifically shown on the drawings or given in BOQ.

4.3 Cables on Surface / Concrete Trenches

Cables for distribution system to be installed on surface, in cable ducts, in concrete trenches or on trays shall be single or multi-core PVC insulated and PVC sheathed of specified voltage grade and size, unless specifically shown on the drawings or given in BOQ.

4.4 Underground Installation

Cables for laying directly underground shall be PVC insulated, PVC sheathed and armored with galvanized steel wire. Cables fully installed in underground ducts / pipes and mechanically protected from end to end shall be PVC insulated and PVC sheathed unless specifically shown on the drawings or given in BOQ.

4.5 Cable Accessories

All cable accessories such as lugs, ties, tapes, glands, flexible pipes, connectors, duets, clips, tags, bushes, etc shall be provided for the complete cabling and wiring system without any additional cost.

5. INSTALLATION

5.1 General

When the laying is effectuated by others, the contractor shall test the cable characteristics insulation and continuity, at all phases of these and communicate them in a report to the Engineer, as per recommendations of the standards according to which the cable is manufactured.

The cables shall be spaced by categories along their entire length as well as upon penetration into buildings and in their interiors, according to their following rated voltages:

- 30 cm at least between a cable carrying I KV - 30KV and other cables.

- 20 cm at least between a cable carrying voltages between 50V - 500V, and any power or control 10 cm at least between a cable carrying voltages lower than 50V and telephone or these possible being grouped.

All installation material, labor, tools and accessories for cable installation shall be furnished by the Contractor. The cable and accessories shall be installed as described in accordance with these specifications, drawings and manufacturer's instructions.

The wiring must be strict in accordance with layouts, details, schematic diagrams given in the drawings.

The light circuit and power circuits shall be run in separate pipe. The circuits/sub-circuits shall be provided identifications by numbers permanently attached. The wiring shall be done to maintain color coding.

5.2 Conduit Wiring

The wiring in conduit shall be started only after the conduit system is completely installed and all outlet boxes, junction boxes, etc., are fixed in position. The filling rate inside the conduits shall not exceed 50 %. Cables directly embedded in the masonry are not accepted.

The wires shall be pulled in conduit with care to prevent damaging the wires, preferably without the use of any lubricant like soap, oil or grease. Where necessary and if approved by the Engineer, the cable manufacturer's recommended lubricant may be used. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than 10 times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body with sunk-in screw terminals. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable / wire shall be provided at each termination to facilitate repairs in future.

The size & quantity of cables contain in one pipe shall not be excess in accordance with IEE regulations.

5.3 Cables on Surface / Trenches

All cables for installation on surface of wall, column, ceiling, trenches, etc., shall be fixed to the surface by means of galvanized steel clips, secured to a steel channel using suitable stud plate, nuts and washers.

The erection of cables and position of support shall be agreed by the Engineer on site, having taken into consideration the accessibility of all such routes. These shall be so arranged that cable crossing one another be minimized if cannot be avoided.

Cables shall be fixed throughout their length by means of approved saddles, clips, etc., at every 600 mm vertically and 900 mm horizontally.

Cables and equipment fixed to a building fabric, i.e., brickwork, concrete, etc., shall be fixed by means of appropriate fixing devices, i.e., Raw bolts, Hilti fixing devices, etc.

Contractor shall be responsible for all drilling of steel work, brick work and masonry where necessary for fixing clamps and brackets for supports.

Cables shall not be pulled into conduit until the conduit system has been completed, cleared and free from obstruction and sharp edges cables shall be put into conduits in such a manner that there will be no cuts or abrasions in the cable insulation, protective braid and jackets. There shall be no link in the conductors.

Distance of saddles shall be used for installation of cables in defined condition of the surface of wall etc.

Grease or other injurious lubricants shall not be used in pulling cables. The use of talc or non injurious lubricants is permissible, if desirable.

The number of wires installed in any conduit shall be such that the resulting space factor does not exceed 50 %. Spliced wires shall not be pulled through conduits.

All conduit wiring shall be carried out in the loop - in principle from outlet box to outlet box and in no circumstances shall joints be used except in fixed base connection blocks housed in outlet boxes.

The vertical clearance between two adjacent cables at any point is 50 mm minimum. Common mounting, channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

The wall crossings where the outdoor cables penetrate in the building shall be carefully obstructed by means of polyurethane foam. The Contractor shall be fully responsible for the perfect tightness of these cable penetrations.

5.4 Underground Cables

The Contractor shall plan and take special care to prevent any damage to existing underground facilities such as piping, cables, foundations, etc. The Contractor shall notify the Engineer of any obstruction encountered and shall provide protective support or removal of such obstructions as instructed by the Engineer. Excavation adjacent to existing facilities, such as foundations manholes, ducts, underground pipelines and paving shall be braced and / or shored properly to protect those facilities during excavation and construction.

Sufficient slack shall be left in cables for this purpose that cut lengths of cables shall allow about 3% more in the measured lengths between terminations.

Cables, whether installed underground or in concrete trenches, shall not be bent to a radius less than 10 times the diameter of the cable or as recommended by the cable manufacturer, whichever is higher.

All cables shall be marked at least at each end, switch gear and equipment termination, where cable enter or leave underground cable trenches or channels, where cable rises from one level to another, at 30M intervals with predetermined identification numbers, by means of proprietary non-deteriorating type, PVC, heat shrinkable, strap-on type or equivalent, for the identification of cable and circuit. These shall be indelibly marked with cable number and securely fixed to the cable. Where conductors are left to be terminated by another party or left to be connected later, they shall be identified. The earth continuity conductor shall be laid in the trench with the cables.

Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged water tight by means of polyurethane foam / bituminized Hessian or equivalent method as approved by the Engineer.

5.5 Cable Termination and Joints

Cables shall be terminated in a safe, neat and approved manner at the associated equipment, included that erected by others.

Compression type connectors (lugs) shall be of the correct size and approved type for the conductors concerned. Compression tools shall be supplied for specific use and shall be maintained in good order. After compression the conductor and terminal shall form a solid mass ensuring good conducting properties and mechanical strength. The compression jointing system used throughout the installation must be approved by the Engineer.

The Contractor shall be responsible for all drilling and if necessary, tapping entries where these have not been provided by others.

When preparing cables prior to fitting glands, the gland manufacturer's instructions for cable preparation shall be observed. In all cases where armored cables are used, care shall be taken to ensure that the lay of the armor is maintained after the gland is completely fitted.

Termination and joints shall be suitably insulated for the voltage of the circuits in which they are used.

Every compression joint shall be of a type, which has been the subject of a test certificate as described in BS 4579.

Cable ends, which are not terminated immediately after cutting, shall be sealed effectively to prevent ingress of moisture and shall be protected from damage until termination.

For all cables above 6 sq. mm in section, if a substantial mechanical clamp is not provided a compression type lug or socket shall be provided. At all equipment, cable shall be installed and terminated so that no strain is imposed on the cable or gland and due allowance made to counter the effect of vibration. At all termination an ample length of 'tail' shall be left.

Where joints in cable conductors and bare conductors are required, they shall be mechanically and electrically sound and they shall be accessible for inspection. Joints in non-flexible cables shall be made either by soldering or by means of mechanical clamps or compression type socket, which shall securely retain all the wires of the conductors.

Any joint in flexible cable shall be affected by means of cable coupler. Cable couplers and connectors shall be mechanically and electrically sound and shrouded in metal, which can be earthed. Where the apparatus to be connected require earthing every cable coupler shall have adequate provision for maintaining earth continuity.

The insulation of cables must be brought into DB’s switch boards or fixtures to which the cables are connected. All openings shall be sealed properly. The outdoor apparatus shall normally be connected by means of cables with conduit termination down to about 30 cm below ground level or concrete foundation. The conduit shall be firmly secured down to their penetration into the trench or channel.

SECTION - D

CONDUITS AND PIPES

1. SCOPE OF WORK

The job includes supply and installation of all Conduits, Pipes and Accessories as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical conduits.

2. GENERAL

The extent of works shown on the drawing does not indicate the exact position of conduit and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings, as per site requirements and as directed by the Engineer.

The quality and material for the accessories of conduits and pipes such as sockets, elbows, bushes, bends, inspection / pull boxes, round boxes, etc., necessary for the completion shall be similar to that of conduit or pipes.

3. STANDARDS

The conduits, pipes and accessories shall confirm the following standards:

BS 31	MS Conduit and accessories
BS 1378	Galvanized Iron Pipes and accessories.
BS 3595	PVC Pipes and accessories.
BS 4607	PVC Conduits and accessories.

4. MATERIAL

4.1 PVC Conduits, Pipes and Accessories

The PVC conduits and accessories for lighting and power circuits shall be standard manufactured length of high tensile strength and sufficiently flexible to provide resistance against breakage. It should not dent or flatten under pressure and it should be chemical resistant to chemical action of the atmosphere. The conduit shall be self extinguishing and should not support combustion.

The PVC conduit withstand against concrete additives, electrolysis, corrosive atmosphere, soils, salts or excessive humidity and should be non-magnetic to reduce voltage drop and minimize power loss. The conduit should be non-conductive & non-sparking.

The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction.

The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 64 mm diameter and 64 mm depth. The junction boxes for wall light points shall have minimum dimensions of 57 mm diameter and 40 mm depth. Round junction boxes shall be provided with one piece Bakelite cover plate fixed to the box by means of galvanized screws.

The PVC pipe shall be rigid and shall be minimum d class, unless otherwise stated on Drawings or Bill of Quantities. For jointing of pipe, all precautions and procedures recommended by manufacturer shall be followed.

4.2 PE Conduit & Accessories

The PE conduits & accessories shall be corrosion resistant, non-toxic, light weight, impact strength, weld ability and abrasion resistance. It should be manufactured as per ISO 4427 and other international standards.

4.3 MS Conduit and Accessories

All conduits shall be of 16 SWG steel, manufactured and tested in accordance with latest relevant standards.

The conduit shall be protected by two base coats of red oxide (antirust paint) and finished in first quality black enamel paint. The coating shall be of heavy enamel, which shall not flake or crack during installation and handling. Each conduit length shall be furnished with threaded ends and a threaded coupling at one end. Soft metal bushes shall be provided at conduit termination to prevent damage to cable during pulling operation.

Junction boxes shall be 100 mm square, having minimum depths of 38 mm or 65 mm as required for accommodating the number of wires. The junction box shall be 16 SWG sheet steel provided with anti-corrosion paint and finished in heavy black enamel paint. The cast Iron outlet boxes for light points shall be round having 50 mm diameter and 63 mm depth. The above dimensions are given as minimum only, and the exact size shall be determined by the Contractor keeping in view the ease of Installation and maintenance. All outlet boxes and junction boxes shall be provided with one piece Bakelite cover plate of suitable design.

4.4 Galvanized Iron Pipes and Accessories

The G.I. pipes shall be galvanized from inside and outside by hot dip galvanizing method. The pipes shall be free from stains, burrs or any other defect. The accessories for G.I. pipes shall be galvanized from inside and outside. The conduit shall be NPT threaded, with at least 5 complete threads and assembled with TEFLON tape.

4.5 Inspection Boxes / Pull Boxes

The rectangular inspection boxes or pull boxes shall be of 16 SWG heavy gauge, sheet steel having nipples welded to box at entry holes to receive PVC conduit with force fit. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not

be less than six times the cable manufacturer's recommended bending radius of the cable. All concealed type pull boxes shall have ebonite sheet of appropriate size fixed to the box by means of galvanized screws.

4.6 Pull Boxes

Pull boxes shall be made of 16 SWG sheet steel box, painted and finished to the same quality as the light Distribution Board. The boxes shall be 50 mm in depth for conduits up to 25 mm diameter, 63 mm in depth for conduits up to 40 mm diameter and 87 mm in depth for conduits up to 50 mm in diameter. For conduits more than 50 mm in diameter, the minimum depth shall be two times the diameter.

4.7 Conduit / Pipe Accessories

Bushes, plugs, glands, etc., shall be of brass and all male bushes shall be of long thread pattern. Covers for boxes shall be screw fixed and finished as the boxes. Gaskets shall be fitted only when finish is galvanized unless otherwise specified.

5. INSTALLATION

The contractor shall provide all conduits & accessories for the installation as required. The drawings shows the approximate & terminal points of conduits. However if for any reason the contractor desire to use any alternative route, he may do so at his own responsibility without interference with other installations and get the prior written permission from Engineer.

Conduits shall be run atleast 150mm from flues, steam or water pipes. Where multiple conduits runs, these shall be arranged symmetrically to present a uniform and neat arrangement. The minimum size of conduit shall be 20mm diameter unless notified otherwise. Conduits are installed to confirm the location of conduit to avoid obstructions, furnaces, hot lines & other places of high temperature.

5.1 PVC Conduits - Concealed

The conduit shall be installed concealed in roof, wall, column, etc.

At all joints and bends, PVC jointing solution of approved make must be used to strengthen and to seal the joint.

Manufactured smooth bends shall be used. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of 90 degree bends and tees will not be allowed.

The conduit shall have a minimum of 38 mm cover of concrete. The conduit shall be laid above the steel of the slab and shall be firmly secured by tying to steel. Under any circumstances RCC structures chiseling not to be made.

All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab or beam.

Where conduits have to be concealed in cement concrete work or in block masonry, the chiseling shall be made with appropriate tools and shall not be made deeper than required. The conduit shall than be fixed firmly in the recess and covered with cement concrete mixture to have to at least 25 mm cover before plastering. The work of curing in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from Engineer for the route, to suit the site conditions before starting chiseling and cutting.

The termination of conduits at or near the Switchboard / Distribution Board is shown diagrammatically on the drawing. The exact locations of the termination shall be confirmed with the Switchboard / Distribution Board to be installed. Conduit ends pointing upwards or downwards shall be properly plugged in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termination of concrete, soft bushes shall be fixed to prevent sharp edges of conduit ends from cutting or damaging the wires or cables to be pulled through them.

The entire conduit system shall be installed and tested before plastering. Any obstruction found shall be cleared by use of cutting mandrel or other approved device and the conduit shall be cleaned out. Water that has entered in conduit shall be

removed by drawing swabs through the conduit. No cable shall be pulled until the water has thoroughly dried out.

Pull boxes / Adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following requirements:

- Pull boxes.

  For straight runs the spacing shall not be more than 30 meters.

  For runs with one 90 degree bend, the spacing shall not be more than 15 meters.

- Adaptable boxes.

  For conduits up to 25 mm diameter, the boxes shall be 50 mm in depth.

  For conduits up to 40 mm diameter, the boxes shall be 63 mm in depth.

  For conduits up to 50 mm diameter, the boxes shall be 87 mm in depth.

Wherever the conduit lengths cross the expansion joint either along the column or slab, suitable arrangement shall be provided so that when the conduit lengths in the expansion joint are stressed, the conduit neither develops any cracks nor breaks down.

Bending, offsetting and similar operations shall be performed through the help of proper bending tool to give a perfect bend of required angle without Desha ping of conduit to the least.

5.2 Conduits on surface

a. The conduits accessories shall be firmly held with the surface of walls by means of PVC saddles, clamps, brackets etc. Rawal plugs or Phil plugs must be used for fixing such saddles etc. The saddles shall be fixed at an interval of 750mm, depending upon the size & weight of conduit. The MS clamps,

brackets etc shall be painted anti-corrosion paint before and after fixing.

b. In all areas where the conduit is exposed to damp or wet conditions, brass or stainless steel screws must be used for fixing.

SECTION - E

WIRING ACCESSORIES

1. SCOPE OF WORK

The job consists of supply, installation and commissioning of switches, switch sockets, etc., and miscellaneous items as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

2. GENERAL

The locations of the wiring accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer. The Contractor shall be responsible for proper functioning of wiring accessories after installation and Commissioning.

3. STANDARDS

All wiring accessories shall confirm to the following international standards:

- BS 67 Ceiling roses.
- BS 1363:1984 13A fused plugs and un-switched socket outlets
- BS 116 Two and three terminal ceiling roses.
- BS 2135 Capacitors for radio interference suppression
- BS 3676 Switch for domestic and similar purposes.
- BS 4934 Safety requirements for electric fans and regulators.

- BS 5060 Performance of circulating fans and their regulators.

4. MATERIAL

4.1 Switches

Switches for controlling light and fan points shall be single pole, rated for 10 Amp, 250 VAC. The body of switches shall be made of poly carbonate / urea with white face plate suitable for flush mounting on sheet steel outlet box. The switches shall be gang type having silver tipped contacts and operate with snap action.

The fixing of plates on outlet boxes shall be means of flat head counter sunk galvanized screws with the head of the screw finish flush with the surface of the plate. Except for switches controlling light points, all single switches for fans, sockets, etc., shall have identification symbols on the operating levers.

Two way switches shall be used to control lights from two different locations as shown on the drawings.

4.2 Switch Socket Outlets

Switch socket units shall be conformed to BS 1363. 2 and 3 Pin rated for 5 Amps. or 2 Pin rated for 5 Amps, 250V.

3 Pin 5 Amps./15 Amps switch sockets shall be mould type having white plastic face plate, suitable for mounting on a sheet steel box of appropriate dimensions. Switch sockets shall have shrouded live contacts such that the earth pin is engaged to socket earth before making with the live contacts. Where specified, the switch socket unit shall have spring loaded dust tight cover for mechanical protection.

4.3 Sheet Steel Boxes

The outlet boxes for installation of switches, fan dimmers and socket outlets shall be 16 SWG sheet steel having appropriate dimensions. The boxes shall have suitable

knockouts or welded nipples for receiving the conduits. An earth terminal shall be provided for connecting at least three earth wires of 4 sq. mm. The outlet boxes shall be given two coats of anti-corrosion red oxide and one coat of enamel before installation. The boxes shall be suitable for mounting flush with the surface of wall or on the surface of wall as may be required. The boxes shall not be less than 75 mm x 75 mm (3" x 3"). All boxes shall be water tight where installed in the vicinity of liquids.

4.4 Ceiling Rose

The ceiling rose shall be suitable for 5 Amps. 250V AC. It shall have white plastic molded base plate, copper or brass terminals for connecting at least two wires of 2.5 sq. mm size. The ceiling rose shall have a cover with cable inlet hole for multi-core PVC insulated and PVC sheathed cable.

4.5 Fans

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed, speed regulator starting, radio interference silent operation and temperature rise is concerned. For testing BS 848 as amended 1 960 shall be complied with.

4.5.1 Ceiling Fans

The ceiling fans shall be three blades capacitor type, mounted with ceiling by means of pre-installed fan hook. The fan shall be suitable for operation on 250V AC with $\pm$ 10% tolerance.

The sweep of the fan shall be as given in BOQ drawings. Fans shall be supplied complete with fan coil unit, capacitor, suitable fan rod, canopy etc.

4.5.2 Bracket Type

The bracket type fans shall be suitable for mounting on the wall and suitable for operation semi-horizontally. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with + 10 % tolerance.

The sweep of the fan shall be as given in BOQ/drawings.

4.5.3 Exhaust Fan

The exhaust fans shall be three blade types, mounted on the steel/plastic structure of its own, which will be fixed to the structure by means of suitable grouted foundation bolts. The fan shall be suitable for operation on 250 VAC with + 10 % tolerance.

The sweep of the fan shall be as given in Bill of Quantities/drawings. Fans shall be direct driven and supplied complete with electric motor, back draft dampers and anti-vermin screen. The bearings shall be ball, roller or sleeve type of permanently lubricated and sealed type. Wheels shall be heavily and rigidly constructed and accurately balanced both statically and dynamically and free from objectionable vibration or noises.

SECTION - F

LIGHT FIXTURES

1. SCOPE OF WORK

The job consists of supply, installation and commissioning of all light fixtures as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact location/positions of light fixtures.

2. GENERAL

The Contractor shall submit samples of each and every light fixture specified and obtain approval of the Owner/Engineer before purchasing. The quality and finishes of local make light fixtures (if mentioned in BOQ) shall be same as that of standard manufacturer.

All fixtures shall be finished in standard color schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

3. STANDARDS

The light fixtures shall confirm the following standards:

- IEC 81 Tubular fluorescent lamps.
- IEC 82 Ballast for tubular fluorescent lamps.

- IEC 155 Starters for fluorescent lamps.
- IEC 400 Lamp holders and starter holders for fluorescent lamps.
- IEC 566 Capacitors for use in TL, HP Mercury and LP sodium vapor.
- IEC 598 Luminaries.
- BS 3677 Discharge lamp circuits.

4. MATERIAL

4.1 Fluorescent Light Fixtures

The fluorescent light fixtures shall have lamps and ballast of proper rating as shown on the drawings. Each lamp shall be provided with independent ballast.

The fluorescent lamps shall be tubular type and 36/18 watts. The fluorescent color shall be warm white characteristics with an average output of 3350 lumens (+5%) for 36 watts and 1350 lumens (+5%) for 18 watts after I00 burning hours. The ballast shall be polyester filled type, totally enclosed and suitable to operate up to 250 VAC. The power loss shall not be more than 9 / 6 watts for watts ballast. A wiring, diagram, wattage, voltage and current figures shall be printed on the body of the ballast.

The lamp holders shall be rotary lock-in type. The starters shall be glow type with radio interference suppressor / by-pass capacitor. The internal wiring of the fluorescent light fixtures shall be done with heat resistant wires at the manufacturer's factory. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90.

The body of the fluorescent light fixtures shall be minimum 22 SWG sheet steel, de-rusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes and earth terminals shall be provided. Connectors suitable for connecting 2.5 sq. mm cable connectors shall be provided for supply connections. An earth terminal for connection to 2.5mm sq. wire shall be provided.

The light fixtures shall be furnished with perpex diffusing panels " 040 opal acrylic” (minimum sheet thickness 3 mm), polystyrene louvers or metal grid louvers or mirror optic reflectors, etc. as specified on the drawings or in BOQ. The louvers shall be

secured firmly and in level. The polystyrene louvers shall be white Egg Crate or as approved. The louvers shall be in one section and not in pieces.

The design of light fixture for recess mounting shall be coordinated with the design of false ceiling prior to commencement of manufacture.

4.2 Incandescent Light Fixtures

The light fixture shall be finished in standard colors unless otherwise stated on drawings or directed by Engineer. All incandescent light fixtures shall be of international standard and quality. This type of fixtures with manufacturer catalogue reference are given on the fixture schedule and in Bill of Quantities. Equivalent fixture may be acceptable provided that the Contractor submits for review all necessary data indicating photo-metric curves to show that the fixture proposed are of the same type, construction and quality.

The lamps for incandescent light fixtures shall be GLS/EPLC lamps and shall be supplied and installed according to the wattage as indicated on drawings.

Weather proof bulk head incandescent light fixture shall comprise of cast aluminum body and gas-kitted clear glass cover secured to the body by means of galvanized nuts / screws to give a weather proof and water tight fit. A wire guard shall be provided for protection of front glass against mechanical injury. The gasket shall be weather resistance type. A G.I. wire guard shall be provided on the glass cover. The lamp holder shall be of bi-pin brass having porcelain outer ring.

The glass shade of light fixtures shall be opal white or clear and free from any air bubbles or voids. The shade may be spherical, cylindrical, flattened bottom or any other shape as specified in the drawings or BOQ. The glass shall be opal white or clear as furnished by the manufacturer with the light fixture unless specified.

4.3 water proof light fixtures

The underwater lights shall be suitable for 24V, 80Hz Dc. The DC supply shall be available from a step down transformer. The fixture shall be completely water tight and shall have scaled reflector flat lamps.

4.4 flood light fixtures

The flood light fixtures shall have cast aluminum body, angle adjustable stand, polished mirror reflector and clear front glass. The flood light fittings for outdoor use shall be weather proof type having rubber gas-kit ring to fit of the front glass.

5. INSTALLATION

5.1 General

The mounting heights of light fixtures are indicated on the drawings, and position of fixtures according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position. All fixing accessories such as ceiling rose, flexible cord, lamp holder, suspension rod; pipe or chain with suitable canopy, etc., shall be provided and installed.

The wiring between ceiling rose or terminal box of the fixture shall be carried out with 3 core 0.75 sq. mm, PVC / PVC cable. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Glasses, shades, reflectors, diffuses, etc., must be in a clear condition after installation.

All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fitting.

5.2 Fluorescent Light Fixtures

The fluorescent light fixtures on the surface of ceiling shall be installed with the back of the body flush with the ceiling surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light

fixture to the ceiling. The recessed type shall be light fixtures installed on false ceiling, the installation method detail shall be coordinated with ceiling design and submitted for approval of Engineer. The installation shall include cutting and making of holes in false ceiling. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling.

Pendent light fixtures shall have two holes in the top of each casing by a 1/4" diameter galvanized pipe or any other standard method as approved by the Engineer. Wiring from ceiling rose to the fixture shall be installed through the pipe. Proper arrangements such as long threads with check nuts, etc. for minor adjustment in the mounting heights of the fixtures shall also be provided.

5.3 Incandescent Light Fixtures

The incandescent light fixture shall be installed on the surface of ceiling or wall by means of nylon plugs and galvanized steel screws, such that their back finish flush with the surface for exposed conduits and flush with outlet box for concealed conduit system. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box. The light on false ceiling shall be installed in a manner as described for fluorescent light fixture.

5.4 Outdoor Lighting

For illumination around buildings during dark hours, light fittings in various arrangements shall be provided in accordance with these specifications. The items not shown on drawings or called for, but which are necessary for a complete working system as required, these shall also be provided and deemed to have been considered as such.

In case, the specified materials and equipment are not used, the Contractor shall then essentially use the standard products of a manufacturer, regularly engaged in the manufacturer of the product and shall meet the requirement of the specifications.

5.5 Emergency lights:

- The emergency light fixtures shall be IP 65 polycarbonate construction suitable for

interior/exterior applications. The florescent lamps shall be 2x8Watt, T-5, and batteries shall be self contained version – sealed nickel cadmium.

- The fixtures shall be suitable for ceiling/wall mount.
- The duration for emergency lights shall be 3 hours, maintained and non-maintained operation.

SECTION - G

EARTHING SYSTEM

1. SCOPE OF WORK

The job consists of supply, installation and commissioning of all material and services of the complete earthing system as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

2. GENERAL

All exposed conductive non-current carrying parts of switchgear, boxes, trays, fixtures etc should be efficiently earthed. It should be separate with the earthing of transformer or generator.

The earthing system consists of earth electrodes, earthing leads, earth connecting points, earth continuity conductors and all accessories necessary for the satisfactory operation of the associated electrical system.

3. STANDARDS

Following standards should be applicable:

BS 951 Earthing Clamps

BS 1433 Hard drawn bare copper conductor for earthing.

BS 2874 Nuts, Bolts, Washers and Rivets for use on copper.

BS 6346 PVC Insulated Cables.

CP 1013 Earthing

Any other standard referred to in above standards or these specifications.

4. MATERIAL

4.1 Earth Rod Electrodes

Drive extensible rods of the same diameter into the ground, either manually or by power driven hammer, to a suitable depth to obtain low resistively in the particular soil.

Weld earth connectors to the top of the rods, in sufficient number to take all incoming cables.

4.2 Earthing Lead

The earthing lead shall connect the earth electrode to earth connecting point or equipment in the building. It shall be round hard drawn bare electrolytic copper of size shown on the drawings.

4.3 Earth Continuity Conductor

Earth continuity conductor (E.C.C) shall be hard drawn bare copper wire or single core PVC insulated copper conductor cable of sizes indicated on the drawings. All thimbles, lugs, sockets, nuts, washers and other accessories necessary for the complete installation of ECC shall be provided & installed.

The earth continuity conductor should form a continuous path from any point of installation to the earthing sets. When two earthing sets are provided for same mains, these shall be at least 6m apart. The earthing lead shall be taken up to the earthing electrodes in a 32mm of G.I. pipe irrespective of wiring system, and shall be efficiently bounded to the earth electrodes by means of sweating socket, brass nut, bolts, etc. to make a permanent and positive connection with the earthing electrodes. The other end of the earthing lead shall be sweated into a cable lug of a correct size for the wire for its connections to the main apparatus to be earthed.

5. INSTALLATION

The earthing system shall give earth resistance, including resistance of soil, earth leads and E.C.C. equal to less than one ohm, without ground pits water spraying.

The fastening of the earthing conductors shall be made on a sufficient length so as to prevent crushing or cross section weakening. The parts on which they are connected shall be conveniently cleansed and surface.

Leads sheaths or steel tape amours are not permitted as earthing conductors. The earthing system shall be installed to ensure that when any part of the earthing system is disconnected for the purpose of carrying out periodic testing an alternative path to earth is available.

At all connections of earth continuity conductor to any metallic body, proper size or brass sockets, thimbles or lugs shall be used to which the copper wire shall be connected by copper brazing. The soldering of copper wire at joints or termination shall not be allowed. All tee-off connections shall be by copper brazing using suitable socket and clamps. After brazing, the jointed surface shall be protected by oxide inhibiting compound of low electrical resistance. For connections to metallic body, the surface shall be thoroughly cleaned before bolting the lug or socket.

The earth continuity conductor shall be generally run in cable trench or in conduits / pipes or in cable trays as shown on the drawings. For under floor runs, these shall be installed in pipe / conduit of appropriate sizes. Where laid along underground cables, these shall be laid directly under ground in unpaved areas and in pipes under paved areas.

The electrode plate shall be installed at a minimum depth of 5 meters from finished ground level or I meter below permanent water level, whichever is less. The minimum horizontal

distance between earth electrodes shall be 3 meters. Proper mixture of lime and charcoal in the ratio of 1:3 shall be made and buried along with the copper plate in the ground to increase the soil conductivity. The electrode shall be installed as per details shown on the drawings. The inspection chambers shall be constructed at locations approved by the Engineer.

A 50 mm diameter UPVC pipe shall be provided from inspection chamber to earth plate for watering purposes. The pipe shall have 10 mm diameter holes at 500 mm center to center all along the length. At the ground level an inspection chamber with cast iron cover shall be constructed having dimensions as shown on the drawings. The inspection chamber shall have a copper supported on angle iron frame. The cover shall be hinged type, as approved by the Engineer and shall finish flush with the ground level.

The earth connecting point shall be installed at locations shown on the drawings. It shall be fixed on wall surface by means of brass screws with nuts, washers and other insulating material as instructed by the Engineer.

The earth continuity conductor of sizes shown on the drawing shall be installed all along the cable runs and connected to the earthing bar / terminals provided in the equipment.

At any joint or termination, the E.C.C. shall be connected using proper accessories. No connection shall be made by twisting of earth conductors.

SECTION - H

STANDBY GENERATOR

1. GENERAL

The project is designed to have standby generator. It shall serve lighting, sockets and air handling units, lifts, telephone exchange, fire and security room, server room, CCTV system and any other use as may be defined by the CONSULTANTS, within the confines of its capacity.

2. GENERATOR INSTALLATION

Generator unit shall comprise of diesel engine and alternator assembly directly coupled by alignment flange mounted on rigidly constructed base frame provided with anti-vibration mounting pad, mounted on skid under base frame (double base frame).

The generator set shall be auto-mains failure type and manufactured as per B.S. 5649 and B.S. 2613.

3. CABLING & CONTROL WIRING

Generator panel shall be separately mounted, cubicle design, floor mounted incorporating circuit breaker, voltmeter, ammeter selector switches, indication lamps KWH meter. The CONTRACTOR will be required to install the panel and make necessary power wiring between generator, generator panel and change over switch. He will also be required to provide necessary interconnections of low current control cabling.

4. EXHAUST PIPING WORK

From engine, exhaust pipe shall be laid to muffler and onward to the exterior. The exhaust pipe shall be 150mm dia. MS pipe. The pipe shall be wrapped with asbestos or glass wool insulation. The pipe shall be securely and firmly supported to structures. The hangers shall be strong enough to hold and withstand thermal expansions and vibrations. At the end of exhaust piping, rain protection canopy shall be provided.

5. BIRD GRILL & RAIN GUARD

At the neck of radiator, the radiator exhaust shall be directed to atmosphere from basement roof through flexible exhaust duct. The duct shall be fabricated of 1.6mm G.I. Sheet having U-section fixed to canvas bellows of good thickness.

Bird grill shall be provided against the canvas bellow and shall match the size of radiator opening and shall be approximately 900 x 1200mm or as per manufacturer's requirements, in size made of 10 SWG G.I. wire. The grill shall be complete with angle iron framing and holding down hardware.

Rain guard shall be provided next to bird grill to protect radiator from rain. It shall be fabricated of 12 SWG G.I. Sheet and shall be complete with framing and holding down hardware.

6. FUEL PIPING & FUEL PUMP

Fuel piping shall be provided from barred drums to daily service tank, from service to engine and residual fuel from engine to daily service tank. The pipe shall be 25mm dia. M.S. with threaded coupling. Necessary gates/valves are required at different stage shall be provided.

For the transfer of fuel from barred drums to daily service tank hand operated mono-pump together with necessary flexible piping shall be provided.

7. APPROVAL FROM ELECTRIC INSPECTOR

The generator installation requires approval from Electric Inspector. The CONTRACTOR will arrange approval from the inspector, and any modifications required for such approvals shall be done by CONTRACTOR at his own cost.

The generator room is required to have necessary operation and maintenance charts, voltage and caution signs, rubber mats, etc the CONTRACTOR will take care of the same.

SECTION – I

LIGHTNING PROTECTION SYSTEM

1. GENERAL

The system of lightning protection shall be installed so as to protect the building against lightning.

2. QUALITY ASSURANCE

Engage an experienced manufacturer who produces system components made of high quality materials as listed herein. Engage an installer who is listed or who is certified by the Lightning Protection Institute as a Master Installer.

Life service of the materials used shall not be less than 30 years.

Lightning protection shall conform to BS-6651.

3. SEQUENCING AND SCHEDULING

Coordinate installation of lightning protection with installation of other building systems and components, including supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

4. COMPONENTS:

a) Air Terminal

It shall be of taper pointed copper air terminal 1000 mm long 15 mm diameter with base and installed above the finish floor level. The air terminal shall be complete with single pointer rod of high tensile brass bar, it shall be reinforced so as to withstand the excessive pressure of air during storms. Use all accessories for fixing as recommended by the manufacturer. All accessories shall be made of copper. Bare copper tape shall be of copper, minimum 25 x 3 mm size similar to Furse TC-030 or equal.

b) Down Conductors

70sqmm PVC Copper conductor in surface GI pipe connected to tape protective conductors on roof down to the test link for earthing as indicated on the drawings. Each down conductor shall be equipped with independent testing points, earth termination lead & earth. The earth termination lead shall be of copper strip as per drawing.

The whole of the earth termination network should have a combined resistance to earth not exceeding 10 Ohms without taking into account any bonding to other services.

Provide horizontal bonding tape around the building at every 10 meter as per BS Standard.

5. INSTALLATION

Install lightning protection as indicated, according to manufacturer's written instructions.

Comply BS-6651.

Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.

Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.

Bond extremities of vertical metal bodies exceeding 60 feet (18m) in length to lightning protection components.

6. CORROSION PROTECTION

Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.

Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

7. FIELD QUALITY CONTROL

Periodic Inspections: Provide the services of a qualified person to perform periodic inspections during or after completion of building.

SECTION – J

POWER TRANSFORMERS

1. SCOPE

The scope of this section of specification is to supply install, test and commission the transformers. The transformers shall be installed at locations shown on the drawings. For installation details the manufacturer's recommendations is to be followed.

2. SPECIFICATIONS

Transformers shall be from manufacturer's standard range complying with the requirements of the IEC 726 standards and shall be capable of delivering full rated output under the Site climatic conditions.

Transformers shall be of the indoor, Dry type, naturally circulated, naturally cooled, hermetically-sealed type, manufactured by SIEMENS or approved equal.

The step down transformer shall meet the following specifications.

- Type : ONAN
- Voltage ratio at no-load : 11000 / 3300 volts.
- Frequency : 50 Hz
- Vector Group : Dy 11
- HV connection : 11000 V Delta
- LV connection : 3300 V with grounded star point.
- Impedance voltage : 4.5% to 6%
- Voltage regulation for rated : Not to exceed 2.5% of no-load operating condition at O.85 P.F. secondary voltage.

The transformers shall be provided with the following accessories.

- Double float Bucholz relay for alarm and tripping with testing facility.
- Silica gel breather, with oil bath
- Lifting Jugs

- Bi-directional rollers.
- Pressure release safety valve.
- Temperature protection system with thermostat & protection relay.
- Anti Vibration Pad
- Earth terminal
- Dial level gauge
- Dial type thermometer with maximum temperature indicator pointer.
- Diagram and name plate
- Pressure Release safety valve
- Off-load tap changer fitted with position indicator and pad-locking arrangement.
- HT porcelain bushings with protective spark gaps.
- LT and neutral porcelain bushings.
- Cable Termination Box on LT and HT side

Maximum winding temp rise shall be 40 degrees centigrade and top oil temperature rise shall be 60 degrees centigrade over ambient temperature.

Neutral (star point) of the secondary windings shall be brought out and earthed directly to the sub-station earthing system.

(i) Tapings

Transformers shall be provided with tapings on the HV windings, at plus/minus 2.5% ,5% & 7% of nominal and shall give their full rated output on any tapping. The tap changer shall be an externally operated off-load device of robust construction, especially designed against risk of damage from short circuits and having all contact surfaces of ample area for satisfactory operation during overloads.

The mechanism shall be manually operated and shall come to rest only when the switch is making full contact. At all times, clear indication shall be given of the ratio at which the transformer is operating. Means shall be provided for locking the tapping switch mechanism in the position corresponding to each voltage ratio.

(ii) Construction

The transformer tank shall be of sheet steel construction suitably stiffened so that the transformer may be lifted and transported without permanent deformation. The transformer shall be fitted with lugs suitable for lifting and jacking the complete unit. The tank shall be provided with a skid under-base with removable wheels to allow the transformer to be moved in any direction.

Tanks and covers shall be designed such that there are no external pockets in which water can collect.

Tank and terminal box joints shall be fitted with gaskets to prevent entry of water. Gaskets shall be of a suitable non-absorbent material. Joint faces shall fit properly and no additional thickness or jointing shall be used to make good irregularities.

The top cover shall have a substantial flange and adequate number of bolts fixing the cover to a similar substantial flange on the transformer tank. The gasket provided at this joint shall be of synthetic rubber bonded cork. Conservator tank shall be provided with Silica gel breather to allow for expansion of oil.

The initial filling of oil shall be carried out at such a temperature that the pressure in the tank is at a minimum. The space above the oil shall be evacuated and filled with dry clean nitrogen. The pressure of nitrogen inside the top cover shall not exceed 0.35 kg/sq.cm. A pressure relief diaphragm device shall be incorporated in the top cover having a bursting pressure of 0.56 kg/sq.cm.

(iii) Instrumentation

Fluid filled transformer shall be provided with:

a thermometer having a re-settable pointer for registering the maximum oil temperature

Bucholz relay with alarm & tripping features.

(iv) Rating Plate

The transformer shall be provided with a rating and diagram plate made from stainless steel.

(v) Earthing

Transformers shall be earthed by means of substantial connections to the tank or case and terminals for this purpose shall be provided at the base of each unit.

(vi) Cable Boxes

Cable boxes shall be provided for the cable connections to the primary and cable/bus duct to the secondary windings. The cable boxes shall be suitable for use outdoors and for bottom/top entry cabling. The boxes shall be air-insulated type, suitable for XLPE/PVC cable/copper bus duct. The cables shall be terminated using the heat shrink termination method.

SECTION – K

UNDERGROUND TRENCH & PIPES

1. UNDERGROUND TRENCH

i. The underground trench for installation of underground cables and wires through pipes, etc. shall be provided internally and externally as shown on the drawings. While the routes for external runs are to be followed taking into account clearance from underground sanitary and water supply pipe lines, etc., those required internally are dependent upon the type and size of equipment being installed in the substation and equipment rooms, etc., and hence this shall have to be specially modified on the basis of the requirements of the equipment manufactures or suppliers.

ii. The layout and the design of the duct shall be approved by the CONSULTANTS before actually commencing the work on it. All other trades shall have to be coordinated while deciding the alignment of underground trenches. The construction of the trench shall be totally water proof such that no seepage or leakage of water takes place either from top, bottom, or sides.

iii. The cables/pipes shall be supported to two horizontally placed metal supports of 37mm x 6mm angle iron and duly clamped at interval not exceeding 750mm. A covering of 3.8mm thick of soft but indestructible by heat material shall be applied to un-served cables. The supports shall be staggered as detailed in Drawings.

iv. The angle iron shall be buried in the trench masonry at the time of construction.

v. The trench shall be absolutely clean when the cable is laid.

vi. Suitable slope shall be provided in the floor of the trench and the lowest point shall be connected to the drainage system so as to ensure self-drainage of water, if any.

vii. Trench inside the building shall be covered with 5.5mm, M.S. checkered plates.

viii. The trench outside the building shall be RCC/UPVC pipe of required diameter with watertight joints, and shall be laid at least 2 below grade.

ix. The main holes of the trench shall be left open till cable is pulled in and positioned. Thereafter the trench shall be covered with RCC slabs and mortar.

x. The main hole covers outside the building shall be of cast iron water proof type of the size of openings indicated on the drawings. The covers for the inside trench however, shall be of 5.5mm thick checkered plates.

xi. The CONTRACTOR shall arrange to provide for a water tight entry of cables where these enter in the building. This shall be done by the use of UPVC/CC pipes provided one for each cable in a reverse slope and with bitumen filling of the end.

xii. Where trenches are left open overnight and where roads are being cut in the day or night; the CONTRACTOR shall exhibit suitable danger signals such as banners, red flags and red lamps at his own cost.

xiii. If any damage is done, to the existing cables, etc., the cost of making goods such damages or entire replacement shall be recovered from the CONTRACTOR.

xiv. The road cuts and filling shall be filled up and suitably watered and cement shall not be laid until all subsidence stops and no time shall be lost in putting the cement concrete. Wet gunny bags shall be spared over it for a period of not less than three days in order to allow full setting of the cement concrete.

xv. All the trenches shall be watered and rammed properly before final dressing. The same applies to lawns public or private but here in place of cement filling some manure of good quality shall be utilized. The turf shall be carefully rammed and preserved in a convenient place before excavation and shall be re-laid after filling up, watering and maturing is completed.

xvi. The road cuts shall be filled up first with mud concrete in the proportion of 1:2 up to 150mm below the road level and after consolidating it properly 150mm of concrete in cement shall be laid over it, but in the case of bitumen surface of road the top dressing are to be adjusted.

xvii. The trenches shall be dug until the CONTRACTOR is certain that the cable is available for laying in it.

xviii. Wherever cables are required to be installed inside a Building or in any other masonry or channel work, it shall be done neatly by use of cleats or any other device as directed by the CONSULTANTS.

xix. Cement concrete pipes or G.I. pipe whichever is required shall be provided for all road crossings and nothing extra will be paid for these. The size of the pipe will be decided by the CONSULTANTS. These pipes will be laid direct in the grounds without any bed without pacca joint. No sand cushioning or tiles used in such situations.

xx. Cables shall always be laid out or laid into the ground through 200mm long C.C. pipe of suitable size. Nothing extra will be paid for this pipe. A reasonable length of cable in the form of coil shall be left at ends of the underground run of the cable for subsequent use.

xxi. Where road berms have been cut or curb stones displaced, the CONTRACTOR shall repair all damages to the satisfaction of the CONSULTANTS and all surplus earth or rock removed to a suitable dumping place which will be indicated by the CONSULTANTS. Where in the course of excavation lawns or roads have to be cut it shall be done in such a way that the turf removed can be re-laid. If this condition is not fulfilled the OWNER shall get the work done by other agency and recover the cost from the CONTRACTOR.

If any damage is done to any other service during the execution of the work, the whole cost of making good such damage shall be recovered from him and where such damage is excessive or deliberate, it shall amount to breach of the terms of this CONTRACT, the CONSULTANT may at his discretion take appropriate action at the cost of the CONTRACTOR.

Section - L

Cable Tray System:

i. The cable trays shall be fabricated by prime quality 1.6mm MS sheet steel or GI sheet, solid or perforated and painted powder coated RAIL- 7032. Supply and install

all accessories like tees, bands, elbows, risers, etc. to complete the cable tray system.

ii. The length should be standard of 2.44 meters.

iii. All fixing or supporting accessories shall also be provided & installed like hangers, brackets, clamps etc.

iv. The cable trays shall be capable to support all type of wiring like high voltage, medium voltage, low voltage etc. it should be fabricated with the standards laid down by NEMA.
For internal areas, it should be mill galvanized.

For external areas, the cable trays and accessories should be hot dip galvanized after fabrication.

After fabrication process, all trays, ladders and accessories (bands, elbows, risers etc like nut, bolts, washers, tees) shall be dipped into liquid zinc bath, the surface including all cut edges being coated with a homogenous zinc layer to provide better protection against low chemical stress, marine air, urban air & other low atmospheric influences which activate corrosion.

SECTION – M

VOICE & DATA COMMUNICATION SYSTEM

1. GENERAL

The proposed cabling system for the UTP and Fiber network cabling and Fiber Links shall be an open system and application and vendor independent and shall be warranted by an International Vendor for a minimum of 20 years. The contractor Installers (labor) and engineers must be trained and certified by this vendor to design and install cabling system.

A Main Patch Panel (MPP) shall be provided at the server room of the Building. The Patch panels are located as marked in drawings. The cable run from the Patch Panel to the associated outlet is limited to 90m. The cable run must be free of bridges, taps and splices.

Wiring system used shall be star topology i.e. each data/voice outlet is connected directly to Patch Panel. Both ends of the cables shall be labeled to EIA/TIA 606 administration standards.

Transmission Media:

For Data:

Vertical runs between floors extending from the MDF to each Patch Panel in a star topology using fiber optic cables installed in cable trays.

Horizontal runs from a patch panel to the data outlets using CAT-6, 4 Pairs UTP twisted pair cables.

For Voice:

1. Vertical runs between floors extending from the MDF to each JTB using multi pair CAT 5 cables installed in cable tray.

2. Horizontal runs from a TJB to the telephone outlet using 2 Pair telephone cables.

Data & voice processing system shall be supplied installed and tested complete in place including but not in a way of limitation, cables, socket outlets, adapters, connectors, patch panels, 110 wiring blocks, patch cords, cable management, floor distributors (racks/cabinets).

The Cabling System shall be designed using standard, proven equipment and materials with the latest technology version or model. If there is any problem during warranty period related to the shortage of Materials, the Contractor shall supply them with no extra cost.

The design shall fully comply with EIA/TIA 568B & ISO 11801 in a full star topology configuration collapsing in the MDF.

The network data cabling systems support at least 1000 Base-T (Gigabit) Ethernet or faster protocol.

The UTP (unshielded twisted pair) Category 6 cable's technical specifications shall be up to the highest industry standards and should have performance specifications better than 250 MHz and should exceed all proposed requirements for data, video & Gigabit applications.

The UTP Category 6 cable's technical specifications shall be up to the TIA/EIA-568B.2-1 industry standards and should have performance specifications better than 250 MHz and ample margin compared to the Category 6 Standard for performance in factors such as NEXT.

Data & Voice cables may be drawn through the same conduits and raceways & terminated in separate face plates.

2. SCOPE

The contractor shall carefully examine the specifications to ensure that he is fully conversant therewith and has included for everything necessary therein, either expressly provided for or as would normally be expected to be provided for by a reputable contractor specializing in the type and nature of the Services described in the Contract.

The Contractor is advised that items or matters not specifically provided for, or partially described or otherwise missing from the specifications, but which are nevertheless necessary for the execution and completion of the Services, shall be deemed to have been included by the Contractor.

The Contractor shall ensure that all selected manufacturers of equipment and materials provide with appropriate warranties and guarantees for their products.

Authorized and certified installers registered with their respective manufacturers shall execute the installation of the Cabling system.

The Contractor shall also be required to submit, in their bid, a list of personnel along with their CV, certifying that the installers it intends to employ on the services have the necessary training and experience.

The LAN cabling system shall meet the emerging EIA/TIA 568A/B and ISO 11801 Category 6, Class E specifications and shall support Gigabit Ethernet, Sonnet/asynchronous transfer mode (ATM) at rates (minimum of) 1 GB/seconds and analog broadband video in addition to existing telecommunication and multimedia technologies.

The voice backbone cabling system shall meet the EIA/TIA 568A/B-5 and ISO 11801 Category 5E, Class D specifications.

The Contractor shall carry out all the necessary surveys, design and engineering so as to provide for the Services, a whole and complete system to ensure full compatibility of the Services with any of the existing facilities pertinent to Cabling System applications & operations.

The scope of the Services include the provision of all material, labor, supervision, construction, equipment, tools, temporary, test equipment, spares, consumable and all other things and services required to engineer, design, supply, install, test and commission the Cabling System.

It is the responsibility of the Contractor to make sure that the system works at the company environment.

The Vendor must provide a list of project Reference within the last three years.

The Vendor must have completed a project with a minimum of 1000 points or higher of Category 6

The Vendor must have experience with minimum 500 points of fiber installed and terminated.

3. SUBMITTALS

Product Data: Submit manufacturer's data on signal transmission media and components.

Shop Drawings: Submit layout drawings of computer cable distribution system and accessories.

Wiring Diagrams: Submit data transmission wiring diagrams for computer system, including rack and terminal connections.

4. QUALITY ASSURANCE:

For Manufacturer:

Firms regularly engaged in manufacture of signal transmission media and accessories of types required, whose products have been in satisfactory use in similar service for not less than 5 years.

For Installer:

Firms with at least 5 years of successful installation experience with projects utilizing systems and equipment similar to that required for this project.

Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of data system with other work.

Sequence installation of data system with other work to minimize possibility of damage and soiling during remainder of construction.

5. COPPER & FIBRE OPTIC CABLE AND CONNECTORS

UTP Copper & fiber optic cables shall be approved & recommended by component manufacturer. This is to enable the component manufacturer to give the necessary product and application warranties for the system.

Provide UTP copper cable, fiber optic cable and connectors, in sizes and types as recommended by the active equipment manufacturer for indicated applications. Mate and match connector materials to factory installed equipment.

Cabling Accessories:

Provide computer accessories, including modular wall and floor jacks, junction boxes, connecting blocks and pre-wired boxes.

The selection and type of material required for the Services shall conform to the specifications given herein and items or matters not specified herein shall conform to ISO/IEC 11801, EN 50173 and EIA/TIA 568B Category 6 Standards as applicable. The Contractor shall also ensure that the materials utilized to complete the Cabling System installation are capable of supporting the minimum expected performance requirements for emerging applications such as ATM services (1.2 GPS), including 10 GB Ethernet. The complete system shall guarantee a minimum of 250 MHz & 100 MHz bandwidth performance and the products shall be from an internationally reputable manufacturer. The selection of materials shall be subject to approval by The Company.

The cables that are used to complete the installation shall be Category 6 UTP, capable of carrying high bit rate signals for extended distances in building distribution systems over frequency ranges up to and potentially beyond 250 or 100 MHz, designed to work on an ISO 11801 Class "E" link.

The cable shall be composed of 23 or 24 AWG bare, solid-copper conductors. The insulated conductors shall be twisted into individual pairs and four such pairs twisted together.

The cables shall be fully color coded as provided hereunder, color contrast being such that each pair in the cable is easily distinguishable from every other pair.

Conductor Identificatio	**Colored Code**	**Abbreviation**
Pair 1	White – Blue Blue – (White)	WT – BL BL
Pair 2	White – Orange Orange – (White)	WT – OR OR
Pair 3	White – Green Green – (White)	WT – GN GN

Pair 4	White – Brown Brown – (White)	WT – BR BR

6. TELEPHONE SYSTEM

6.1 General

The work included under this section consists of furnishing of all labor, services and skilled supervision necessary for the construction, erection, installation and connection of all facilities specified herein and as shown on the drawings and/or normally required for the complete telephone system and its delivery to the owner on completion in all respects ready for use, except the main telephone exchange equipment (PABX) and telephone instruments which will be supplied and installed by the relevant authority in accordance with the requirements of the PTCL.

6.2 Telephone Services

The telephone service entrance location shall be coordinated with PTCL. For bringing in the service connection and underground UPVC pipe 75mm diameter shall be installed, a minimum 500mm below ground level and as shown on drawings. Pull wire shall be furnished and installed in the pipe line as recommended by PTCL.

6.3 Telephone Conduit System

The telephone conduit system, including telephone outlet boxes, rosettes, junction boxes, etc. shall be generally in conformity with the specifications of similar items given in BOQ and shall be in accordance with the recommendation of PTCL.

6.4 Telephone Junction Boxes

The telephone junction/terminal boxes shall be cubical design of 1.6mm sheet steel fabricated with a hinged door fixed flush with the wall and having built in concealed lock. The color of the box shall be powder coated RAIL 7032, and it shall be installed in such a manner so as to have easy access for service and repair. The TJB shall be vermin proof. It shall be made to accommodate tag blocks with indicating and marking arrangements.

6.5 Telephone Wiring

Wiring of telephone system will be done by multi-core PVC insulated and sheathed cables complying with BSS 2746. The conductor shall be of high conductivity tinned copper diameter 0.6mm. PVC insulated and PVC sheathed. All telephone cables shall be continuous between telephone outlets and junction boxes. All connections shall be made, marked and identified on tag blocks and socket outlets.

7. SPECIFICATIONS OF UTP CABLES:

Cable Type	Category 6 UTP
Conductor Size(mm)	23 or 24 AWG
Number of Pairs	4
Nominal Outer Diameter (mm)	6.0
Impedance(Ohm)	100+/-15
Velocity of propagation (% speed of ligh	69
Frequency (MHz)	250
Max. Attenuation @ 250 MHz (dB)	32.1
Worst case NEXT @ 250 MHz (dB)	38.3

8. FIBRE OPTIC & UTP CABLING

The backbone cabling interconnecting distribution cabinets to the main Central distribution cabinet shall be of multimode fiber cable 50/125 microns; 12-core cable with color-coded fibers. All fiber optic cables shall be laid in straight run without intermediate splices and all fibers shall be terminated at either end using suitable fiber cable patch panels mounted on the wiring closets.

All fiber optic backbone links between the main cross connect and the Telecommunication rooms have a backup link using a different route from the main fiber optic link. Each of these links shall be 12-core fiber optic cable as described in this document.

The Contractor shall be responsible for the supply, installation, testing and commissioning of the complete fiber cable backbone interconnection/cross connection requirements of the "building/complex" LAN Cabling System.

The Contractor shall install suitable fiber optic pigtails/connectors needed to complete the entire fiber cable installation as per the manufacturer's recommendation and shall ensure that the backbone is capable to handle the traffic and provide error- free universal data transport for the foreseeable future.

The backbone Fiber optic cable shall be run either vertically between floors or horizontally to connect wiring closets to the MDF.

The 12 core fiber optic cables shall be installed from the Main Cross-Connect to each Telecommunication rooms. The cable shall be tied down to the designated area at the rear side using cable ties around the outer jacket, leaving 2 to 3 meters of excess length of the cables, in addition to the length required to facilitate the termination process.

All of the fibers in the backbone shall be terminated with LC type connectors at the time of the installation. The Contractor shall ensure proper testing of the fibers and make them available whenever they are needed. No fibers shall leave un-terminated, all fibers must be terminated. A document with fiber cable test results for every fiber cable link shall be provided by the Contractor.

The Contractor shall observe the manufacturer's specifications for maximum tension and minimum bend radius for each fiber optic cable. The contractor shall provide a copy of the manufacturer's specifications to the owner prior to the commencement of the work.

Care must be taken when mechanical pulling devices are used, that maximum tension limits are not exceeded. Minimum bend radius specification shall not be violated when the cables are routed through walls or around corners. The contractor shall ensure that all installation personnel are aware of these limitations.

The Contractor shall follow an intelligent numbering system based upon the destination and channel number. The numbering system shall have a prefix ‘F’ to indicate it is a fiber optic cable, followed by the destination IDF, then a hyphen and the channel within the cable.

100 pairs UTP shall be installed between the Telephone MDF and the Voice/Data MDF. This cable shall be of category 5, 100 MHz and shall be terminated in a rack mounted patch panels installed in the telecommunication closet at the MDF.

Multi-pair, CAT 5, 100 MHz UTP cable shall be installed as backbone between the voice MDF to the IDF in each floor/location as indicated in the drawings.

Logical labeling should be as per ANSI/TIA/EIA-606. Labels should be ring and printed type. No labels should be written by hand.

9. OPTICAL FIBRE CABLE TECHNICAL SPECIFICATION

Fiber optic cables within the premises shall use multimode, graded-index.

Fibers must comply with EIA/TIA 492 specifications and OM3 fiber specification as in IS 11801 standard.

Fibers will have dual wavelength capability; transmitting at 850 and 1300nm ranges.

All fibers shall be color coded to facilitate individual fiber identification. The coating shall be mechanically strippable.

Core	50 μm ± 3 μm
Core Non-Circularity:	<6%
Core/Cladding Concentric	<3.0 μm
Numerical Aperture:	0.200 ± 0.015

Cladding diameter:	125 μm ± 1 μm
Cladding Non-Circularity:	<2.0%
Colored Fiber Diameter:	250 μm ± 15 μm
Buffering Diameter:	890 mm ± 50 mm
Minimum Tensile Strengt	100,000 psi
Fiber Minimum Bending R	.75 in. (1.91 cm)
Cable Minimum Bending I During Installation: After Installation:	 20 times cable diameter 10 times cable diameter

Operating Temp. Range:	32°F to 122°F (0°C to 50°C)
Storage Temp. Range:	-40°F to 149°F (-40°C to 65°C)
Maximum Fiber Loss:	3.5 dB/km at 850 NM 1.5 dB/km at 1300 NM
Minimum Bandwidth:	1500 MHz km at 850 nm (OFL) 500 MHz .km at 1300 nm (OFL) 2000 MHz km at 850 nm (DMD, laser) 500 MHz km at 1300 nm (DMD, laser)

10. DATA & VOICE OUTLETS

The Contractor shall provide the identification labels at each and every information outlet with clear information of its connection. (TR, cabinet number, patch panel number and port number). The labeling shall be on the faceplate of the information outlet according to EIA/TIA 606 Administration Standard.

The contractor has to provide clear identification labels for data & voice.

In the process of installing the information outlets, if the Contractor envisages difficulty in mounting the outlet at planned location in the drawings. The contractor shall notify the Engineer/Owner, the contractor shall not make his own discretion in modifying or changing any information provided in the drawings.

The type of information outlets shall be of modular RJ45 of Matt Chrome/ metallic or any other approved finish, 8 position, 8 conductor designed for high speed networking applications that use data transmission rates over frequency ranges up to and potentially beyond 250 MHz & 100MHz. The outlets shall be of insulation displacement connectors type (IDC).

The 8 position/8 conductor outlet shall meet the category 6 transmission requirements for connecting hardware specified in ISO/IEC 11801 and EIA/TIA-568A/B and Class E design guidelines.

The modular outlet shall provide maximum versatility in designing a premise distribution system. It shall be designed to snap into modular faceplate. When the outlet is inserted into the faceplate or frame, it shall lock into place and shall only be released using the dual-purpose wire insertion tool. The mounting and removal system shall allow easy installation and modification. The faceplate jacks must be shutter protected and shall include a label window required to write circuit identification number. Each port must support a color icon to identify the port function.

The plastic used to construct the modular data outlet shall be of high impact, flame-retardant, made of poly(phenylene oxide) with flammability rating meeting UL 94V-0UL, the jack wires shall be at least 50 micro-inch lubricated gold plating over 100 micro-inch nickel under plate. The connector shall be of copper alloy, at least 100 micro-inch bright solder over 100 micro-inch nickel under plate.

The insulation displacement connector shall accept 24/23 AWG solid copper wire conductors. The connector shall have multicolor labels marking wire terminals with numbers, assuring fast, accurate installation. The outlet must support wiring configuration as per T568A and T568B on the same RJ-45 jack

The connector shall be wired using the wire insertion tool (impact tool). The module shall be wired from the centre to the outside and shall not untwist paired conductors more than 12.7 mm. In the process of terminating the cables in patch panels/outlets the Contractor shall ensure ISO/IEC and TIA/EIA category 5E/6 transmission performance requirements.

11. PATCH CORDS

The contractor shall supply patch cords for all the installed points on the network switch side as well on the workstation side. The cord length shall be of two different sizes, 1m on the network switches side and 3m on the workstation side.

The patch cable shall meet the requirements warranted to meet ISO/IEC 11801, EN 50173 and EIA/TIA 568A/B category 6 wiring standards capable of connecting high speed information terminal devices to information outlets, to interconnect information terminal devices and 8-position modular jack panel applications. The patch cord shall be designed to provide support for extended multimedia transmission distance over frequency ranges up to and potentially beyond 100/250MHz.

The patch cord shall support the computer networking applications over frequency ranges up to and potentially beyond 250 MHz and shall be compatible with voice and information applications.

The construction of the cord shall be of stranded type cordage tightly twisted, 24 AWG, 8 conductor. The cord shall be terminated to an 8-position RJ-45 modular plug on both ends. The cords shall support the transmission requirements warranted to meet ISO/IEC 11801 Class E, EN 50173 or TIA/EIA 568B Category 6, Class E component specifications and standards.

The Contractor supplied cord shall be of factory crimped modular plug at both ends.

Pre-wired patch cords,110 to 8 position(RJ45), constructed of 24 gauge, stranded wire in PVC jacket shall be used to add modularity to 110 system.

12. PATCH CORD ORGANIZER

The Contractor shall supply and install sufficient patch cord organizers/inter-bay patch cord organizers that are used for routing patch cords in 19-inch (48.3-cm) frames. The patch cord organizers shall support the requirements of routing patch cords both at the equipment side as well as the Category 6-patch panel cabling side at the wiring closets. These organizers shall be located in the 19-inch frame inside the wiring closet.

The Contractor supplied patch cord organizers/inter-bay patch cord organizers shall support the requirements of routing cords in both horizontal and vertical pathways.

13. PATCH PANELS (JACK PANELS)

The Contractor shall supply and install the modular patch panels to meet the full cabling system requirement of the "building/complex". Every category 6 cables serving the information outlets at work areas shall be terminated at the patch panels. The Contractor shall ensure that the supplied patch panels meet the ISO/IEC 11801, EN 50173 and TIA/EIA 568 warranted component specifications and standards.

The patch panels shall be of 19-inch rack-mounted panels. The rear of the panel shall feature connecting blocks mounted on a printed wiring board. These connecting blocks shall be capable for use in terminating category 6 station wires, equipment, or tie cables. The modular patch panel shall be capable of supporting up to 24 jack positions (ports) as required by the design drawings of the voice and data system and shall have the facility to write the circuit designation details at the front side of each jack. The contractor shall provide 20% spare capacity for both voice and data.

The insulating displacement connector field in the patch panel shall be made continuous to the 8-pin modular jack field on front of the panel through printed wiring board connections to enhance the features to confirm to EIA/TIA 568A/B cabling recommendations.

The construction of the modular jack panel shall be of category 6 – compliant and shall have the stringent requirements of connecting hardware as specified in EIA/TIA 568A/B commercial/ residential building Cabling System standards.

When the patch panels are tested in accordance with the appropriate test methods described in EIA/TIA 568 A/B and ISO/IEC 11801, EN 50173 Category 6 specifications. The modular patch panels shall meet the worst-pair near-end cross talk (NEXT) requirements over the entire frequency ranges up to and potentially beyond 100/250 MHz on all pair combinations.

Care must be taken to ensure that the cables are terminated correctly at category 6 cross connect hardware (patch panels).

The pair twist of the cables must be maintained as close to the termination at the patch panel IDC Modular outlet as possible. Cables shall not be untwisted for more than 12.7 mm. The cable conductor's entry shall be at the center of the IDC module and the module shall be wired from the center to the outside.

The cable conductors shall be terminated as described in EIA/TIA 568A/B and ISO/IEC 11801, EN 50173 Category 6, Class E wiring sequence by using the proper insertion tool (impact tool).

When terminating the cables in the insulating displacement connector field, care must be taken to ensure that the strip – back is limited only as much cable jacket as is required to perform connecting hardware terminations. The cables shall be properly secure terminations. The cables shall be properly secured to the 19 – inch rack with cable ties as well as at the patch panels.

The IDC connectors must be color coded to meet both T568A and T568B wiring Configuration.

Each port of the patch panel must support color Icon to identify the port function.

Each port must be numbered in sequence with white printing on black background or other high contrast colors.

Each port on the patch panel must have a label place holder and for the patch panel number.

The IDC connector on the back of the patch panel shall support 22 to 25 AWG solid conductors cables.

The package must include frame mounting screws, labels, cable ties and instruction sheet.

14. IDC WIRING SYSTEM

The IDC blocks shall be used for the voice cross connect and should be 19” rack mountable type.

The IDC blocks shall be capable of terminating up to 336 pairs.

Shall be capable to terminate 22-26 AWG solid conductors or 22-26 AWG stranded conductors.

Shall be made of high-impact UL 94V-0 rated thermoplastic.

Maximum insulated conductor outside diameter 0.05”

Complete kit include connecting blocks, labels and label holders shall be used.

Jumper troughs shall be used to route cable horizontally and vertically.

15. CABLING CABINET (Racks)

The Contractor shall supply and install cabling System Cabinets to house the passive and active network equipment. The cabinets shall be free/standing or wall mounting types.

The Cabling System cabinets shall meet the requirements of accommodating the high volume of cabling 19" 24-port patch panels & LAN Equipment fully assembled with the following items.(Cabinet dimension 42U 600 mm x 800 mm nominal width & depth). The cabinets must meet the following specifications:

42U 800 x 800 Ready Rack

500 KG load rating

42U 600 4mm Safety Glass Door (On the front).

42U 600 1.6 mm steel Door (On the rear).

600 x 800 side vented top cover.

Castors heavy duty braked.

42U Panel mounting angle kit.

800 X 800 thermostat controlled Low Noise Fan Tray.

A power outlet strip shall have a 2 meter flying lead, (3-wire extension cord) with a 3 prong British plug with fuse and shall have 13 amp. 250 volt 3 prong British outlets with individual on/off switch and indicator light with mounting brackets. The AC Mains distribution integral at the rear pillar of the cabinet should have at least 10 of 13 amp. Power Outlets. Cable management panel inclusive of other accessories such as earthling kits, screws, washers, grip-nuts and a removable shelf, able to resist a weight of 50 to 60 kgs. The cabinets shall be rugged and strong and all steel shall be finished scratch proof in a durable enamel Grey paint on both sides.

The cabinets must include Low Noise Thermostat controlled fans and shall automatically switch on and off according to the temperature inside the cabinets, the temperature range shall be from to 10 to 60 degrees centigrade. The dimensions of the tray shall be of 600 mm x 800 mm. The fan tray shall have minimum of four fans 250 Volts AC + 6% 50 Hz. The low noise top mounted fan tray shall aid the cooling requirement of the LAN equipment installed inside the cabinets, and in the process of installing the fan tray on top of the cabinet it shall not occupy any of the usable U height in the cabinet.

The front glass door shall have at least 4 mm toughened & 50 percent light transmission smoked safety glass able to resist a weight of 80 to 100 Kgs. Placed within 200 mm of the door center. The door shall be lockable and shall have a swing handle supplied with 2 keys.

The rear door shall be the same as the front except the construction of the door shall be of rugged and strong 1.6mm steel finished in a durable enamel Grey paint on both sides, and without glass.

The internal panel mounting angles shall be supplied in pairs to provide 19" mounting positions with hole patterns to accept captive nuts on universal centers. In the design of the panel mounts the centers of each U height shall be notched, to make the positioning of cage nuts much simpler. The panel mounting shall be fitted onto panel mount angle supports to allow infinite adjustment throughout the depth of the track.

The cabinets shall be supplied at least with one shelf kit. The shelf should carry a load rating of 50 Kgs. And shall be manufactured with holes/slots providing sufficient airflow to LAN equipment when installed inside the cabinets.

Four steel castors with rubber wheels at least 40 mm high. These castors shall be mounted at the corners of the cabinet and be able to support the total weight of the cabinet and all options.

The cabinets must support the installation of fire protection units and all 19" equipment including frames for 110-punch block.

The supplied cabinets must meet the following standards:

IEC 297-2

D/N 4/494 Part 7

D/N 4/491 Part 1

Load rating 500 Kg

Rust proof coating

EN 60950

VDE 0100

Material 1.6mm steel

Paint finish according to RAL 7035

For the 25U freestanding cabinets the specifications is as follows:

The 19” 6U, 350 x 600, rack mounted type. Tempered glass front & rear door with key lock for maximum protection.

A power outlet strip shall have a 2 meter flying lead, (3-wire extension cord) with a 3 prong British plug with fuse and shall have 13 amp. 250 volt 3 prong British outlets with individual on/off switch and indicator light. The AC Mains distribution Integral at the rear pillar of the cabinet should have at least 6 of 13 amp. Power Outlets.

The cabinet shall be fitted with at least a 2 way low Noise Fan Tray and medium duty castors.

The supplied cabinets must meet the following standards:

IEC 297-2

D/N 4/494 Part 7

D/N 4/491 Part 1

Load rating 500 Kg

Rust proof coating

EN 60950

VDE 0100

Material 1.6mm steel

Paint finish according to RAL 7035

18 42 U free standing open frame

Integrated cable and cord management

allows for more efficient and effective cable management

Focused on accessibility

Extruded aluminum construction

Modular open frame design (no doors and side panels to remove)

Pre-threaded mounting holes

42U with 270 holes per vertical channel meets EIA/TIA RMU rack mounting unit dimension

Mounting screws with pilot point

Cable guides provide an effortless solution to transitioning cables

Flexible cable guides allow cable to snap-in easily for quick cable routing

Spacing of cable guides aligns exactly with the standard ISO 1101 rack

Unique switch gate Door / Cover provides easy access to the door

Edge protected pass through holes for transition of cables to rear side

SECTION - N

ADDRESSABLE FIRE ALARM SYSTEM

1. SCOPE

The work consists of supply, installation and commissioning of all material and services of the complete Addressable Fire Alarm system as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

2. STANDARDS

Following standards/codes shall be applicable:

BS 5839

NFPA 72

Any other international standard

3. OPERATION

The Fire Alarm System shall be pre-signal non-coded type complete with battery backup.

As per drawings the break glass type fire alarm stations and automatic detectors shall be installed at site. In case of any Fire, the manual station shall be operated by pulling down the handle or breaking the glass. The actuation of this station shall cause an audio as well as

visual alarm at the fire alarm control and indication unit, duly indicating the location of the respective station/zone.

An authorized person shall immediately visit the affected area and if after investigating, it is deemed necessary, alarm in the whole building shall be initiated from either the alarm switch located beside the fire alarm control panel by inserting a special key or the actuation of any indication at the Main Fire Alarm Control Panel. The general alarm shall be initiated by an authorized person after inspecting the affected location.

Circuit shall be so arranged that an open circuit in an initiating or indicating loop shall cause the individual zone and common trouble indication at the fire alarm control panel.

4.0 MATERIAL

4.1 Wiring

Fire Alarm Cable shall be 2 core shielded twisted pair, fire resistant, PVC insulated, 250/440 volts grade cable to be laid in concealed PVC conduit.

4.2 Power Supply

The supply and operating voltages shall be 220 volts, 50 c/s and 24 volts D.C. respectively. The control stations shall be provided with sufficient capacity nickel cadmium battery with charger to operate the complete system for the least 15 hours in case of mains failure. A 20 Amp SPN switch socket shall be provided near the central fire alarm panel to feed the mains supply.

4.3 Fire Alarm Control and Indication Unit

The fire alarm control and indication unit shall be a Solid State Modular Unit consisting of the following Modules; suitable number of modules shall be used to provide facility for 6 loops. It shall not be possible to remove the key without turning the key to its normal position, thus resetting the alarm contacts.

i. Loop Module

loop Module shall have multiple of supervised initiating circuit with a trouble and an Alarm Lamp for each loop. Detection circuit wiring shall be two wire Class `A' and shall power all Detectors (Relay outputs and) voltage output for each zone alarm and voltage output for each zone trouble shall be provided.

ii. Audible Expander Modules

Audible Expander Modules shall provide for supervised control circuit for polarized alarm signaling devices. Loop activated lamp shall be provided for each loop to aid on system testing and trouble- shooting provide (1) (2) (3) indicating circuits.

iii. Power Module

Power Module shall supply the necessary power for the loop module and all Detectors (and shall contain a Battery Charger to charge the batteries) An AC power to Lamp shall be provided to indicate the normal condition of the panel. Individual supervisory lamps shall be provided for AC power failure indication, ground fault detection, and low battery. All controls shall be behind a key locked door to prevent unauthorized operation. Two supervised control circuits for audible signaling shall be provided as part of this module. Common trouble and common alarm relay and logic outputs shall be provided. The panel cover shall be key locked to prevent unauthorized access.

4.4 Manual Call Point

It shall be re-settable (non-breaking) glass type, electronically addressed and suitable for semi finish and surface amount installation as per drawing. The break-glass manual station shall be operated by pulling down the handle. When operated, the handle shall remain down with the pre-signal alarm contacts closed until the station is reset. The general alarm contacts shall remain open until after investigation. The general alarm switch shall be operated by an authorized person with a special key.

4.5 Fire Alarm Bell

Fire alarm (bell) shall be of red color surface mounted installed where indicated on the drawings. Sound intensity shall be such that an audible signal will be heard clearly throughout the structure when all the bell ring. The bell shall be connected in multiple cross loop conductors.

4.6 Smoke Detector

The detector shall use the light scattering principal to measure smoke density & shall send data to FACP indicating analog level of smoke density. It should be low profile design, electronically addressed, twin LED's for 360 degree vision and removable optical chamber for cleaning & maintenance. The operating voltage shall be 24V DC and surface mounted ceiling and shall include a separate twist-lock base that includes a temper proof feature.

4.7 Heat Detector

It should be low profile design with fixed temperature and rate of rise heat detection type. The heat detector shall be intelligent addressable device rated for 135 degrees. Electronically addressed and twin LED's for 360 degree vision. The operating voltage shall be 24V DC and surface mounted as per drawing.

4.8 Fire Alarm Sounder

It shall be of red color surface mounted installed as per drawing. It should be electronically addressed and strobe provided by high intensity LED cluster. The operating voltage shall be 24V DC.

4.9 Annunciator

The remote visual annunciator shall have the capacity for indicating 6 distinct alarm loop and one common trouble condition. The annunciator shall be back lighted type to increase visibility and to deter tampering with the lamps. The descriptions of each zone shall be approved by the Engineer In-charge. In the normal condition the annunciator shall have a blank appearance. Alarm and trouble condition shall be annunciated both visually and audibly. Lamp shall be 24 V DC, and replacement shall be readily available. Lamp replacements shall be accomplished without tools.

A test switch shall be provided for periodic testing of all lamps in the annunciator. To reduce tampering the annunciator shall have a key operated silence switch and a key

locked cover. For aesthetic reasons the unit shall be compact, have a brushed metallic trim ring and be surface mounted.

4.10 Function of Addressable Fire Alarm Control Panel (FACP)

i. Design

The FACP shall be solid state, modular design with integral static protection. All indicating lamps shall be long life, low maintenance solid state light emitting diodes (LED). It shall have graphically LCD display, programmable from PC built-in gas extinguishing control and integrated security alarm facilities. It should be designed to receive signals emitted by manual call points & fire detectors, producing sound & light indications. It should provide options for integration of external sound units & executive devices.

ii. Enclosure

The FACP enclosure shall be semi flush mounted. The enclosure shall be hinged from the left and the cover shall have clear windows and locking mechanism to keep the system operating and status switches from being tampered keys shall be made available to fire department and other authorized operating personnel. Finish shall be "FIRE ALARM RED" and "BLACK".

iii. Loops & Identification

All controls shall be labeled, all loop locations shall be identified, and the FACP shall be provided with a set of permanently mounted operating instructions, to avoid confusion. Loop location identification shall be as approved by the Engineer In-charge and contain up to three lines of text with 1/8" minimum character heights.

iv. Components of Fire Alarm Control Panel

a. All hardware and software to allow the panel configuration and operation to be changed at the panel. System that require off-site programming are not acceptable.

The memory data for panel configuration and operation shall reside in non-volatile, memory provided by battery backed RAM. Removal of the board shall not cause loss of memory contents.

Switches for panel setup, set reset, manual, evacuation alarm, silence and acknowledge. Individual supervisory LEDs shall be provided for power, run, alarm, trouble, disconnect, low battery and ground fault.

b. Indicating zones: As indicated on the drawings, each zone containing smoke detectors shall provide power and monitoring for up to only 50% detectors. (All hardware and software shall be provided to facilitate selection of circuit performance to provide alarm verification for smoke detector circuits with field false alarms. When a detector signals an alarm, the panel shall automatically reset the detector, wait and their double checks to verify the alarm. Each zone shall have a red LED to indicate alarm and yellow or amber LED to indicate a trouble condition.

c. Indicating Loops: 1 or 2 indicating circuits shall be provided. Each circuit shall provide power for polarized alarm signaling devices. A red LED to indicate the energized state of the circuit and a yellow LED to indicate a trouble condition shall be provided for each circuit. A disconnect switch for each circuit shall be provided to allow the FACP to be tested with sounding alarm signals. When disconnected, the FACP shall indicate both trouble condition and disconnect.

v. Manual Functions

At any time, even without an alarm condition on an indicating circuit, the operator shall provide the following manual capabilities in the FACP by means of switches located behind a key locked cover:

a. In case of fire if a general evacuation is needed all bells shall sound. These signals can be initiated from the main panel and secondary switch at manual fire alarm initiating device (break glass unit).

b. Silence the local audible signal. This shall also cause the LED(s) to cease flashing and to be continuously `ON'.

c. Silence the alarm signals.

d. Reset the FACP, after all initiating devices have been restored to normal.

e. Disconnect any individual initiating or indicating circuit from the alarm sequence. This action shall light a disconnect LED and cause a trouble condition.

f. Perform a complete operational test of the system microprocessor with a visual indication of satisfactory communication with each board.

g. Test all panel LEDs for proper operation without causing a change in the condition on any zone.

vi. System Supervision

a. Upon application of primary power, or reapplication following power failure, the FACP shall automatically be in a normal supervisory condition.

b. In the normal supervisory condition, a green "POWER" LED shall be illuminated, indicating the presence of primary power.

c. A green "RUN" LED shall be illuminated indicating that the microprocessor is communicating with the system and the memory contents are satisfactory.

d. The following shall be electrically supervised:

All initiating and indicating device circuits.

All plug-in circuit board shall have proper board type in the position. System that use electrical continuity to supervise the presence of plug boards, but that do not assure that board position have been exchanged, shall provide equivalent means for specified supervision, beyond that provided by the locked cover.

4.11 Test

Upon completion, the Contractor shall conduct a total system test where line supervision and each device shall be tested. All the tests shall demonstrate that the system meets the tests shall operating requirements of this specification, that individual conductors of all circuits are free of grounds, shorts and breaks, and that no grounds exist between any piece of equipment in the control unit and the cabinet. All final connections, testing, adjusting and calibrating shall be made under the direct supervision of a factory trained technician of the system supplier.

4.12 Installation

The Fire alarm system shall be installed as mentioned in the drawings. The system shall be connected, tested and commissioned as per manufacturer's instructions and in the presence of Engineer In-charge. The wall recessed mounting Fire alarm manual stations shall be installed at a height of 4.5' feet above finished floor level. The connections of the appropriate Contactors of the Fire alarm system shall be made as per manufacturer's instructions.

The Fire alarm system conduit shall be laid 15cms (6") from the electrical conduits and cross the electrical conduit at 90 degree only. The Fire alarm system conduit shall be marked with red color at terminations in order to distinguish it from other conduit system.

SECTION - O

CONVENTIONAL FIRE ALARM SYSTEM

1. SCOPE

The work consists of supply, installation and commissioning of all material and services of the complete Addressable Fire Alarm system as specified herein and / or shown on the Drawings and given in the Bill of Quantities.

2. STANDARDS

Following standards/codes shall be applicable:

BS 5839

NFPA 72

Any other international standard

3. OPERATION

The Fire Alarm System shall be pre-signal non-coded type complete with battery backup.

As per drawings the break glass type fire alarm stations and automatic detectors shall be installed at site. In case of any Fire, the manual station shall be operated by pulling down the handle or breaking the glass. The actuation of this station shall cause an audio as well as visual alarm at the fire alarm control and indication unit, duly indicating the location of the respective station/zone.

An authorized person shall immediately visit the affected area and if after investigating, it is deemed necessary, alarm in the whole building shall be initiated from either the alarm switch located beside the fire alarm control panel by inserting a special key or the actuation of any indication at the Main Fire Alarm Control Panel. The general alarm shall be initiated by an authorized person after inspecting the affected location.

4. MATERIAL

4.1 Wiring

Fire Alarm Cable shall be 2core, fire resistant, PVC/PVC insulated, 250/440 volts grade cable to be laid in concealed PVC conduit.

4.2 Power Supply

The supply and operating voltages shall be 220 volts, 50 c/s and 24 volts D.C. respectively. The control stations shall be provided with sufficient capacity nickel cadmium battery with charger to operate the complete system for the least 15 hours in case of mains failure. A 20 Amp SPN switch socket shall be provided near the central fire alarm panel to feed the mains supply.

4.4 Manual Call Point

It shall be re-settable (non-breaking) glass type, electronically addressed and suitable for semi finish and surface amount installation as per drawing. The break-glass manual station shall be operated by pulling down the handle. When operated, the

handle shall remain down with the pre-signal alarm contacts closed until the station is reset. The general alarm contacts shall remain open until after investigation. The general alarm switch shall be operated by an authorized person with a special key.

4.5 Fire Alarm Bell

Fire alarm (bell) shall be of red color surface mounted installed where indicated on the drawings. Sound intensity shall be such that an audible signal will be heard clearly throughout the structure when all the bell ring. The bell shall be connected in multiple cross loop conductors.

4.6 Smoke Detector

The detector shall use the light scattering principal to measure smoke density & shall send data to FACP indicating analog level of smoke density. It should be low profile design, electronically addressed, twin LED's for 360 degree vision and removable optical chamber for cleaning & maintenance. The operating voltage shall be 24V DC and surface mounted ceiling and shall include a separate twist-lock base that includes a temper proof feature.

4.7 Heat Detector

It should be low profile design with fixed temperature and rate of rise heat detection type. Electronically addressed and twin LED's for 360 degree vision. The operating voltage shall be 24V DC and surface mounted as per drawing.

4.8 Fire Alarm Sounder

It shall be of red color surface mounted installed as per drawing. It should be electronically addressed and strobe provided by high intensity LED cluster. The operating voltage shall be 24V DC.

4.9 Function of Conventional Fire Alarm Control Panel (FACP)

i. Design

The FACP shall be solid state, modular design highly reliable & functional type with integral static protection. All indicating lamps shall be long life, low maintenance solid state light emitting diodes (LED). It shall have graphically LCD display, programmable from PC built-in gas extinguishing control and integrated security alarm facilities. It should be designed to receive signals emitted by manual call points & fire detectors, producing sound & light indications. It should provide options for integration of external sound units & executive devices.

ii. Enclosure

The FACP enclosure shall be semi flush mounted. The enclosure shall be hinged from the left and the cover shall have clear windows and locking mechanism to keep the system operating and status switches from being tampered keys shall be made available to fire department and other authorized operating personnel. Finish shall be "FIRE ALARM RED" and "BLACK".

iii. Functions

The functions of conventional fire alarm systems shall be as follows:

a. Control over fire alarm lines & controllable output for fault conditions (short circuit & interruption) and automatic reset.
b. Detection of removed fire detector and automatic reset.
c. Ability to identify automatic fire detectors and manual call points.
d. LED indication for fire & fault conditions.
e. Built-in sound signalization for fire condition (one-tonal continuous) that can be switched off.
f. Built-in sound signalization for fault condition (one-tonal continuous) that can be switched off.
g. Test mode of fire alarm lines.
h. Disable of fire alarm lines.
i. Disable of output for fire condition.

iv. Components of Fire Alarm Control Panel

a. All hardware and software to allow the panel configuration and operation to be changed at the panel. System that require off-site programming are not acceptable.

The memory data for panel configuration and operation shall reside in non-volatile, memory provided by battery backed RAM. Removal of the board shall not cause loss of memory contents.

Switches for panel setup, set reset, manual, evacuation alarm, silence and acknowledge. Individual supervisory LEDs shall be provided for power, run, alarm, trouble, disconnect, low battery and ground fault.

b. Indicating zones: As indicated on the drawings, each zone containing smoke detectors shall provide power and monitoring for up to only 50% detectors. (All hardware and software shall be provided to facilitate selection of circuit performance to provide alarm verification for smoke detector circuits with field false alarms. When a detector signals an alarm, the panel shall automatically reset the detector, wait and their double checks to verify the alarm. Each zone shall have a red LED to indicate alarm and yellow or amber LED to indicate a trouble condition.

v. Manual Functions

At any time, even without an alarm condition on an indicating circuit, the operator shall provide the following manual capabilities in the FACP by means of switches located behind a key locked cover:

a. In case of fire if a general evacuation is needed all bells shall sound. These signals can be initiated from the main panel and secondary switch at manual fire alarm initiating device (break glass unit).

b. Silence the local audible signal. This shall also cause the LED(s) to cease flashing and to be continuously `ON'.

c. Silence the alarm signals.

d. Reset the FACP, after all initiating devices have been restored to normal.

e. Disconnect any individual initiating or indicating circuit from the alarm sequence. This action shall light a disconnect LED and cause a trouble condition.

f. Perform a complete operational test of the system microprocessor with a visual indication of satisfactory communication with each board.

g. Test all panel LEDs for proper operation without causing a change in the condition on any zone.

vi. System Supervision

a. Upon application of primary power, or reapplication following power failure, the FACP shall automatically be in a normal supervisory condition.

b. In the normal supervisory condition, a green "POWER" LED shall be illuminated, indicating the presence of primary power.

c. A green "RUN" LED shall be illuminated indicating that the microprocessor is communicating with the system and the memory contents are satisfactory.

d. The following shall be electrically supervised:

All initiating and indicating device circuits.

All plug-in circuit board shall have proper board type in the position. System that use electrical continuity to supervise the presence of plug boards, but that do not assure that board position have been exchanged, shall provide equivalent means for specified supervision, beyond that provided by the locked cover.

4.11 Test

Upon completion, the Contractor shall conduct a total system test where line supervision and each device shall be tested. All the tests shall demonstrate that the system meets the tests shall operating requirements of this specification, that individual conductors of all circuits are free of grounds, shorts and breaks, and that no grounds exist between any piece of equipment in the control unit and the cabinet. All final connections, testing, adjusting and calibrating shall be made under the direct supervision of a factory trained technician of the system supplier.

4.12 Installation

The Fire alarm system shall be installed as mentioned in the drawings. The system shall be connected, tested and commissioned as per manufacturer's instructions and in the presence of Engineer In-charge. The wall recessed mounting Fire alarm manual stations shall be installed at a height of 4.5' feet above finished floor level. The connections of the appropriate Contactors of the Fire alarm system shall be made as per manufacturer's instructions.

The Fire alarm system conduit shall be laid 15cms (6") from the electrical conduits and cross the electrical conduit at 90 degree only. The Fire alarm system conduit shall be marked with red color at terminations in order to distinguish it from other conduit system.

SECTION – P

CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

1. GENERAL

A. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.

B. All systems and components shall have been thoroughly tested and proven in actual use.

C. All systems and components shall be provided with the availability of a toll-free, 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge for as long as the product is installed.

D. All systems and components shall be provided with a one-day turnaround repair express and 24-hour parts replacement. The repair and parts express shall be guaranteed by the manufacturer on warranty and non warranty items.

2. GENERAL SPECIFICATIONS

Indoor/Outdoor CCTV Camera Dome System

A. The indoor/outdoor CCTV camera dome system shall be a discreet, miniature camera dome system consisting of a dome drive with a variable speed/high speed pan and tilt drive unit with continuous 360° rotation, 1/4-inch high resolution color (or monochrome or color/black-white) CCD camera, motorized zoom lens with optical and digital zoom and auto focus; and an enclosure consisting of a back box, lower dome, and a quick-install mounting.

B. The indoor/outdoor CCTV camera dome system shall meet or exceed the following design and performance specifications:

3. DOME DRIVE

A. The variable speed/high speed pan and tilt drive unit shall meet or exceed the following design and performance specifications:

1.		Pan Speed Variable between 360° per second continuous pan to 0.1° per second
2.	Vertical Tilt	Unobstructed tilt of +2° to -92°
3.	Manual Control Speed	0.1° to 80° per second, and pan at 150° per second in turbo mode. Tilt operation shall range from 0.1° to 40° per second
4.		Automatic Preset Speed Pan speed of 360° and a tilt speed of 200° per second
5.		Presets Eighty preset positions with a 20-character label available for each position; programmable camera settings, including selectable autofocus modes, iris level, LowLight™ limit, and backlight compensation, for each preset; command to copy camera settings from one preset to another; preset programming through control keyboard or through dome system on-screen menu
6.	Preset Accuracy	+/- 0.1°
7.	Proportional Pan / Tilt Speed	Speed decreases in proportion to the increasing depth of zoom

8.		Automatic Power-Up User-selectable to the mode of operation the dome will assume when power is cycled, including automatically returning to position or function occurring before power outage
9.		Zones Eight zones with up to 20-character labeling for each, with ability to blank the video in the zone
10.	Motor Drive	Cogged belt with 0.9° stepper motor
11.	Motor Operating Mode	Micro step to 0.015° steps
12.		Motor Continuous duty, variable speed, operating at 18 to 30 VAC, 24 VAC nominal
13.		Limit Stops Programmable for manual panning, auto/random scanning, and frame scanning
14.		Inner Liner Rotating black ABS liner inside sealed lower dome
15.	Alarm Inputs	Seven N.O./N.C. dry contacts
16.		Alarm Outputs One auxiliary Form C relay output and one open collector auxiliary output
17.	Alarm Output	

Programming Auxiliary outputs can be alternately programmed to operate on alarm

18. Alarm Action
Individually programmed for three priority levels, initiating a stored pattern or going to a pre-assigned preset position

19. Resume after Alarm After completion of alarm, dome returns to previous programmed state or its previous position

20. Window Blanking Eight four-sided, user-defined shapes, with each side being of different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above user-defined tilt angle; blank all video below user-defined tilt angle

21. Patterns Four user-defined programmable patterns including pan, tilt, zoom, and preset functions; pattern programming through control keyboard or through dome system on-screen menu

22. Pattern Length Four patterns of user-defined length, based on dome memory

23. Autosensing
Automatically sense and respond to protocol utilized for controlling unit whether Coaxitron® or RS-422 P or D protocols;

		accept competitors' control protocols with the use of optional translator cards
24.		Menu System Built-in for setup of programmable functions; multilingual, including English, French, Italian, Spanish, Portuguese, and German, and alternative languages in Russian, Turkish, Polish, and Czechoslovakian
25.	Auto Flip	Rotates dome 180° at bottom of tilt travel
26.		Password Protection Programmable settings with optional password protection
27.		Clear Clear individual, grouped, or all programmed settings
28.	Diagnostics	On-screen diagnostic system information
29.		Freeze Frame Freeze current scene of video during preset movement
30.		Display Setup User-definable locations of all labels and displays; user-selectable time duration of each display
31.	Zoom	Azimuth/Elevation / On-screen display of pan and tilt locations and zoom ratio

32.		Compass Display On-screen display of compass heading; user- definable compass setup
33.		Video Output Level User-selectable: normal, or high to compensate for long video wire runs
34.	Dome Drive	
	Compatibility	All dome drives are compatible with all back box configurations
35.		RJ-45 Jack Plug-in jack on dome drive for control and setup of unit and for uploading new operating code and language file updates. Compatible with personal computers and PDAs such as Palm and iPAQ
36.		Remote Data Port
	Compatibility	Ability to control and setup unit and to upload new operating code and language file updates through optional remote data port that is located in area with easy access. Compatible with personal computers and PDAs such as Palm and iPAQ
37.		UTP Compatibility Ability to plug into back box an optional board that converts video output to passive, unshielded twisted pair transmission
38.	Fiber Optic	
	Compatibility	Ability to plug into back box an optional third-party board that

converts video output and control input to fiber optic transmission

39. Third-Party Control Systems — Ability to plug in optional board that converts control signals from selected third-party controllers

40. Power Consumption — Maximum 70 VA

4. BACK BOX AND LOWER DOME

The back box and lower dome shall meet or exceed the following design and performance specifications:

A. In-Ceiling Environmental

1. Connection to Dome Drive — Quick, positive mechanical and electrical disconnect without the use of any tools

2. Trap Door — Easy-access trap door that allows complete access to the installation wiring and, when closed, provides compete separation of the wiring from the dome drive mechanics

3. Terminal Strips — Removable terminal strips with screw-type terminals for use with a wide range of wire gauge sizes

4. Auxiliary Connections — One Form-C relay output at <40 V, 2 A maximum, and

		a second open collector output at 32 VDC maximum at 150 mA
5.	Alarm Inputs	Seven alarm inputs
6.	Installation	Quick-mount spring clips
7.	Cable Entry	Through a 0.75-inch conduit hole
8.	Environmental Features	Factory-installed heaters and blowers
9.		Operating Temperatures Maximum temperature range of -60° to 140°F (-51.1° to 60°C) for two hours, and a continuous operating range of -50° to 122°F (-51.1° to 50°C) continuous operation
10.		Memory Built-in memory storage of camera and location- specific dome settings such as presets and patterns. If new dome drive is installed in back box, all settings to download automatically into new dome drive
11.	Color	Black, baked-on enamel powder coat
12.	Construction	Aluminum
13.	Lower Dome Material	Acrylic, optically clear, with no distortion in any portion of the dome up to +2° above the horizontal

14.	Dome Color	Clear and smoked versions
15.	Trim Ring Connection	Two captivated screws

B. In-Ceiling Interior

1.	Connection to Dome Drive	Quick, positive mechanical and electrical disconnect without the use of any tools
2.		Trap Door Easy-access trap door that allows complete access to the installation wiring and, when closed, provides compete separation of the wiring from the dome drive mechanics
3.		Terminal Strips Removable terminal strips with screw-type terminals for use with a wide range of wire gauge sizes
4.		Auxiliary Connections One Form-C relay output at <40 V, 2 A maximum, and a second open collector output at 32 VDC maximum at 150 mA
5.	Alarm Inputs	Seven alarm inputs
6.	Installation	Quick-mount spring clips
7.	Cable Entry	Through a 0.75-inch conduit hole

8.		Operating Temperatures Maximum temperature range of 32° to 122°F (0° to 50°C)
9.		Memory Built-in memory storage of camera and location- specific dome settings such as presets and patterns. If new dome drive is installed in back box, all settings to download automatically into new dome drive
10.		Color Black back box, baked-on enamel powder coat; white trim ring
11.	Construction	Aluminum
12.		Lower Dome Material Acrylic, optically clear, with no distortion in any portion of the dome up to +2° above the horizontal
13.	Dome Color	Clear, smoked, chrome, and gold versions
14.	Trim Ring Connection	Snaps in place
15.	Safety Cable	Plastic tether

5. DIGITAL VIDEO RECORDER

A. The digital video recorder (DVR) shall provide a high-quality recorder capable of storage and playback of images from 1 to 16 camera inputs at a simultaneous refreshing recording rate of up to 480 images per second (NTSC) at CIF resolution with a CD-RW as standard equipment. Refer to paragraph B.8. for total frame rates at 2 CIF and 4 CIF resolutions. The DVR shall possess a watchdog system, triplex

operation, Windows® 2000 operating system with Service Pack 4 with the latest security updates from Microsoft, watermarking of each frame, inputs for external alarms, video motion detection, and scheduled event recording. Remote software shall be provided for operation via PC, web, and Pocket PC handheld devices.

B. The DVR shall meet or exceed the following design and performance specifications:

PROCESSOR:

1. Processing Unit: Pentium® 4, 2.8 GHz processor with 256 MB of RAM

2. Recording Modes: Continuous, motion detection, alarm activation, or scheduled recording

3. Storage: Hard drive with 80, 250, 500, 750, or 1,000 GB of storage

4. Operating Software: Windows 2000, Service Pack 4

5. Signal Format: NTSC/PAL

6. Resolution:

NTSC 320 x 240, 640 x 240, 640 x 480, 720 x 240, or 720 x 480 pixels, depending on model

PAL 352 x 288, 704 x 288, 704 x 576, 720 x 288, or 720 x 576 pixels, depending on model

7. Compression: Pelco proprietary

Frame Rate:	NTSC	PAL
	CIF 480 ips	400 ips
	2CIF 112 ips	96 ips
	4CIF 80 ips	64 ips

8. Functions: Operate as a recorder and a full-duplex multiplexer

9. PTZ Control: Pan, tilt, and zoom functions via RS-422 communications (D, P, and Coaxitron® protocols)

10. Viewing / Recording: Configurations of full screen, 4, 9, 12, or 16 cameras, or custom-designed display views

11. Full-Triplex

Operation: Simultaneous playback and live viewing while recording live images

12. Programmable

Schedules: 24 individual schedules

13. Program Modes: Motion event, alarm input, or continuous recording

14. Hardware Watchdog

System: A hardware device to monitor the system clock for Windows lockup; upon lockup of the system the recorder shall automatically reboot without losing any of the programmed settings

15. Password Protection: Four user levels of protection for setup functions, operation, and system exiting

16. Motion Detection: Built-in motion detection for each camera to start recording or to increase the recording rate of the system

17. Motion Areas: Selectable detection area and sensitivity for each camera

18. Alarm/Motion

Activation: Alarm input will start the unit recording, or if already recording, increase the recording rate and image quality

19. Pre-Alarm or Pre-Motion

Recording: Record images for up to 60 seconds before the alarm sensor has been activated

20. Bandwidth Throttling: Network throttling of transmitted video

21. Alarm History Log: Available through a query

22. Alarm Outputs: Sixteen dry contact alarm outputs to activate external devices

23.	Motion Activation:	When a unit is in scheduled time recording and a camera detects motion or an alarm is activated, the system shall begin recording the event
24.		Remote Control: Full remote control operation of pan, tilt, and zoom functions via TCP/IP protocol and RS-422 interface
25.	LAN/WAN Connection:	Software and hardware provided for viewing and controlling DVR over the network
26.		Video Quality: High-quality video recording of at least VHS grade compared to the original video; supports NTSC or PAL video
27.	Color Palettes:	Minimum of 16 million color palettes
28.	Gray Scale:	256 shades
29.		Backup: A backup management system is to be provided to back up data to external devices (CD or other storage devices) without interrupting hard disk recording
30.	Hard Disk Drives:	From 80 GB up to 1TB
31.		Programming: On-screen programming and operation through a PC keyboard or PS/2 mouse.

32. Digital Zoom: Digital zoom of the image on the screen during playback modes

33. Authentication: Software provided for image verification of each image recorded

MECHANICAL:

Mounting: Capable of being mounted in an EIA-standard 19-inch rack or placed on a shelf or desktop Connectors:

a. Depending on model, eight or sixteen BNC video inputs plus eight or sixteen looping video outputs with automatic termination

b. Two 9-pin, D-type connectors for COM 1 and COM 2 ports (disabled)

c. Two 6-pin, mini-DIN connectors for a PS/2 mouse and keyboard

d. One 15-pin, D-type port for a PC monitor connection

e. One 25-pin D-type port for Printer connection

f. One S-video jack for analog monitor output (disabled)

g. Two multiplexed analog video outputs (optional)

h. One RJ-45 connector for network connection

i. Four RJ-45 ports for RS485/RS422 support

j. Depending on model, eight or sixteen push-in connectors for alarm inputs and eight or sixteen push-in connectors for relay outputs

k. Six high-speed USB 2.0 ports

Dimensions:

a. Desk Mount

7.0 (H) x 17 (W) x 19.9 (D) inches

(17.78 x 43.18 x 50.55 cm)

b. Rack Mount

7.0 (H) x 19.0 (W) x 22.0 (D) inches

(17.78 x 48.26 x 55.88 cm)

Operating Temperature: 50°F to 95°F (10° to 35°C)

Relative Humidity: Maximum 80% non condensing

Optical Drive: CD-RW

ELECTRICAL:

Input Voltage 100-240 VAC, 50/60Hz, auto ranging

7. GENERAL SPECIFICATIONS

A. The DSP color CCTV camera shall consist of a 1/3-inch format CCD imaging chip.

B. The DSP color CCTV camera shall meet or exceed the following design and performance specifications:

8. VARI-FOCAL LENGTH, DC-DRIVE, AUTO IRIS LENS

The lens shall be a 1/3" format, variable focal length, auto iris lens, along with any accessories that may be required for a complete lens system.

The lens shall meet or exceed the following design and performance specifications:

The lens shall be a "CS" mount.

The lens shall be used with 1/3" or smaller format cameras.

The lens shall provide DC-drive auto iris, manual zoom and manual focus adjustments.

The lens shall provide high resolution optics in a compact body.

The lens shall automatically compensate for changing light conditions utilizing DC-drive voltages from the amplifier circuitry resident in the camera.

The lens shall be equipped with a 4-pin “square” connector for auto iris functions.

SECTION – Q

PUBLIC ADDRESS/SOUND SYSTEM

1. SUMMARY

This section includes supply and installation of equipments for amplifying, distributing, and reproducing sound signals.

2. GENERAL

A complete sound system is required for project and shall consists of an amplifiers, loud speakers, microphone, outlets on walls and the necessary wiring etc. The Contractor is required to supply and install complete sound system equipment, surface/concealed P.V.C conduit wiring etc. as specified herein or otherwise required for proper functioning and on drawings, the Contractor shall submit detailed shop drawings of the sound system offered by them, for final approval and acceptance of the consultants.

3. AMPLIFIER

The amplifier shall consist of a preamplifier unit and 25 watts power amplifier. The unit shall be fully transistorized and modular type so that by sliding different components and clip-on connections are made it forms one compact unit.

The preamplifier shall have two microphones inputs and shall be suitable to drive at least two amplifiers in parallel or to feed one or more remotely located power amplifier. The preamplifiers should have besides microphone channels at least one music channel for use with record player. The preamplifier shall be completed with master tune control and volume controls as required. The external connections shall be by plugs. The hum and noise level shall be between 44 dB to 62 dB and distortion shall be less than 2% at maximum output.

It shall be suitable to operate on 220 volts 50 c/s single phase circuit. The output voltage made be of manufacturer standard (48-70V). There shall be two loudspeaker output and switching arrangement. The input and output impedance, sensitivity, distortion, hum and noise levels etc. shall be as per manufacturer’s standards keeping in view the best performance of the sound system.

4. MICROPHONE

The microphone shall be unidirectional moving coil type with frequency response range of 40 c/s to 18Kc/s. The impedance shall be 500 Ohms. The microphone shall be provided with metal stand of pleasing appearance having anti-vibration base, adopter, swivel holder, and about 3 meters of microphone cable, built-in plug and switch.

5. LOUD SPEAKERS

The loudspeakers shall be recessed mounting type, 5 watts output having impedance of about 8 Ohms. Frequency range shall be 60-15Kc/s. The loudspeaker shall be of pleasing appearance and it shall be suitable to install on the false ceiling or on the walls as required.

All accessories required for complete sound system and to suit the type of equipment offered shall be supplied and installed by the Contractor. Such accessories shall include switching device, socket outlets for microphone on wall, matching transformer, line transformer, adopter and other installation materials etc. The Contractor shall submit a complete list of accessories for the entire sound system offered by him. The price of such accessories shall be included in the BOQ.

6. WIRING

The wires for loudspeakers outlets wiring shall be twin core P.V.C insulated and screened. The size of wire shall be 2.5mm^2 minimum.

7. FUNCTIONAL DESCRIPTION OF SYSTEM

Delete functions in subparagraphs below that are not required and edit remaining descriptions to suit Project; add other functions as required.

Selectively connecting separate zones to different signal channels.

Selectively amplifying sound among various microphone outlets and other inputs.

Communicating simultaneously to all zones regardless of zone or channel switch settings.

Paging, by dialing an extension from any local telephone instrument and speaking into the telephone.

Producing a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed. Reproducing high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; and output free of non uniform coverage of amplified sound.

8. EQUIPMENT AND MATERIALS

Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

Modular equipment type using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

9. PREAMPLIFIERS

It should be either separately mounted or as an integral part of power amplifier.

Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.

Total Harmonic Distortion: Less than 1 percent.

Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

Input Jacks: Minimum of two. One matched for low-impedance microphone; the other match able to cassette deck, CD player, or radio tuner signals without external adapters.

Minimum Noise Level: Minus 55 dB below rated output.

Controls: On/off, input levels, and master gain.

10. POWER AMPLIFIERS

Mounting: Rack mounted.

Output Power: 70-W balanced line.

Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.

Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.

Output Regulation: Less than 2 dB from full to no load.

Controls: On/off, input levels, and low-cut filter.

Input Sensitivity: Matched to preamplifier and providing full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

11. COMPONENTS

Parameters listed in this Article are typical values. Performance and product characteristics vary among manufacturers. Revise to suit Project.

Microphone:

Type: Dynamic, with cardioids polar or unidirectional characteristic.

Impedance: 150 ohms.

Frequency Response: Uniform, 50 to 14,000 Hz.

Output Level: Minus 58 dB minimum.

Finish: Satin chrome.

Cable: C25J.

Mounting: Desk stand with integral-locking, press-to-talk switch.

Quantity of Microphones: [Four] <Insert number>.

Quantity of Desk Stands: [Three] <Insert number>.

Equipment Rack: For house amplifiers and auxiliary equipment racks should be 19 inches.

Group items of same function together, either vertically or side by side, and arrange controls symmetrically.

Power-Supply Connections: Approved plugs and receptacles.

Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.

Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.

Enclosure Panels: Ventilated rear and sides and solid top. Use louvers in panels to ensure adequate ventilation.

Finish: Uniform, baked-enamel factory finish over rust-inhibiting primer.

Power-Control Panel: On front of equipment housing, with master power on/off switch and pilot light; and with socket for 5-A cartridge fuse for rack equipment power.

Service Light: At top rear of rack with an adjacent control switch.

Vertical Plug Strip: Grounded receptacles, 12 inches (300 mm) o.c. the full height of rack, to supply rack-mounted equipment.

Maintenance Receptacles: Duplex convenience outlets supplied independent of vertical plug strip and located in front and bottom rear of rack.

Spare Capacity: [20] <Insert value> percent spare space capacity in rack for future equipment.

Coordinate paragraph and subparagraphs below with Drawings.

Cone-Type Loudspeakers: Comply with TIA/EIA SE-103.

Minimum Axial Sensitivity: Pressure rating of 45 dB.

Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.

Size: 8-inches (200 mm) with 1-inch voice coil and minimum 140grams ceramic magnet.

Minimum Dispersion Angle: 100 degrees.

Rated Output Level: 10 W.

Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.

Surface-Mounting Units: Ceiling, wall, or pendant mounting, as indicated, in steel back boxes, acoustically dampened. Front face of at least 1.2mm steel and whole assembly rust proofed and shop primed for field painting.

Revise finish description below to suit aesthetic requirements.

Flush-Ceiling-Mounting Units: In steel back boxes, acoustically dampened. Metal ceiling grille with white baked enamel.

Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.

Conductors and Cables: Jacketed, twisted pair and twisted multi-pair, un-tinned solid copper.

Insulation for Wire in Conduit: Thermoplastic, not less than 0.8mm thick.

Microphone Cables: Neoprene jacketed, not less than 0.8mm thick, over shield with filled interstices. Shield No. 34 AWG tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.

Plenum Cable: Listed and labeled for plenum installation.

12. EXECUTION INSTALLATION

Wiring Method

Install wiring in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces including plenum ceilings. Conceal cables and raceways except in unfinished spaces.

Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings so designed and installed to avoid damage to cables. Secure cable at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, or fittings.

Wiring within Enclosures

Bundle, lace, and train conductors to terminal points with no excess use lacing bars in cabinets.

Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.

Separation of Wires

Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

Splices, Taps, and Terminations

Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

Identification of Conductors and Cables

Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

Wall-Mounting Outlets: Flush mounted.

Floor-Mounting Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.

Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

13. EARTHING

Revise this Article to suit system requirements. Include earthing electrodes for special applications only.

Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment earthing.

14. FIELD QUALITY CONTROL

Perform the following field tests and inspections and prepare test reports:

Schedule tests with at least seven days' advance notice of test performance.

After installing public address and music equipment and after electrical circuitry has been energized, test for compliance with requirements.

Operational Test

Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.

Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:

Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.

Repeat test for each separately controlled zone of loudspeakers.

Minimum acceptance ratio is 50 dB.

Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.

Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. Retesting: Correct deficiencies, revising tap settings of speaker-line matching transformers where necessary to optimize volume and uniformity of sound levels, and retest. Prepare a written record of tests.

Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

15. ADJUSTING

On-Site engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

16. DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain public address and music equipment.

SECTION – R

NURSE CALL SYSTEM

1. SUMMARY

This Section includes visual nurse call equipment using lamp and electronic tone annunciation at a central annunciator station to register calls from patient and other call-in stations.

Paragraph below specifies microprocessor-based audiovisual/voice equipment.

This Section includes audiovisual equipment using voice communications and microprocessor control. All stations in an area are connected to a master station. Master stations are capable of communicating selectively with each other and with connected patient and other stations.

2. SUBMITTALS

Delete items in this Article not required for Project.

Product Data: For each type of product indicated.

Shop Drawings: Detail the system including the following:

Delete inapplicable subparagraphs below.

Cabling Diagrams: Single-line block diagrams showing cabling interconnection of all components for this specific equipment. Include cable type for each interconnection.

Wiring Diagrams: Power, signal, and control wiring.

Station Installation Details: For built-in equipment; dimensioned and to scale.

Equipment Cabinet Drawings: Dimensioned and to scale.

Delete first paragraph below unless Project includes special patient equipment listed.

Coordination Drawings: Detail system components that fit, match, and line up with provisions made in equipment specified in other Sections or in separate contracts:

Delete equipment below not in Project or not applicable to Coordination Drawings.

Patient head-wall units.

Patient consoles.

Patient beds with built-in nurse call features.

Manufacturer Certificates: Signed by manufacturers certifying that nurse call equipment complies with requirements.

Field Tests Reports and Observations: Include record of final adjustments certified by Installer.

Operation and Maintenance Data: For nurse call equipment to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 "[Closeout Procedures] [Operation and Maintenance Data]," include the following:

Operating instructions.

Troubleshooting guide.

Wiring diagrams and terminal identification.

Equipment parts list.

Product data for types and sizes of wires and cables used.

Warranty: Special warranty specified in this Section.

3. QUALITY ASSURANCE

Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

Manufacturer Qualifications: A firm experienced in manufacturing equipment similar to that indicated for this Project and that maintains technical support services capable of providing user with training, parts, and emergency maintenance and repair with a 24-hour-maximum response time.

Source Limitations: Obtain nurse call equipment components through one source from a single manufacturer.

Electrical Components, Devices, and Accessories: Listed and labeled according to UL 1069 as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

4. COORDINATION

Retain paragraph below if patient control units operate items not part of nurse call equipment.

Coordinate patient control units with items controlled that are not part of nurse call equipment.

Delete inapplicable subparagraphs below.

TV: Channel selection and volume.

Lights: Up light and down light at patient location.

Delete paragraph and subparagraphs below if nurse call equipment is not built into equipment or cabinets.

Coordinate wiring paths and maintenance access at locations listed below. Coordinate trim features and finishes at these locations to present a unified design appearance.

Delete equipment below not in Project. Add others to suit Project.

Patient head-wall units.

Patient consoles.

Patient beds with built-in nurse call features.

Nurse station.

5. WARRANTY

When warranties are required, verify with Owner's counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 1 Section "Product Requirements."

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace batteries that fail in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.

Warranty Period: Include the following warranty periods, from date of Substantial Completion:

Retain subparagraph and associated subparagraphs below to match battery type specified in Part 2. Verify availability of warranties with manufacturer.

Nickel-Cadmium, Wet-Cell Batteries:

Full Warranty: [Five] <Insert number> years.

Pro Rata: [15] <Insert number> years.

6. EXTRA MATERIALS

Extra materials may not be allowed for publicly funded projects.

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Revise subparagraph below to suit Project.

Lamps: For corridor dome lights and zone lights equal to [20] <Insert number> percent of amount installed.

Fuses: One for every 10 of each type and rating, but no fewer than <Insert quantity> of each.

Printed Circuit Boards: Each kind, equal to [10] <Insert number> percent of amount installed, but no fewer than one unit.

Retain subparagraph below for audio/visual system only.

Master Station Privacy Handset: [One] <Insert number>.

7. SYSTEM REQUIREMENTS

Coordinate the features of materials and equipment to form an integrated system. Match components and interconnections for optimum performance of specified functions.

Revise percentage in paragraph below to suit Project.

Expansion Capability: Equipment ratings, housing volume, spare keys, switches, relays, annunciator modules, terminals, and cable conductor quantities adequate to increase the number of stations in the future by 25 percent above those indicated without adding internal or external components or main trunk cable conductors.

Delete first paragraph below if equipment does not connect with an existing system. Add descriptions of specific operational sequences that must be achieved.

Existing System Compatibility: Functionally and electrically compatible with existing system so components and wiring operate as an extension of the existing system and all functional performance of the existing system applies to the final system. Colors, tones, types, and durations of signal manifestation are common between new and existing systems.

Resistance to Electrostatic Discharge: System, components, and cabling, and the selection, arrangement, and connection of materials and circuits, shall be protected against damage or diminished performance when subjected to electrostatic discharges of up to 25,000 V in an environment with a relative humidity of 20 percent or less.

Equipment: Solid state, modular.

Connection method in paragraph below is optional for some manufacturers.

Wall-Mounted Component Connection Method: Components connect to system wiring in back boxes with factory-wired plug connectors.

8. FUNCTIONAL PERFORMANCE

Retain and edit this Article for visual/tone equipment.

Patient Station Call: Lights a steady call-placed lamp on the station, steady lamps in the zone light and corridor dome light associated with the patient's room, and steady lamps at the central annunciator and master, staff, and duty stations. At the same time, it sounds a distinctive tone at intervals, at the central annunciator and master, staff, and duty stations. Legends at the central annunciator and master station identify the calling station.

Pull-Cord Station Call: Flashes a call-placed lamp on the station and distinctive-color lamps in the zone light and corridor dome light and at the central annunciator and staff and duty stations. At the same time, it sounds a distinctive tone at intervals, at the central annunciator and master, staff, and duty stations. A legend at the master station identifies the calling station.

Emergency-Call Station Call: Produces the same responses as pull-cord station calls, except flashing and tone repetition rates are more frequent, tone frequency is higher, and lamps in the zone light and corridor dome light are a different color. Indicator lamps may be extinguished and the system reset only at the calling station.

System Reset: Operating reset button at the originating station cancels signals associated with the call.

Cord-Set Removal: A patient station call is initiated when the cord set is removed from the jack in the patient station faceplate. Inserting a cord-set plug or a dummy plug into the jack and operating the station reset button reset the call.

Patient Control Unit: Controls entertainment volume and channel selection. Nurse button on the unit initiates a patient station call. Integral speaker reproduces entertainment sound.

9. FUNCTIONAL PERFORMANCE

Retain and edit this Article for basic audiovisual/voice equipment.

Station Selection: Master station is capable of selectively communicating with other stations or groups of stations on its system by operating selector switches.

Master Station Privacy: Capable of conversing with individual stations in complete privacy.

Hands Free: Called station is capable of conversing hands free.

Annunciation: At the master station, a tone announces an incoming call and an annunciator light or liquid-crystal display identifies the calling station and indicates the priority of the call. Memory lamps or lighted displays identify stations selected for outgoing calls.

System Reset at Master Station: A normal incoming call is canceled, associated lights and audible tones are extinguished, and the system is reset when the station switch is returned to the normal position after responding to a call.

Patient Station Call: Lights the call-placed lamp at patient station, zone, and corridor dome lights. It sounds a tone and lights the call lights at staff/duty stations and actuates annunciation at the master station. When the calling station is selected at the master station, the patient can converse with the master station without moving and without raising or directing the voice. During voice communications, entertainment audio at the calling station is automatically muted.

Pull-Cord Call Station and Emergency-Call Station Call: Lights call-placed lamp and corridor dome light, and flashes zone light. Master station tone pulses and annunciator light for that room flashes. When master station acknowledges the call by operating a switch, the tone stops but lights continue to flash until the call is canceled at the point of origin.

Code Blue, Staff, and Duty Station Call: Lights the call-placed lamp at the station and actuates annunciation at the master station. When the called station is selected at the master station, the caller and the master station operator can converse.

Code Blue: Unique sound and light pattern, indicating the highest priority emergency.

Staff Station: Unique sound and light pattern, indicating an emergency.

Duty Station: Sound and light pattern, indicating a call to the nurse station.

Handset Operation: Lifting handset on master station disconnects speaker microphone and transfers conversation to the handset.

Station Privacy: No patient, staff, or duty station can be remotely monitored without the lighting of a warning lamp at the monitored station.

Patient Station Cord Set: When a patient station cord-set plug is removed from the jack in the station faceplate, a patient station call is initiated as described above. When the master station call button for the station is pressed, the tone stops but lights continue to flash until the call is canceled at the point of origin or the plug is reinserted or replaced with a dummy plug.

Patient Control Unit: Controls entertainment volume and channel selection. Speaker is used for both nurse communication and entertainment sound. Entertainment sound is automatically muted when station is communicating with master station. Nurse button on the unit initiates a patient station call.

Three paragraphs below specify optional functions provided in some higher-budget audiovisual/voice equipment. Some functions may be proprietary. Coordinate with Drawings.

Selective Paging: Master station is capable of initiating a message to selected groups of stations or speakers simultaneously by using station group switches.

Staff Reminder: Master station can initiate a staff reminder that a patient requires direct staff response by operating a reminder control while in contact with the patient station. This will light a distinctive-color lamp in the corridor dome light at the patient's room and in the appropriate zone lights. Reminder calls are canceled by operating a staff reminder cancel switch in the patient's room.

Edit paragraph and subparagraphs below if one method of initiating priority signal is preferred over another.

Call Priority Indication: Call priority switch near each patient station, or integral with the master station, controls the priority status of the call transmitted by individual stations. The switch selects one of the following status levels:

Normal: No change to the normal call initiation and canceling sequence.

Emergency: Call initiation produces signals and indications identical to those of emergency-call stations. Indicator lamps are extinguished and the system is reset only at the originating station.

Priority: System response is the same for emergency status, except voice communication between the master station and the calling station is locked in from the time of call initiation until the system is reset at the originating station.

Two equipment articles below specify products specific to each of the two alternative equipment types. Retain one to select equipment type. "Miscellaneous Equipment Component Descriptions" Article that follows equipment articles includes products common to both equipment types.

10. EQUIPMENT DESCRIPTIONS

Retain and edit this Article for audiovisual/voice equipment.

Master Station: Speaker-microphone unit with operating controls.

Indicator lamps with legends or by liquid-crystal displays designate identification and priority of calling stations and called stations.

Delete first subparagraph below if call priority option is specified.

Pulse rate of incoming-call lights denotes priority of calls awaiting response.

Station Selection Controls: Switches select stations for two-way voice communications.

Signal Tones: Announce incoming calls.

Delete first subparagraph below if call priority option is specified.

Pulse rate and frequency of tone identify the highest priority call awaiting response at one time.

Volume Control: Regulates incoming-call volume.

Privacy Handset with Hook Switch: Of the type that does not require push-to-talk switch, attached to each station, unless otherwise indicated.

Delete subparagraph below if optional reminder function is not specified.

Staff Reminder Control: Initiates flashing of corresponding corridor dome lights for patients requiring service. Permits scanning equipment to indicate which patients are currently in reminder status.

Delete subparagraph below if individual select ability of patient-call priority indication is not specified or if selection of patient-call priority indication is at room station.

Call Priority Selection: Controls associated with patient station selection switches determine the priority indication displayed when a call is initiated at a patient station.

Central Equipment Cabinet: Lockable metal. Houses amplifiers, tone generators, power supplies, controls, terminal strips, and other components.

Amplifier: With fidelity and overall gain necessary to achieve the sound transmission and reproduction characteristics specified, considering interoperability with the installed speakers/microphones and wiring.

Power Output: Not less than 3 W at a total harmonic distortion not exceeding 5 percent.

Hum and Noise: 60 dB below full output with normal input open.

Volume Control: Concealed within the amplifier unit to control the volume of sound reproduced at all stations.

Protection: Circuit to prevent damage to the amplifier in case shorted or open output.

Selective Paging Amplifiers: Plug-in card mounted in central equipment cabinet; rated 15 W.

System Power Supply: For 24-V dc for operation of the call system.

Equipment Rating: Suitable for continuous operation between 32 and 120 deg F (0 and 49 deg C), from a primary line voltage between 105- to 125-V ac, 60 Hz.

Output: Regulated 24-V dc with protection against overloads. Line-to-load regulation shall not exceed 2-1/2 percent with ripple and noise remaining below the 10 mV, RMS level.

Overload Protection: Electronic fold-back circuit set to limit the volt-ampere output to less than 100 VA during overloaded or shorted output. Restore power output automatically on removal of overload without resetting circuit breakers or replacing fuses.

Power-on indicator lamp.

Surge Protective Device: Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors, with [LED indicator lights for power and protection status] <Insert accessories>.

Subparagraph and associated subparagraphs below are optional depending on applicable codes and regulations. See Evaluations in Division 16 Section "Central Battery Inverters" for discussion of battery types.

Battery Backup Unit: Sealed [nickel-cadmium, wet-cell] <Insert type> battery supplies power through an automatic switch when normal power fails, for a period of not less than [six] <Insert number> minutes at rated output.

Automatic retransfer to normal power, after a [15] <Insert number>-minute time delay.

Two-rate battery charger with an automatic trickle rate and a recharge rate.

Speaker/Microphones:

Type: Permanent-magnet, dynamic or ceramic, protected against dust and humidity.

Sound Reproduction: Sound level of 90 dB plus or minus 3 dB at a distance of 48 inches (1220 mm) on the axis without overdriving or distorting any frequencies between 300 and 3000 Hz when installed in an enclosure or in the pillow speaker.

Power Handling Capacity: Not susceptible to damage from overdriving within the range of power available from the amplifier.

Impedance Matching: Coordinated and matched to the input and output circuits of the amplifier, both for single connection and for group monitoring, to provide the sound reproduction specified. Subsystems or components shall not be combined, which could cause unacceptable distortion such as feedback between pillow speakers and un-muted room speaker/microphone combinations. This protection shall extend throughout the entire range of operation (volume control) of all components.

Single-Patient Station: Speaker microphone with 2-inch (50-mm) dynamic cone, a polarized receptacle to match the cord-set plug, monitor lamp, reset switch, and call-placed lamp; assembled under a single faceplate.

Dual-Patient Station: Speaker microphone with 2-inch (50-mm) dynamic cone, two polarized receptacles to match cord-set plugs, monitor lamp, and reset switch; assembled under a single faceplate.

Retain one of two subparagraphs below.

Single call-placed lamp serves both beds.

Dual call-placed lamps, one for each bed.

Staff and Duty Stations: Audible call-tone signal device, speaker microphone with 2-inch (50-mm) dynamic cone, monitor lamp, reset switch, routine-call lamp, emergency-call lamp, and call push button; assembled under a single faceplate.

Code Blue Station: Audible call-tone signal device, speaker microphone with 2-inch (50-mm) dynamic cone, monitor lamp, reset switch, Code Blue emergency-call lamp, and call push button; assembled under a single faceplate.

Ambulatory-Patient Station: Speaker microphone with 2-inch (50-mm) dynamic cone, monitor lamp, reset switch, call-placed lamp, and call push button; assembled under a single faceplate.

Verify adequacy of standard amplifier capacity for Project applications.

Selective Paging Speakers: 8-inch (200-mm) cone type with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet, multi-tap matching transformer, flush-mounting steel back-box, and white enamel-finished metal ceiling grille.

Delete paragraph below if optional call priority indication is not specified.

Call Priority Switch Station: Three-position, tamper-resistant priority selection switch. Positions designated by labeling "Normal," "Emergency," and "Priority."

Delete paragraph below if optional staff reminder function is not specified.

Staff Reminder Cancel Switch Station: Momentary contact.

11. MISCELLANEOUS EQUIPMENT COMPONENT DESCRIPTIONS

Retain and edit this Article for either visual or voice equipment.

Emergency-Call Station: Locking-type push button, labeled "Push to Call Help"; reset trigger to release push button and cancel call; and call-placed lamp; mounted in a single faceplate.

Pull-Cord Call Station: Water-resistant construction. Includes the following, mounted under a single faceplate:

Pull-Down Switch: Lever-locking type, labeled "Pull Down to Call Help."

Reset trigger.

Call-placed lamp.

First six paragraphs and associated subparagraphs below specify plug-in components. Coordinate types and quantities furnished with Owner. Quantities stated are examples only. Verify Owner's sterilization procedures and adjust requirements to suit Project. UL 1069 does not address sterilization.

Patient Control Unit: Equipped with plug and 96-inch- (2400-mm-) long white cord.

Ethylene oxide, sterilize-able.

Delete first subparagraph below if control of room lights is not in patient control units.

Light-Control Switch: Arranged for independent on-off control of patient's up and down light.

Integral Speaker: 2 inches (50 mm), with 0.35-oz. (9.9-g) magnet, rated 0.2 W.

Controls: Speaker volume, TV control, and nurse call.

Housing: High-impact white plastic.

Attachment: Stainless-steel bed clamp with permanently attached Mylar strap.

Quantity: 12 units for every 10 patient beds.

Call-Button Cord Set: Plug and 72-inch (1800-mm) white cord; equipped with momentary-action, call-button switch.

Ethylene oxide, sterilize-able.

Washable cord.

Palladium switch contacts in high-impact white housing with cord-set strain relief.

Attachment: Stainless-steel bed clamp with permanently attached Mylar strap.

Quantity: 3 cord sets for every 10 patient beds.

Geriatric Call-Button Cord Set: Plug and 72-inch (1800-mm) white cord; equipped with momentary-action, light-pressure switch in soft outer jacket.

Ethylene oxide, sterilize-able.

Washable cord.

Palladium switch contacts in high-impact white housing with cord-set strain relief.

Attachment: Stainless-steel bed clamp with permanently attached Mylar strap.

Quantity: 2 cord sets for every 10 patient beds.

Squeeze-Bulb Switch Cord Set: Plug and 72-inch (1800-mm) washable tube with white, washable, neoprene squeeze-bulb activator, plug-mounted, momentary contact switch.

Ethylene oxide, sterilize-able.

Attachment: Stainless-steel bed clamp with permanently attached Mylar strap.

Quantity: 2 cord sets for every 10 patient beds.

Call-Button Plug: Designed to plug into patient station cord-set receptacle. Button switches call circuit. Furnish 2 plugs for every 10 patient beds.

Dummy Plugs: Designed to plug into patient station cord-set receptacle when call-button plug or patient cord set is not used. Furnish 3 plugs for every 10 patient beds.

Indicator Lamps: Light-emitting-diode type with 20-year rated life, unless otherwise indicated.

Retain one of two paragraphs below to select material and finish for faceplate.

Station Faceplates: Type 302 stainless steel, 0.0375-inch (0.95-mm) minimum, on brushed finish. Maghine-engraved labeling identifies indicator lamps and controls.

Station Faceplates: High-impact plastic, [beige] <Insert color> color. Molded or maghine-engraved labeling identifies indicator lamps and controls.

In first paragraph below, coordinate number of lamps with functional requirements.

Corridor Dome Lights and Zone Lights: Three-lamp signal lights.

Lamps: Front replaceable without tools, low voltage with rated life of 7500 hours. Barriers are such that only one color is displayed at a time.

Lenses: Heat-resistant, shatterproof, translucent polymer that will not deform, discolor, or craze when exposed to hospital cleaning agents.

Revise colors in subparagraph below to suit Owner's preference.

Filters: Two per unit, amber and red.

Cable: Features include the following, unless otherwise indicated:

Conductors: Jacketed single and multiple twisted-pair, copper cables. Sizes and types as recommended by equipment manufacturer.

Cable for Use in Plenums: Listed and labeled for plenum installation.

Earthing Components: As specified in Division 16 Section "Earthing."

12. EXECUTION INSTALLATION

To select system wiring method, retain one of first two paragraphs below and revise to suit Project. Coordinate with Drawings.

Wiring Method: Install wiring in raceway except within consoles, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

Wiring Method: Install wiring in raceway except within consoles, desks, and counters; and except in accessible ceiling spaces and in gypsum board partitions, where cable wiring method may be used. Use UL-listed plenum cable in environmental air spaces including plenum ceilings. Conceal cable and raceway wiring except in unfinished spaces.

Install cables without damaging conductors, shield, or jacket.

Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

Pull cables without exceeding cable manufacturer's recommended pulling tensions.

Pull cables simultaneously if more than one is being installed in same raceway.

Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.

Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

Install exposed raceways and cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings designed and installed so as not to damage cables. Secure cable at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, or fittings.

Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train conductors to terminal points with no excess. Provide and use lacing bars in cabinets.

Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power-wiring runs. Run in separate raceways or, if exposed or in same enclosure, provide 12-inch (300-mm) minimum separation between conductors to speaker microphones and adjacent parallel power and telephone wiring. Provide separation as recommended by equipment manufacturer for other conductors.

Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes, terminal cabinets, and equipment enclosures. Install terminal cabinets where there are splices, taps, or terminations for eight or more conductors.

Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks if required.

Identification of Conductors and Cables: Retain color-coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams. Label stations, controls, and indications using approved consistent nomenclature.

Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

Label exposed cables at intervals not exceeding 15 feet (4.5 m).

Prepare cable administration drawings to show building floor plans with cable administration point labeling. Identify labeling convention and show labels for terminal hardware and positions, cables, stations and devices and equipment earthing conductors.

13. EXISTING SYSTEMS

Retain this Article if equipment being specified is to connect with existing sound, intercommunication, or nurse call equipment.

Examine existing systems for proper operation, compatibility with new equipment, and deficiencies. If discrepancies or impairments to successful connection and operation of interconnected equipment are found, report them and do not proceed with installation until directed. Schedule existing systems' examination so there is reasonable time to resolve problems without delaying construction.

14. EARTHING

Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other signal impairments.

Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment earthing except at connection to main building ground bus.

15. FIELD QUALITY CONTROL

Retain first paragraph below to require a factory-authorized service representative to perform, or assist Contractor with, field inspections, tests, and adjustments. Retain one of two options to suit Project; delete both to require only an inspection before field testing.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[, test, and adjust] field-assembled components and equipment installation, including connections[, and to assist in field testing]. Report results in writing.

Test Procedure: Comply with the following:

Schedule tests a minimum of seven days in advance of performance of tests.

Report: Submit a written record of test results.

Operational Test: Perform an operational system test, and demonstrate proper operations, adjustment, and sensitivity of each station. Perform tests that include originating station-to-station and all-call messages and pages at each nurse call station. Verify proper routing, volume levels, and freedom from noise and distortion. Test each available message path from each station on the system. Meet the following criteria:

Speaker Output: 90 dB plus or minus 3 dB, 300 to 3000 Hz, reference level threshold of audibility 0 dB at 0.02 milli Pascal of sound pressure.

Gain from patient's bedside station to nurse station, with distortion less than 65 dB (plus or minus 3 dB, 300 to 3000 Hz).

Signal-to-Noise Ratio: Hum and noise level at least 45 dB below full output.

Test Procedure:

Frequency Response: Determine frequency response of two transmission paths by transmitting and recording audio tones.

Signal-to-Noise Ratio: Measure the ratio of signal to noise of the complete system at normal gain settings, using the following procedure: Disconnect a speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure the ratio of signal to noise and repeat the test for four speaker microphones.

Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 300, 400, 1000, and 3000 Hz into each nurse call equipment amplifier, and measure the distortion in the amplifier output.

Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets these Specifications and complies with applicable standards. Report results in writing.

Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

16. ADJUSTING

Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sound levels and controls to suit actual occupied conditions. Provide up to [three] <Insert number> visits to Project during other-than-normal operating hours for this purpose.

17. DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel and caregiver staff to adjust, operate, and maintain nurse call equipment.

SECTION – S
SECURITY ACCESS SYSTEM - VELOCITY SYSTEM

1. GENERAL

1.1 **Section includes**

Security access system, Velocity by Hirsh Electronics, including the following:

1. Server hardware and software.
2. Application software.
3. Intrusion detection devices.
4. Security access devices.
5. Access control, relay control, and alarm monitoring controllers.

1.2 RELATED SECTIONS

A. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCES

A. NFPA 70 – National Electrical Code.

B. UL294 – Standard for Access Control Systems.

C. NFPA 72 – National Fire Alarm Code.

D. NFPA 101 - Life Safety Code.

1.4 REGULATORY REQUIREMENTS

A. System shall be UL-Listed.

1.5 EXISTING SYSTEM DESCRIPTION

A.

1.6 NEW SYSTEM DESCRIPTION

A. The Hirsch Electronics “VELOCITY Version 3.1 Security Management System shall be a modular and network capable access control and intrusion detection system. The Security Management System shall have the ability of handling corporations with multiple remote sites, controlled access with various reader technologies supported simultaneously, alarm monitoring with text and graphics based annunciation, Photo Call-Up, Photo ID Budging, DVR and CCTV switcher control that allows for easy expansion or modification of readers, inputs, and outputs. The system control at the central computer location shall be under a single software program control, shall provide full integration of all components, and shall be alterable at any time, depending upon the facility requirements. Reconfiguration shall be accomplished on-line through system programming, without hardware changes.

B. The system shall support both manual and automatic responses to alarms entering the system. Each alarm shall be capable of initiating a number of different actions, such as camera switching, activation of remote devices, email of alarm/event, text page of alarm/event, Threat Level change, and door control.

C. Access control functions shall include, validation based on time of day, day of week, holiday scheduling, automatic or manual retrieval of cardholder photographs, and access validation based on positive verification of card, card/PIN, and PIN.

D. The VELOCITY System shall interface to the CCTV matrix control system through a serial software interface, simulating alarm inputs. The CCTV system shall be programmed to respond to the alarm input, switching the appropriate camera(s) to the appropriate monitor/s and/or recording devices. All control of camera selection, position, zoom, focus, iris, pre-position, etc. shall be controlled by the CCTV system’s keyboard/joystick controls or the Velocity computer keyboard and mouse. Advanced switcher programming shall be performed through the switcher and associated keyboard or software programming interface.

E. The VELOCITY System shall interface to the DVR system through an API software interface. The DVR system shall be programmed to respond to the alarm inputs through

Velocity's Triggers/Actions Manager. In response to an alarm, the DVR shall record video as programmed, including: Pre-Alarm, Alarm Duration, Post Alarm, and Frames per second as defined for that camera. All control of position, zoom, focus, and iris shall be controlled by the DVR system's keyboard/joystick controls or the Velocity on-screen PTZ controls. Initial DVR setup and Advanced programming shall be performed through the DVR's configuration software programming interface.

F. Utilizing assigned passwords, it shall be possible to define the levels of system operation for each individual Operator. Operator Actions range from basic monitoring to full control of the system databases.

G. The system programming shall be user-friendly Windows environment (use conventional "Title Bar", "Menu Bar", "Tool Bar" and "Status Bar") and allow mouse control of key functions. The programming shall be MENU driven and include on-line "Documentation", "Help" or "Tutorial" information. The software shall utilize combo boxes for previously entered system-required data where applicable.

H. The system shall provide supervised alarm point monitoring. Upon recognition of an alarm, the system shall be capable of displaying alarm information in text format in a dedicated Alarm Viewer, real-time status in a Status Viewer, on a graphic floor plan, initiate alarm recording on a DVR, switching CCTV cameras, email an alarm notification to one or more people, and send a text page to a cell phone or display pager that are associated with the alarm point. The system shall be capable of arming or disarming alarm points both manually and automatically, by time of day, and day of week.

I. The method of communication from remote locations to the central components shall be transparent to the user.

J. After installation, the OWNER shall be able to perform hardware configuration changes as desired without the services of the MANUFACTURER.

K. Equipment repair shall be able to be accomplished on site, by module replacement, utilizing spare components.

L. All controller components shall utilize "Distributed-Processing" concepts. The distributed processing shall include the ability

to down-load operating parameters to any field panel, thus allowing the field panel to provide full operating functions independent of any other system component.

M. The system shall be capable of utilizing the existing LAN / WAN connecting the buildings or a dedicated security Ethernet network for Hirsch DIGI*TRAC Controller and Velocity Client communications. Install Hirsch SNIB2 communications interface in each controller to communicate to the controllers via 10/100 Mbps, 128 bit AES encrypted Ethernet.

N. The Controllers shall utilize Version 7.4 or later Flash downloadable CCM (Command and Control Modules) firmware.

O. Upgrade CCM Firmware in existing controllers as required.

1.7 ALTERNATES:

A. Alternate Item #1: Provide a complete photo ID Budging system, including: Pan/Tilt/Zoom camera with Synchronized Flash, Tripod, and backdrop (Hirsch Model IDCAMKIT; Ultra Magic Card RIO Printer (Hirsch IDP-MLR); Printer Rolls (Hirsch Model IDP-ML5-PR).

B. Alternate Item #2: Provide a Dual Monitor PC Card (Hirsch Model DMC) and an additional 17 inches (423 mm) Flat Panel Monitor (Hirsch Model HMS-M17FP).

C. Alternate Item #3: Provide as an option a Fault-Tolerant Server Computer, Windows Server 2003 R2 operating system, SQL Server 2005 database, 17” Flat Panel Monitor (Hirsch Model HMS-L2D-3-17FP).

1.8 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Manufacturer’s Data:
   1. Submit three (3) copies of:
      a. Product Data Sheets.
      b. Installation Instructions.
   2. Authorized Dealer Certificate and Certified Training Certificates of installers who will be working on this project.

C. Shop Drawings:

1. Submit three (3) copies and digitally in AutoCAD 14 or later format on a CD (3 copies), shop drawings, including:
    a. Layout of equipment on supplied AutoCAD drawings.
    b. Security Console elevation drawings.
    c. Field Controller equipment location wall layouts, including size requirements.
    d. Detailed wiring diagrams of Field Controllers, Door Details, and head-end devices.
    e. Load calculations of all security equipment for proper sizing of electrical provided by the customer and standby emergency generator circuits.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

F. As-Built Drawings:

1. Update Shop Drawings to create final As-Built Drawings. Submit 3 copies and digitally in AutoCAD 14 or later format on a CD (3 copies).

G. Operation Data: Include three (3) copies of the software Administrator and Operator Manuals.

H. Maintenance Data: Include maintenance and repair procedures.

1.9 QUALITY ASSURANCE

A. Manufacturer: The access control system shall be from a single-source manufacturer that specializes in intrusion detection and access control systems with a minimum of 5 years experience.

B. Installer: Company specializing in intrusion detection and access control systems with a minimum of three years experience on systems of similar size and scope. Technicians working on project must have been certified on the hardware and software used for this project.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.
4.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Owner will provide, on-site, a secure, dry, locked storage area for all equipment delivered under this scope of work.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.11 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.12 WARRANTY AND SERVICE AGREEMENT

A. All equipment, materials, and labor shall be guaranteed for a period of 24 months from the date of final acceptance by the Owner.

B. Provide any software maintenance updates or upgrades at no additional cost to the Owner for this period.

C. Perform two (2) scheduled preventative maintenance site visits per year during the warranty period.

D. Response Times – Normal business hours shall be 7 AM to 5 PM Monday through Friday. Calls for service before noon shall be responded to on-site before the end of the day. Calls after noon shall be responded to on-site by noon the following business day.

E. Provide extra costs for time outside of normal business hours if the Owner requires emergency service.

F. Submit an all-inclusive Annual Maintenance Agreement cost for years 3 and 4, including two (2) preventative maintenance sites visits per year.

G. Submit normal and after hours labor costs and typical costs for equipment for items not covered under the Warranty, like: Acts of God, vandalism, misuse.

1.13EXTRA MATERIALS

A. Provide one (1) each of the following Hirsch Electronics components to serve as system spares:
   1. SNIB2 – Secure Network Interface Board (as required).
   2. MRIB – MATCH Reader Interface Board (as required).
   3. DS47L (as required)
   4. DS47L-SPX (as required)
   5. Card Reader (as required)

PRODUCTS

1.14MANUFACTURERS

A. Acceptable Manufacturer: Hirsch Electronics; 1900-B Carnegie Ave., Santa Ana, CA 92705. ASD. Toll Free Tel: (888) 809-8880. Tel: (949) 250-8888. Fax: (949) 250-7372. Email: info@hirschelectronics.com. Web: http://www.hirschelectronics.com.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

1.15BASIC CENTRAL SYSTEM COMPONENTS

A. Security Management System: Hirsch Electronics Corporation, Velocity Security Management System, model VEL (Velocity Server plus unlimited remote clients).

B. Central Processing Unit Computer Specifications:

1. The software shall operate on a Dell or equal personal computer. The requirements for the computer, rated to the size of the system, are as follows:

C. Central Processing Unit (CPU):

1. The computer CPU shall be type Pentium 4, 2GHz/533MHz or greater.

D. Random Access Memory (RAM):

1. The computer shall have a minimum of 1GB RAM for the Server (plus 40MB per active client) and 512 MB RAM for Clients and Single User Workstation running on Windows XP Professional SP2 or Windows Vista (1GB recommended).

E. Disk Drives:

1. The computer shall have a 40 GB IDE, SATA or SCSI hard disk drive minimum, a 3.5" floppy disk drive, and CD-ROM (CD-R on the Server recommended).

F. Monitor:

1. The computer shall have a 17” Flat Panel Monitor, XGA color.

G. Mouse:

1. 2 button bus type

H. Keyboard:

1. The computer shall have a standard 101-keyboard layout and IBM-compatible.

I. Modem:

1. The modem shall be a 56K internal modem with PC Anywhere 12 Remote Control Software for the server computer. The owner will provide a dedicated voice-grade phone line at the Head-End Server location.

J. Serial Ports:

1. Provide 2 serial ports.

K. Parallel Ports:

1. Provide 1 parallel port.

L. Ethernet Port:

1. Provide 1 10/100/1000 Cat5 Ethernet port (onboard or separate card)

M. Sound Card and Speakers:

1. 1. Provide audio output (onboard or separate sound card) and speakers.

N. Operating System:

1. The VELOCITY Server computer shall operate under Windows Server 2003 SP1 or R2 and the Single User Server or Client shall operate under Windows XP Professional SP2 or Windows Vista. 32 and 64 bit versions shall be supported.

O. Database:

1. The VELOCITY Server shall have Microsoft SQL Server 2005 Express Database included and loaded with the application. The system shall optionally run on MS SQL Server 2005. 32 and 64 Bit versions shall be supported.

P. Printers: (as required for each workstation)

1. Report Printer - The computer shall have one parallel or USB printer port, and corresponding printer, Hirsch Model HMS-PLBW Laser Printer, and printer drivers for Windows XP Pro SP2.
2. Budging Printer - The computer shall have one parallel or USB printer port, and corresponding printer Hirsch ID Badge Printer, Hirsch Model IDP-MLR, and printer drivers for Windows XP Pro SP2.
3. Alarm and Event Printer - The computer shall have one parallel or USB printer port, and corresponding printer, Hirsch Model PR-1 Dot Matrix Printer, and printer drivers for Windows XP Pro SP2.

Q. UPS:

1. The UPS (Uninterruptible Power Supply) for the Server, Hirsch Model UPS-HMS, and Client, Hirsch Model UPS-HMS, shall provide for 20 minutes of continued operation in the event of an AC Power Failure.

R. Tape Drive – Internal on Server:

1. The tape drive shall be a 20/40 GB Travan, Model Hirsch HMS-TBI. Provide 12 Blank Tapes.

S. Tape Drive Software

1. The tape drive software shall be Symantec Backup Executive.

T. Communications Interface To Field Controllers Supported:
    1. RS-232.
    2. RS-485.
    3. TCP/IP.
4. Dial Up.

U. Control Panel Specifications:
    1. The control panel shall incorporate microprocessor-based, digital technology, using high speed processing for maximum reliability.

V. Distributed Intelligence:
    1. The system shall use distributed intelligence architecture, with controllers operating independently of one another.
    2. Regionalized functions for all controllers connected to an Xbox communications loop shall include: Use Count, Absentee Limit, Temporary Days, Pass back, and Input/output linking and shall not require the host to be online for processing and control.

W.Stand Alone Operation:
    1. All database information required for stand-alone operation shall be stored at the control panel level. All decision-making shall be performed at the control panel, eliminating the need for degraded mode operation.
    2. Proprietary software programs and control logic information used to coordinate and drive system hardware shall be stored in Flash Downloadable Read Only Memory.

X. XML Writer Application:
    1. The system shall support as standard sending any or all event and alarm transaction events out of a selected port in a standard XML format.
    2. A Time Zone may be defined to limit when this data is exported.
    3. Multiple XML Writers may be defined and run concurrently for different applications.

Y. MS Message Queue Application:
    1. The system shall support as standard sending any or all event and alarm transaction events in a standard XML format to a Microsoft Message Queue.

2. A Time Zone may be defined to limit when this data is sent to the queue.
3. Multiple MS Message Queues may be defined and run concurrently for different applications.

1.16SYSTEM CONFIGURATION

A. The head-end shall support one (1) Server Computer that may optionally be used as a full functioning Client. The system shall support unlimited remote Client computers will full system functionality. The unlimited client capability will be inherent to the software and will not require additional licensing by the manufacturer.

B. The server software shall support Cold Redundant, Warm Redundant, Hot Redundant, and Clustered server environments.

C. During installation, support for a split SQL Server Database server and Application/Communications server shall be available.

D. Host Computer to Controller Communication Protocols:
1. Communications between the computer and the controller shall be accomplished by Scramble*Net Communications and shall be encrypted using a 64-bit cipher feedback method (HES - Hirsch Encryption Standard). The encryption shall be full time and not require any programming or key setting to operate.
2. The system shall utilize RS232 up to 50' for hardwired applications.
3. The system shall utilize RS485 up to 4000' (4-wire hardwired). Longer distances are allowed with a communications multiplexer / amplifier (Hirsch Model NET*MUX4), if applicable.
4. The system shall utilize TCP/IP for communicating over dedicated or shared Ethernet networks. For 10/100 Ethernet communications to the controller, install SNIB2 128 Bit AES Encrypted communications interface board in each controller.
5. All of the communications protocols shall be supported simultaneously on the system.

E.

F. Host Computer to Controller Communication Transmission Methods/Hardware:

1. Communications between the computer and the controller shall be able to use any or all of the following methods:
    a. Hardwired.
    b. Leased line modem.
    c. Fiber Optic.
    d. Microwave.
    e. RF.
    f. Ethernet 10/100.
    g. Dial-Up modem.

G. Proprietary Network Interface Hardware:

1. The controller shall be interfaced to an industry standard personal computer running proprietary software with the addition of an opto-isolated network communications interface board (Hirsch Model: SNIB). The Scramble Net Interface Board will accept RS232 or RS485 communications interface. Each board is uniquely addressable through on-board dipswitch settings and has an adjustable baud rate from 1200 – 19,200. The board shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable.
2. Optionally, the enhanced SNIB2 communications interface board may be installed for 10/100 Ethernet, 128 Bit AES encrypted communications input to the controller. Downstream RS485 hardwired communications to controllers daisy chained off the "master" controller on any communications port can communicate up to 115 K Baud.

The SNIB2 board firmware will be Flash Downloadable to accommodate any future communication enhancements.

H. Maximum System Wide Capacities:

1. The following shall be the maximum system wide capacities. These capacities will be inherent to the software and do not require additional licensing by the manufacturer. The actual number shall be dependent upon the mix of controllers that make up the system:
    a. Doors: Unlimited.
    b. Supervised Alarm Inputs: Unlimited.
    c. Control Relays: Unlimited.
    d. Controllers: Unlimited.
    e. Users: Unlimited.

1.17SYSTEM SOFTWARE

A. General layout of the software “Windows” will include but not be limited to:

1. Main Menu Bar shall be used to access all Velocity Functions from a standard pull down menu method.
2. Tool Bar ICONS shall be used to access all common Velocity Functions with a single mouse click.
3. Customizable Graphical User Interface shall allow for configuring the screens in a variety of layouts. Layouts for each window include: Docked to the Top, Bottom, Left, and Right; Floating; Child – Minimized, Maximized, Restored. Each Operator shall have their own unique layout for available options. If dual-monitors are used, the Customizable GUI shall apply to both monitors. It shall be possible to restore factory defaults for each user with a single action.
4. Tool Tips describing the feature(s) that the selected item represent, will be displayed in small “bubbles” underneath the selected item, field caption or other component. These tool tips shall be user definable.
5. The Administration Console shall use the familiar Microsoft Explorer metaphor with a tree of folders in the left pane and details of selected folders in the right pane. The left pane shall include the following main components: Main Administration Console, Velocity Configuration, DIGI*TRAC Configuration, and Interface Configuration.
    a. The Main Administration Console shall include:
        1) Alarm Viewer.
        2) Badge and Graphics Designer.
        3) Customization Manager.
        4) Enrollment Manager.
        5) Event Viewer.
        6) Graphics.
        7) Report Manager.
        8) Status Viewer.
        9) SQL Manager.
        10) Velocity Scheduling Agent
        11) Video Explorer.
        12) Who’s Inside
        13) CCTV Camera Viewer.

b. The Velocity Configuration Module shall include:
   1) Person Templates
   2) Credential Templates.
   3) Time Zones.
   4) Holidays.
   5) Door Groups.
   6) Function Groups.
   7) Operators.
   8) Roles
   9) Command Sets.
   10) Workstations.
   11) Alarm Responses

c. The DIGI*TRAC Configuration Module shall contain:
   1) Add either an S*NET, X*NET, or Dial-Up communications port, either serial or TCP/IP.
   2) Add XBOX
   3) Add DIGI*TRAC Controller.
   4) Import New Controller
   5) Add Dial-Up Location and Modem Pool Settings.
   6) Doors, Readers, Inputs, Outputs, Expansion Inputs, Expansion Outputs.

d. The Interface Configuration Module shall define the parameters for communicating to a CCTV switcher, Serial Port Redirector, Email Notification of Alarms, Message Queue writers, Central Station Interfaces (optional and sold separately) and DVR integration.

6. Dialog Boxes will provide a means for entering information into fields and displaying information from the System Software database.

B. Workstation Customization:

1. Each Operator may customize the Graphical User Interface display location and size of the software components. After Logging Off and then Logging In again, the User Interface will display the software components exactly as the Operator left them when they Logged Off.
2. Alarm Viewer will bring the “Alarm Viewer Window” forward on new alarm(s) while you are in other Velocity windows.

C.

D. Time Zones:

1. Time Zones define periods during which readers, cards, codes, alarm inputs, doors or other system features are active or inactive. Basic configuration parameters shall “ask” the Operator to define “when” the user is enabling (or disabling) a specific feature. In addition to Monday-Sunday, there shall be one day of the week called Holiday. When selected, there will be 4 Holiday Schedules that determine if the Holiday is to be followed for this Time Zone. There shall be 64 Standard Time Zones, 64 Master Time Zones, and 20 Grand Master Time Zones.

E. Holidays:

1. Holidays are used within the system for the purpose of defining if a Time Zone is to be followed on a defined Holiday. Each Time Zone has up to 4 Holiday schedules. There are 366 user definable Holidays this year and 366 days next year. It shall be possible for the Operator to “Make the rest of Today a Holiday”. Holidays shall be selected from a calendar, including the ability to select multiple days.

F. Door Groups:

1. Door Groups shall allow the user to establish groups of readers, each with its own unique Time Zone, at a facility for the purpose of granting or denying access to Credentials. Door Groups are assigned to Credential Templates, and people being added to the system take on the Door Group of the Credential Template selected during the enrollment process. A new Door Group may be defined when adding a Credential or Credential Template without having to exit and re-enter the Credential function for that Person.
2. The Door Group application shall allow the user to view any existing Door Group listed in the dialog box. A user, with proper authority, shall be able to modify, add, or delete a Door Group from the System Software.
3. More than one Door Group may be added to a Credential as long as there is no overlap of a

controller in a door group already added to the Credential.

4. Door Groups may be combined into Master Door Groups, which can then be added to a Credential.

G. Function Groups:

1. Credentials can be assigned to perform a single User Function, like Momentary Access, or multiple functions like Momentary Access in one controller and Control Trigger Function in a relay controller for Elevator Access. When multiple User Functions are required by a Person, a Function Group may be defined and associated with one or more credentials. The Function Group requires a Scramble Pad keypad to be used, where the Person's base Credential PIN number is entered, followed by an * (Asterisk), followed by a one or two digit Extension digit, which defines which User Function will be issued for which Control Zone. This allows for a single person to perform multiple User Functions like: Unlock Door, Relock Door, Change Threat Level, Mask Alarm Inputs, Lock Down Doors.

H. Credential Templates:

1. A Credential Template can be used when adding Credentials to people. The Credential will take on the properties of the Credential Template selected. This will minimize the number of keystrokes and time required to add a Credential to a person. The Credential Template properties include: Credential Name; Badge Template; Activation and Expiration Date and Time; ID Format; Card Type; Code Length; Duress Digit; Credential Function and Category; Door Group, Multiple Door Groups, or Function Group; Threat Authority; 2 Person Rule options; Use Count, Day Limit, and Absentee Limits; Apply Credential Management Globally; Tag, Alert, Disable Credential; Issue Number; Status; Executive Override for Pass back; Special Needs Access Extension.

Credential Templates may be linked, whereby any User Credentials that are added with a Linked Credential Template can be group edited by editing the definition of the Linked Credential Template. A User's credential may be unlinked and customized or it can be linked to another Credential Template.

I. Command Sets:

1. A Command Set defines an action or actions to be sent to a controller or controllers. Command Sets can include: Unlock and Relock a Door; Lock Down and Release a Lock Down on one or more doors; make the rest of today a Holiday; Mask all Interior Alarm Points; change the facility Threat Level; Forgive All Pass back. Once defined, a Command Set can be executed from the Command Set Window, or from a Graphic Floor plan ICON, if defined. There shall be an unlimited number of Command Sets available to be defined. Command sets shall be defined with pick lists and shall be restrict able by Operator Group and Workstation.

J. Roles

1. Each Operator is assigned one or more Roles that defines at each authorized workstation, what that Operator is allowed to see and do, including:
   a. Add-Ins
   b. Application Permissions
   c. Cameras
   d. Command Sets
   e. Credential Templates
   f. DIGI*TRAC Hardware
   g. Door Groups
   h. Event Viewer Filters
   i. Function Groups
   j. Graphics
   k. Person Groups
   l. Person Templates
   m. Reports
   n. Status Viewer Groups
   o. Video Explorer Groups

2. Alarm and Event Routing can be defined by Operator Role. Specific alarms and events can be routed by Time Zone to Operators to allow for only those Operators needing to see certain alarms and events can see them.

K. Operator:

1. Operators entered into the system shall take on the properties of the Role/s to which they are assigned. If the Operator is already defined in the Operating System, the “Find” feature can be used to select this Operator for use in Velocity.

L. Velocity Scheduling Agent

1. There shall be a Velocity Scheduling Agent that allows functions to be performed on an as needed basis, like activating and deactivating credentials. It can also schedule Tasks like: Synchronize Controller Clocks; Run Historical Log Archiver; Print Reports; Email Reports; Import/Export User Data; Execute third party applications; Dial-Up remote sites; Perform Database Maintenance (backups), and Run Command Sets on a Daily, Weekly, Monthly basis.

M. SQL Database Manager:

1. The SQL Database Manager shall launch SQL Server Management Studio Express for manual backups and restoration of backups when running SQL Server 2005 Express.

N. Diagnostic Window:

1. There shall be a Diagnostic Window available to aid in system diagnostics / troubleshooting. Once a Controller is selected, the Standard Setup and Status diagnostic commands may be selected from a drop down list and sent to the selected controller. The response from the controller is displayed in the Diagnostic Window, and may be viewed, copied to the clipboard, a Report created and printed or saved to a file.
2. In addition, any supported DIGI*TRAC Command can be sent to the selected controller.

O. Status Viewer:

1. There shall be a Status Viewer which displays in a spreadsheets type format, the real-time status of all or selected Doors, Readers, Inputs, Relays, Expansion Inputs, Expansion Relays, and Controllers. Devices may be grouped in to “Status Groups”, which are selectable from a drop down list. Devices may have selected information displayed. The available list includes the following:
    a. Name and Address.
    b. Status.
    c. Alarm and Acknowledged Status.
    d. Masking Status.
    e. Line Module Input Status and Type.
    f. Relay Status.
    g. Detailed relay status
    h. Controller Threat Level status

i. Revision Number.
j. Enabled Status.
k. Controller Alarm Relay, Tamper, and Battery Status.

P. Alarm Viewer:

1. The Alarm Viewer shall have 4 panes: Alarm, Acknowledged Alarms, Instructions, and Comments. At the bottom of the Main Console display are counters to indicate Active Alarms, Acknowledged Alarms, and Off Normal Conditions. Double clicking the Counter will launch the Alarm Viewer. The Alarm Viewer may also be manually launched, or automatically in the event of a new alarm occurrence. Alarm Viewer properties that may be configured include:
   a. Require Acknowledgement Before Clearing.
   b. Auto Acknowledge on RTN (Return to Normal).
   c. Require Entry of Note on Acknowledgement.
   d. Force New Note on Multiple Acknowledgements.
   e. Require Entry of Note on Clear.
   f. Force New Note on Multiple Clear.
   g. Restore Alarm Viewer on New Alarm.
   h. Specify the number of Cached Alarms to Load at Launch of Alarm Viewer.
2. Foreground, Background, Alarm, and Secure colors may be changed. In addition, the Columns of data viewed in the Alarm and Acknowledged windows may be selected and the sequence in which they will appear. The available columns include:
   a. ICON.
   b. DVR Video.
   c. Count.
   d. Controller Time.
   e. Host Time.
   f. Description.
   g. Address.
   h. Level.
   i. Alarm ID.
   j. Acknowledge Time and Acknowledged By (available for the Acknowledged Pane).
3. Tool bar ICONS shall include:
   a. Acknowledge Selected.
   b. Clear Selected.
   c. Acknowledge All.

d. Clear All.
e. Add Note.

4. Right Clicking an Alarm Event shall display a list of available options, including:
   a. Acknowledge.
   b. Clear.
   c. Acknowledge All.
   d. Clear All.
   e. Record Note.
   f. Go To Graphic.
   g. Display User Photo.
   h. Replay WAV file.
   i. DVR Alarm Video: Show Viewer and Get Recorded Alarm Video.

Q. Event Viewer:

1. The Event Viewer can display all or Filtered Transactions. Custom filers may be defined and selected, or Standard selections can be made for main categories of Event types. Column width, order, selection, and scrolling direction are user definable, as well as text and background color.
2. The number of cached events to load when launched, up to 10,000, may be defined. The Operator shall be able to scroll back in time to view events no longer seen on the screen, without the need for running a report.

R. Velocity Learning Center - An Internet Explorer like “Velocity Learning Center” page shall be available for accessing on-line help, tutorials, manuals, Known Issues, and Product Registration information.

S. Create Defect Report

1. There shall be a wizard to create a system defect report to aid in reporting issues to factory technical services personnel.

T. Customization Manager:

1. There shall be a Customization Manager that allows the Operator to define an alternate language or change the English name or label for each element of the software.
2. Audio WAV files may be defined for playback when a particular Alarm Type is active.
3. Priority Levels may be defined (1-99) for each Alarm Type.

4. Operator Instructions per Alarm Type shall be user definable.
5. Individual Alarm Points may be customized on an individual point level, where each alarm point can have a unique priority, wav file, and operator response instructions.
6. Alarm points that are customized can have an assigned “escalation” where if an operator doesn’t respond in a user defined period of time, the alarm event can be escalated to another Operator with the selected Role.

U. Report Manager:

1. The Report Manager shall allow the Operator to select from a number of pre-defined Reports. Custom Reports can be created outside the software, and added to a Custom folder, making the Custom Reports available from within the Report Manager application.
2. Once a Report is selected, the default Criteria and Sorting options may be used, or custom Criteria and Sorting options may be selected. The report criteria can be optionally displayed on the top of the report.
3. Once the report is run, it may be viewed, printed, or saved in various standard file formats.

4. Standard Reports included as standard shall include:
    a. Customization Reports:
        1) Component Resources.
        2) Customizations Report.
    b. DIGI*TRAC Configuration
        1) Controllers.
        2) Doors.
        3) Expansion Inputs.
        4) Expansion Relays.
        5) Inputs.
        6) Network Layout.
        7) Printers.
        8) Readers.
        9) Relays.
    c. History Logs:
        1) Active Alarms by Date.
        2) Alarm Log by Date.
        3) Alarm Log by Date with Comments.
        4) All Events Log.
        5) External Events Log.
        6) Internal Events Log.

7) Operator Log.
8) User Activity Log.

d. Person Information:
1) Credential Status.
2) Door Access by Person.
3) Dossier Style by Person.
4) Expired and To-Be-Expired Person Access.
5) Expired Credentials.
6) Last Access by Person.
7) Person Access and Function Group Summary.
8) Person Access and Function Group Summary with Codes and Cards.
9) Person Access by Door.
10) Person Access Summary.
11) Person Access Summary with Codes and Cards.
12) Person FG Summary with Codes and Cards.
13) Person Function Group Summary.
14) Who Is Inside Where.

e. Velocity Configuration:
1) Command Sets.
2) Door Groups.
3) Function Group Extensions.
4) Functions Groups with Users.
5) Functions with Users.
6) Holiday Schedules.
7) Holidays.
8) Master Door Groups.
9) Master Door Groups with Persons.
10) Operator Groups.
11) Operators.
12) Time Zones – Grand Master Time Zone.
13) Time Zones – Master Time Zone.
14) Time Zones – Standard Time Zone.
15) Time Zones – Standard Time Zones in Use.

V. CCTV Interface:

1. System Software shall allow the ability to define, view, monitor, and control the CCTV Matrix Control System. Simulated Alarms can be sent to the switcher, as well as Tours, Presets, select a specific camera, Grab and Store a CCTV image, and pan/tilt/zoom/iris controls for the selected camera. In

addition, one or more Triggers and Actions can be defined for each camera.

W.DVR Interface:

1. The DVR interface configuration allows a qualified Operator to add a new DVR to Velocity. Properties defined when adding a DVR include:
    a. DVR Name.
    b. DVR Description.
    c. DVR Vendor (American Dynamics: DV8000, DV16000, Intellex IP, and Ultra; and Integral Technologies DVX series currently supported).
    d. DVR I.P.
    e. I.P Port (Control).
    f. I.P. Port (Live Video).
    g. DVR Server Name.
    h. Port (Listen).
    i. Time Zone.
    j. DVR Enabled.
2. From the DVR Interface Configuration, the Operator shall be able to Search and Retrieve video from one or more cameras for a specified period of time. In addition, the Event Viewer History enables a qualified Operator to track and report events that are specific to the DVR subsystem history logs. These logs include:
    a. Active Alarms by Date.
    b. Active Alarms by Date with Comments.
    c. Alarm Log by Date.
    d. Alarm Log by Date with Comments.
    e. All Events Log by Category.
    f. All Events Log by Date.
3. The DVR interface shall allow a qualified Operator to:
    a. View Cameras.
    b. Generate a Host Alarm.
    c. Stop a Host Alarm.
    d. Get Alarm List from DVR.
    e. Search and Retrieve Recorded Video.
    f. Play Local Video.
    g. Time Synchronization.
    h. Diagnostics.
    i. View DVR Properties.
4. When Viewing cameras, the Operator may select Small, Medium, or Large display size, and select for viewing 1, 4, 9, or 16 cameras to display in the View

Window. Cameras may be selected then dragged to the window the Operator wishes to view the camera in. If the camera has Pan/Tilt/Zoom/Focus/Iris control, the Operator can open the control functions and operate the on-screen controls for the selected camera.

5. An Operator shall be able to define Triggers and Actions that allows Alarms and Events in Velocity to cause Alarm recording in the DVR through an API interface. A camera preset can be defined as well as a View Group to automatically display on alarm.
6. In Graphics, DVR Cameras and DVR recorder ICONS can be placed on floor plans and used to view the associated video from the selected camera.
7. Video can be exported from a DVR and store it on the Velocity PC, then transfer the video to other media like CD-R and CD-RW.
8. There shall be a Velocity Video Explorer application that lets a qualified Operator to view multiple cameras from multiple DVRs in a single window. Cameras can be displayed in 1, 4, 9, or 16 display views and these views can be saved as View Groups for fast and easy selection by the Operator.
9. Alarms can be sent from the DVR to Velocity. Alarms include: Motion and Video Loss. When used with MATE Behavior Watch advanced analytics, these alarms can be displayed in Velocity

X. Console Preferences:

1. The Console Preferences shall define specific settings or devices for use with Velocity. These shall include: Show Splash Screen on Startup; Access and Enable Customized Values for Components in Customization Manager; Use 24-Hour Time Format; Automatically start Velocity when computer starts; PIN and Code reuse options; Display Credential template and time to display; SQL Server and Network Connections settings; Alarm Options for Stacking, Make Note requirements, repeat Multimedia until Acknowledged, and Alarm Queuing options; Report, Budging, and Alarm/Event Printer properties; CCTV Properties.

Y. DIGI*TRAC Configuration:

1. This function shall contain the required definition of the hardware components of the system. The

database files shall be based on the hierarchy of the system hardware as it is physically installed in the field.

a. The system shall have the ability to export controller configurations in an XML format for later use on this or other systems.
b. The system shall have the ability to import a previously exported controller configuration for ease of adding a new system.
c. The system shall have the ability to drag and drop and duplicate controllers in the hardware tree. No reprogramming of Door Groups shall be required when dragging and dropping one or more controllers in the hardware tree.

Z. Controller Properties:

1. Controller Properties shall define all General settings for the Controller. These setting will include: Name, Type, Address, Local Time Zone, Enabled Status, Firmware Revision Number and Date, Expansion Option Boards Installed and available Hardware. All additional Controller Setup Options can be defined here and are detailed in the Firmware Features section below.

AA. Controller Device Properties:

1. The Controller Device Properties shall define all connected field devices, including: Doors, Readers, Inputs, Relays, Expansion Inputs, and Expansion Relays. Device names and all operating parameters shall be definable if operation other than the included defaults is required.

BB. Graphics:

1. The Graphics application shall allow the Operator to add, delete or modify graphic floor plans and add indicator ICONs to graphic floor plans that represent Controllers, input/output points, readers, or cameras located in the facility. Formats for Graphics supported include: jpg; bmp; dxf; wmf; emf.
2. There shall be two Modes, Live and Design. The Live mode shall be used for real time monitoring. In addition, right clicking an ICON presents the Operator with a list of available Access or Control

Functions that can be issued to the device. The Design mode allows the Operator to Define which Graphics are to be used, place ICONs on the Graphics, and define properties for each ICON.

3. There shall be a Pan and Zoom Viewer that provides a key plan that can be panned and scrolled by moving the red box, which indicates the current viewing area.
4. There shall be a Directory of available Graphics to easily select the desired Graphic to display.
5. The Graphics application shall display the real-time state and condition of Alarm Points and Doors. The Door ICONs shall change from a closed door ICON to an Open door ICON, representing that the door is open. When the door is closed, a closed ICON will appear again. The Alarm ICONs shall change from a closed contact ICON to an Open contact ICON, representing that the alarm device is active. When the Alarm Device is restored to its normal condition, a closed contact ICON will appear again. The ICON will also display the Device Name and Alarm Condition that caused it to go into an Alarm condition. The Color of the ICON will also change based on whether it is in alarm or secure.
6. User definable ICONs can be created and used. Link ICONs can added to quickly link to other graphics. Command Set ICONs can be used to issue a Command Set with a single mouse click.
7. Custom Links shall be available to provide additional functionality. These links include:
    a. AXIS Camera Link – This link shall enable the Operator to launch an AXIS IP camera from any graphics page. A dedicated viewer window will open for each camera link by double clicking the link.
    b. Quick Link – This link shall enable an Operator to launch an HTML page from any graphics page. A dedicated window will display the defined HTML page when the link is double clicked.

CC. Badge and Graphics Designer:

1. The Badge and Graphics Designer shall allow the Operator to create and customize an unlimited number of Badge Templates that may be assigned to

a Person in the Enrollment Manager and create Backdrops to be used in the Graphics module.

2. An Object Toolbar shall be available for selecting Objects to appear on the Badge Template or Backdrop, including: Bit Map Logos, Photos, Fixed Text, and Database Fields. Each Object shall have a Properties box where the specific Properties of that Object are defined, including: File, database field, Font Color, Font Style, Font Size.

DD. Enrollment Manager:

1. The Enrollment Manager application shall maintain information related to a Person, and Credentials assigned to that person. Multiple Credentials per person shall be supported. New people can be added with the assistance of a Person Template to automatically enter User Defined field data and select Person Groups for this person.

2. The Personal Information pane shall include the General, 10 Additional Tabs, and a Person Group tab. The system shall be capable of defining 999 user definable fields and place them on any of the 10 Tabs. The captions of the Tabs are customizable and can be restricted by Operator. There shall be an "Additional Images" tab that can be used to store additional photos of the person, photos of relatives, and/or photos of Assets assigned to the person. These field names can be either a "Text Box", "Dropdown" where the Operator can enter text, or select from a Dropdown List, a "Dropdown List" where selecting from the List is required, Date, Number, Unique number, Auto-unique, Auto-sequential, unique text, and the Dropdown and Dropdown Lists can sort in Ascending or Descending order. Fields can be made "Required", where the Person's record cannot be saved unless data is entered in that field. Field captions can have their color changed. A Photo field shall be available for acquiring a live video image, acquire an image from a TWAIN device, or acquiring a photo from an existing file. A Record Last Updated field shall be available, as well as Preview and Print a Badge. A signature field shall also be available.

3. A Person can be placed in one or more Person Groups. An Operator's Role/s determines which Users an Operator can view.
4. Once a person is added, one or more Credentials may be added to that Person. Credentials may be added using a Credential Template, or directly without a Credential Template. The Credential will take on the properties of the Credential Template if used. There shall be a Card Enrollment Station used for entering card data into the system. PIN Numbers can either be randomly selected, or Operator/User selected. Multiple card formats shall be supported, including: multiple bit length Wiegand, ABA (magnetic stripe), and custom. Each credential can have assigned one or multiple Door Groups, Master Door Groups, or Function Groups for access and control authorization. If a new Door Group is required and not currently defined, the Operator can create a new one from within the credential management application. Additional credential properties that may be assigned include:
    a. Badge Template.
    b. Card Data.
    c. Hot Stamp Card Number.
    d. Activation Date/Time.
    e. Expiration Date/Time.
    f. PIN Length.
    g. PIN Number.
    h. Duress Digit.
    i. Day/Use/Absentee Limits.
    j. 2 Person Rule.
    k. Threat Authority.
    l. Tag.
    m. Alert.
    n. Disable.
    o. Pass back Executive Override.
    p. Special Needs Access.
    q. Issue Number.

Devices may be configured to allow for scanning and automatic field data entry from a Business Card scanner, Drivers License Scanner, Passport Scanner, and PIV Smart Card Reader. Fields can be mapped to allow for proper placement of the scanned data in the correct field.

There shall be the ability in the credential management program to provide Print and Issue control for budging, where the

maximum number of times a badge can be issued and printed can be set, as well the current count listed. The reason for a badge reissue shall be logged for auditing purposes.

5. Once a Person is selected from the List, the Credential Status and information is displayed for the assigned Credentials. The information includes: IDF, ID, Function, Description, Status, Expires On, Last Access, Last Door, Tag, and Alert. An Operator may right click on a Credential, and will be presented with the following options: Tag, Alert, Disable, Forgive Pass back, Override Code Tamper, Reset Limit Count, Force Download, Unassigned, Delete, and Properties.

6. The bottom of the Enrollment Manager window shall display counters for: People, Assigned Credentials, Unassigned Credentials, and Guest Credentials.

7. Multiple User search options shall be available, including: “Find Person” query search builder; form based quick search, and Quick Find.

8. There shall be the capability to group edit multiple User’s user defined fields and Person Groups.

EE. Download Monitor:

1. The system shall display the status of all data downloads to the field controllers.

FF. Switch Operator:

1. There shall be the capability to change Operators without the need for the current Operator to Log Off the computer. The new Operator’s Velocity permissions are then used during the session to control access to Velocity functionality.

GG. Velocity Data Import/Export:

1. There shall be the capability to Import user related data into the database. This data can be in either a text file, Comma Separated Value format, or XML format. The imported data can be mapped to any of the user definable fields available within the Velocity Enrollment Manager. In addition, a User’s photo, signature, and credential info, including PIN, card number, hot stamp card number, and the

Credential and Person Templates to use when importing are available for importing.

2. There shall be the capability to Export user related data from the Velocity database. This exported data can be formatted in a text file, Comma Separated Value, or XML format. This data can be selected from any of the fields available in the Velocity Enrollment Manager.

HH. Add-Ins: The following "Add-Ins" are available to be added to Velocity by an authorized Operator.

1. Velocity Remote Desktop – The Operator shall be able to launch a terminal services session from within the Velocity shell.
2. Launch pad – The Operator shall be able to launch standard Windows applications within Velocity.

II. Software Developers Kit (SDK): The Security Management Application shall support an SDK to allow for external third party applications to interact with the Enrollment Manager Application. It shall also provide for external event and alarm monitoring and control back into the application in an XML format.

1. API – There shall be available as an option, an Application Programming Interface to allow third party applications to manage Users and Credentials in the Security Management application, including add, edit, and delete functions.
2. XML – There shall be available as an option, an XML interface to allow for the Security Management application to receive commands in an XML format, as defined by the SDK, to perform commands like: List Alarms, Acknowledge Alarms, Unlock Doors, issue Command Sets, and others, and to provide command responses in an XML format.
3. The Vendor shall have available a Professional Services Group to assist and/or provide solutions using the SDK.

1.18HARDWARE REQUIREMENTS

A. Controllers:

1. There shall be three primary types of controllers:
   a. Access control (1 Door [Hirsch Model M1N], 2 door [Hirsch Model M2N] and 8 door - [Hirsch Model M8N].

b. Alarm monitoring (16 supervised inputs - [Hirsch Model M16N]), expandable to 32 inputs.
c. Relay control (8-32 relay [Hirsch Model MSPN-8R] with the addition of REB8 relay expansion boards and (64 relay - [Hirsch Model M64N]).

B. Each controller shall have the following common features.

1. Controller Board: The controller board shall be microprocessor based, incorporating Flash ROM (firmware) downloadable from the Host Computer, RAM (User Information, System Setups, Event Transaction Buffer) and a Clock/Calendar. The ROM shall be modularly upgradeable in the field for enhancements to system features. All powered connections to the controller board shall be protected by fuses. All wiring connections to the controller board shall be to "Phoenix" type screw terminals. Each door connection shall consist of terminals for two readers, one 10 Amp rated Form C dry output relay for lock control, and one input for monitoring a status switch, a request-to-exit device, and a tamper switch. There shall be status indicator lights for active relays, as well as diagnostic indicator lights to aid in system troubleshooting. There shall be dedicated alarm output relay/s for external reporting of the following conditions: Alarm; Duress; Tamper; and Trouble.
2. Enclosure: The controller enclosure shall be a NEMA style metal cabinet designed for surface mounting. It shall have a tampered, removable hinged door with a high security key lock. It shall have conduit knockouts to allow from 1/2" to 1" EMT conduit to be used for wire entry into the cabinet.
3. Internal Power Supply: The controller shall have an internal power supply that will accept 50 Hz/ 200 - 240 VAC, or 60 Hz/100 - 120 VAC. The primary side of the power supply shall be protected with a fuse. The power supply shall provide 28 VDC power to the controller board, internal battery charger, selected card readers, and reader interface boards.
4. Standby Battery: The controller shall have an internal standby battery that is capable of running the system during AC power interruptions. It shall

be recharged by a charging circuit incorporated into the controller board.

5. Expansion Options: A maximum of five (5) expansion boards can be installed in each controller, with the exception of four (4) in the Model M64N and none in the Model 1N. A SNIB (SCRAMBLE*NET Interface Board) is included with each controller with the “N” designation in the part number and takes up one of the available expansion slots. A SNIB2 is included with each controller with the “N2” designation in the part number.
6. Alarm Inputs: The controller shall be capable of accepting up to 32 additional supervised alarm inputs, in increments of eight (8). The sensitivity of the line supervision shall be 2% AA Standard. The alarm expansion boards shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable. This option shall be limited to 16 additional supervised alarm inputs for the 16 zone alarm input controller (Model M16N) and none for the Model M1N. The alarm expansion board shall be Hirsch Model AEB8.
7. Relay Output: The two (2) access control (Model M2N and Model M8N) and one (1) alarm monitoring (Model M16N) controllers shall be capable of accepting up to 32 additional Form C, 2 Amp rated relay outputs in increments of 8. The 1 - 32 relay controller (Model MSPN-8R) shall accept up to a maximum of 24 additional Form C, 2 Amp rated relay outputs in increments of 8. The 1 - 64 relay controller (Model M64N) and the Model M1N shall not accept any additional relay outputs. These outputs shall be used for control applications other than standard door access, such as elevator floor control, local door annunciators, HVAC interface, etc. The relay expansion boards shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable. The relay expansion board shall be Hirsch Model REB8.
8. CODE/Buffer: The controller shall be capable of expanding the CODE database up to a maximum of 132,000 Users with the addition of a memory expansion board. The board shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable. The CODE/Buffer expansion board shall be Hirsch Model MEB\CB64

(64,000 Users) or the MEB\CB128 (128,000 Users). Both Expansion Boards shall expand the Buffer capacity as well as the Code record capacity. The Model M1N shall not accept any CODE/Buffer Expansion board.

9. Event Transaction Buffer: The controller shall be capable of expanding the event transaction buffer up to a maximum of 20,000 events and 2,000 alarms with the addition of a memory expansion board. The board shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable. The event transaction buffer expansion board shall be Hirsch Model MEB\BE. The Model M1N shall not accept a Buffer Expansion board.
10. Intelligent Reader Interface: The control panels shall utilize an intelligent reader interface (Hirsch MRIA or MRIB) to communicate with card readers of various types. The interface shall be microprocessor based and allow data formats including ABA magnetic stripe, Wiegand (26 to 55 bit), Proximity, Bar Code, Touch Memory, RF and Biometric. The interface shall utilize a digitizing algorithm, which will convert the card data to a unique number, thus, eliminating the need for facility codes. A single interface shall support both entrance and exit readers with keypads associated with each door. The interface shall be U.L. Listed to U.L.294. The reader interface shall be included as standard in all Scramble Pads.

1.19CONTROLLER FIRMWARE

A. General Features:

1. The software for the controller shall reside in Flash ROM (firmware) and be located on a plug removable module on the controller board to facilitate easy field upgradeability of the features. All of the necessary software for a fully functional System is located in the controller. The controller firmware shall include the following general features at a minimum and be fully supported by the VELOCITY head-end.
   a. 3 - 15 digit keypad Code's.
   b. Duress digit for keypad Code's.
   c. 150 Time Zones for access restriction and automatic event control.
   d. 128 Access Zones for access management.

e. 256 Control Zones for alarm and relay management.
f. 366 programmable holidays this year, 366 days next year. Each Holiday may be assigned to 1 – 4 Holiday Schedules.
g. Automatic daylight savings time clock adjustment.
h. 27 different functions for Code's and cards, e.g. access, unlock, re-lock, alarm mask, relay control.
i. Add user records.
j. Tag users for annunciation at host computer.
k. 4,000 Users.
l. 1500 event, 1500 alarm transaction buffer.

B. Access Control Features;

1. The controller shall include the following access control features at a minimum:
   a. Restrict access by: time of day; day of week; door; holiday.
   b. Momentary Access of door up to 8100 seconds.
   c. Extended Access for User Definable Momentary Access duration (requires Scramble Pad). Scramble Pad will display time remaining on the minute, and annunciate at the defined "Warning Time".
   d. Special Needs Time Extension to provide additional time for Momentary Access and Door Open Too Long for selected people.
   e. Unlock/Re-lock of door by CODE, card or Time Zone.
   f. Door status monitoring shall allow for: door forced monitoring; door-open-too-long monitoring; door-open-too-long while door is unlocked; auto-re-lock of door when opened or closed.
   g. Request-to-exit masks alarm and/or unlocks door.
   h. 2 person requirement by door. A user can be defined as Normal, A/B Rule A, A/B Rule B, Executive Override. Can be disabled by Time Zone.

i. 63 Pass back Zones. Can be disabled by Time Zone. A User can designated with Pass back Executive Override.
j. Use Count limits on users
k. Absentee Rule limits on users.
l. Temporary Day limits on users.
m. Occupancy Counting / Minimum & Maximum limits per Pass back Zone.
n. Dead man CODE / Timer.
o. Threat Levels – 99 Levels may be defined. Based on the Level in effect for the facility, selected readers may be disabled, dual readers in Card/Code Only During Time Zone can require dual, and selected User's Credentials can be disabled.

C. Alarm Management Features:

1. The controller shall include the following alarm management features at a minimum:
   a. Momentarily mask alarm by CODE and/or card.
   b. Mask/unmask alarm by CODE and/or card or by Time Zone.
   c. Alarm device supervised while masked.
   d. Tamper switch on alarm device monitored while masked.
   e. Tamper Input may be configured to operate as a "Latch Monitor" with the appropriate door lock hardware.
   f. Entry/Exit delay per alarm input.
   g. Alarm input triggers relays.

D. Relay Control Features:

1. The controller shall include the following relay control features at a minimum:
   a. CODE and/or card, input, or other relay triggers relays.
   b. Trigger relay/s by time zone.
   c. Relay may be normally de-energized or energized.
   d. Disable relay/s during time zone.
   e. Clear relay at end of time zone.

1.20 CARD READER/KEYPAD SPECIFICATIONS

A. Readers:

1. The controllers shall accept all of the following reader technologies concurrently: Scrambling Keypad; Mag Stripe; Wiegand; Proximity; Smart Card; Bar Code; Biometrics - Retinal Scan, Hand Geometry, Fingerprint; Radio Frequency. The readers can be used for access control, alarm management, and/or relay control and shall be capable of being used alone (keypad only, card only) or a scrambling keypad and any other reader technology may be combined to operate as a dual technology reader where two valid IDs (PIN and card) are required.

B. Scramble Pad:

1. The controller shall be capable of using scrambling keypad readers. The keypad shall incorporate the following features: Scrambling display of numbers 0 - 9 (numbers appear in different location every time it is used); +/- 4 degree horizontal and +/- 26 degree vertical viewing restriction; accept 3 - 15 digit CODEs simultaneously; be disabled for 1 minute and report CODE Tamper violation (guessing CODEs); be disabled and report Physical Tamper violation (attempt to remove keypad from mounting box); silent CODE duress; status LEDs for reporting granted, denied, and overridden transactions, AC Fail, Programming Mode active, responses to Status Request of Alarm Inputs and Relay Outputs; weather resistant; supervised by controller; and built-in diagnostics. The Scramble Pad shall include the MATCH Reader Interface functionality for connection of up to two (2) card readers. The scrambling keypad shall be the Hirsch Scramble Pad Model DS47L.
2. A version of the scrambling keypad shall be available for use in high ambient lighting conditions or where the front is subject to direct sunlight. This version shall have a +/- 26 degree horizontal and +/- 4 degree vertical viewing restriction. The high intensity display scrambling keypad shall be the Hirsch Scramble Pad Model DS47L-HI.
3. A version of the scrambling keypad shall be available with an integrated proximity card reader. Presentation of the card shall automatically auto-start the scrambling display. The scrambling keypad with integrated proximity card reader shall be the Hirsch ScrambleProx Model DS47L-SPX.

4. A version of the scrambling keypad with high intensity display shall be available with an integrated proximity card reader. Presentation of the card shall automatically auto-start the scrambling display. The scrambling keypad with integrated proximity card reader shall be the Hirsch ScrambleProx Model DS47L-SPX-HI.
5. A version of the scrambling keypad shall be available with an integrated smart card reader. Presentation of the card shall automatically auto-start the scrambling display. The scrambling keypad with integrated smart card reader shall be the Hirsch ScrambleProx Model DS47L-SS-IE.
6. A version of the scrambling keypad with high intensity display shall be available with an integrated smart card reader. Presentation of the card shall automatically auto-start the scrambling display. The scrambling keypad with integrated smart card reader shall be the Hirsch ScrambleProx Model DS47L-SS-IE-HI.

C. Mag Stripe Card Readers:
1. The controller shall be capable of using standard ABA/ISO high and low energy track 2 cards and readers. The reader shall have a wide throat to accept laminated photo ID cards. For indoor and outdoor use, the mag stripe reader requires the addition of a MRIB (MATCH Reader Interface Board) or a MRIA (MATCH Reader Interface Assembly).

D. Wiegand Card Readers:
1. The controller shall be capable of using standard Wiegand readers and cards with 26-55 Bit standard Wiegand data formats. The readers can be swipe, insert, turnstile, or key.

E. Proximity Card Readers:
1. The controller shall be capable of using proximity readers that output a standard 26-55 Bit Wiegand data format. The readers can have a short or long read range and be unidirectional or bi-directional.

F. Bar Code Reader:
1. The controller shall be capable of using Bar Code readers and cards with standard Wiegand data format output. The reader shall be swipe, black,

weather resistant, and capable of reading multiple symbols, including concealed bar codes.

G. Miscellaneous Readers:

1. The controller shall be capable of using any reader technology that outputs a standard ABA/ISO data format or a standard 26-55 Bit Wiegand data format. Readers that meet this requirement include: Radio Frequency; Biometrics - Hand Geometry, Retinal Scan, Finger Print, Voice Recognition; Smart Card, including Mifare, DESFire, and FIPS-201 compliant readers.

EXECUTION

1.21EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

1.22INSTALLATION

A. Install system in accordance with manufacturer's instructions.

B. Install wiring for detection and signal circuit conductors in conduit. Use 22 AWG minimum size conductors.

C. Make conduit and wiring connections to existing door hardware devices as required.

1.23FIELD QUALITY CONTROL

A. Test in accordance with NFPA 72 – National Fire Alarm Code

B. Test in accordance with Hirsch Electronics testing procedures for “Velocity Security Management System”.

1.24TRAINING

A. The two designated System Administrators shall attend the 4 Day Factory Velocity Class.

B. The Dealer shall coordinate with the System Administrators for two 8 hour Operator training sessions on the Operational System to be conducted on-site on the actual running system.

1.25MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services for final system checkout and acceptance testing as required.

1.26PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION – T

LIST OF APPROVED MANUFACTURER

Low Voltage Switchboards / Distribution Boards

a. Hussain & Company.
b. Zelon Engineering
c. Electrech (Pvt) Ltd.
d. YUWATECH Engineering

Circuit Breakers

a. M & G
b. TERASAKI
c. ABB

LV Cables and Wires

a. Pakistan Cables Ltd
b. AGE Cables
c. NEW AGE Cables.

PVC Conduits and Accessories

a. Galco
b. Prince

c. Jeddah

Back Boxes

a. Hussain & CO.
b. Ezzi Engineering

Switch & Socket Outlets

a. Clipsal E-Series
b. M.K Slim Line
c. Orange.

FAN & Accessories

a. Pak Fan
b. GFC Fan
c. Millat Fan

Lighting Fixtures

a. Philips
b. Zain light
c. Osram lights
d. Pierlite

Data Communication System

a. Siemens
b. Clipsal Datacom
c. 3M
d. Panduit

Telephone Cable

a. Pakistan Cables Ltd.
b. Pony Taiwan

Fire Alarm System

a. Gent (UK)
b. Zeton (UK)
c. Zeta (UK)
d. Simplex
e. Honey Well (USA)

Closed Circuit Television (CCTV) System

a. Pelco (USA)
b. Tyco
c. Samsung (Korea)

Nurse Call System

a. C - Tec UK
b. Rondish USA

Lightening Protection System

a. W.J. Furse – U.K
b. Erico – U.K

Queue Management System

a. Guardall-(Canada)

Public Address System

a. TOA
b. Bosh
c. Boss

Transformers

a. Siemens
b. PEL

Cable Tray System

a. Unique Engineering
b. Electrech (Pvt) Ltd.
c. YUWATECH Engineering

Access Control System

a. Zultec Group.

NED UNIVERSITY
OF ENGINEERING & TECHNOLOGY– KARACHI

TENDER DOCUMENTS FOR

Extension of Cowasjee Material Testing Laboratory
@
NED Main Campus

VOLUME – III

Bill of Quantities

Department of Earthquake Engineering
NED University of Engineering and Technology, Karachi-75270.

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY – KARACHI

EXTENSION OF COWASJEE MATERIAL TESTING LAB @ NED University Main Campus

SUMMARY OF COST

1.	ARCHITECTURAL, CIVIL & FINISHING WORKS	Rs.	
2.	STRUCTURAL WORKS	RS.	
3.	ELECTRICAL WORKS	RS.	
4.	AIR CONDITION WORKS	Rs.	_____
	TOTAL COST	**Rs.**	

Contractor Signature with Seal

Ned University of Engineering and Technology, Karachi-75270.

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Extension of Cowasjee Material Testing Lab

Bill of Quantity (Schedule Items)

Architectural & Civil Works

Sr. No.	PWD Schedule 2012 Ref. No.	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
01	Code -103 (Item #.01)	**EXCAVATION** Excavation for foundation trenches and drains in all kinds of soil (except gravelly and murum soil, wet silt, clay or mud conglomeration of gravel and boulders, soft, sandy or disintegrated sandy and hard rock) and back filling the excavated material in foundation, plinth or under floor including breaking clods, watering, consolidation by ramming in layers not exceeding 9 inches (229 mm) in depth to full compaction, dressing and disposal of surplus excavated stuff as directed, lead upto one chain (30.5 R.m) and lift upto 5 feet (1.52 m)	Cu.m.	156	188.96	29,477.76
02	Code-123 Item # 11 Item # 16+17+18	**Dismantling** Dismantling cement concrete block masonry work in lime or cement mortar in foundation, basement, plinth and ground floor including stacking salvaged material (serviceable) and disposing of surplus material as directed with in three chains (91.5 m). Dismantling C.C. work cast in situ in foundation, basemont, plinth and ground floor including disposing of the material as directed within three chains (91.5 m).	Cu.m. Cu.m..	8 8	349.25 931.86	2,794.00 7,454.88
03	Code-127 Item # 23	Supplying and laying for sub-base, soling coat, 4" to 3" (102mm to 76 mm) gauge stone boulders to required grade and camber including packing with spawls,chips and consolidating with power roller with all lead and lift	Cu.m.	31	1606.82	49,811.42

04	Code-106 Item #01	Providing and laying in situ 1:4:8 (1 cement 4 sand and 8 coarse aggregate) cement concrete using screened graded bajri 3/4 inch (19 mm) and down gauge in foundation, basement and plinth including form work, compacting, curing and removal of form work etc. complete, foundation and basement up to 5 feet (1.52 R,m) depth and plinth up to 4 feet (1.2 R-m) height from ground level ..	Cu.m.	3	4,399.33	13,197.99
05	Code-105 Item # 11	Providing and laying 1:3:6 (1 cement 3 sand and 6 coarse aggregate) cement concrete using graded gravel (bajri) 1 inch (25 mm) and down gauge in under floor including levelling, compacting and curing etc. complete.	Cu.m.	32	4,259.92	136,317.44
06	Code-108 Item # 09	Providing and laying 2 inches (51 mm) thick damp proof course with cement concrete 1:2:4 cast in situ using graded screened bajri of 3/4 inch (19 mm) and down gauge including compacting, curing, form work and its removal etc. complete with applying a coat of hot bitumen (maxphalt 80/100 or equivalent) using 35 Lbs. per hundred square feet (1.71 Kg/sm) on damp proof course after complete drying and cleaning the surface .	Sq.m.	13	462.75	6,015.75
07	Code-110 Item # 02 Item # 12	Providing and laying 1:3:6 cement concrete solid block masonry more than 6 inches (152 mm) thick using graded screened bajri 3/4 inch (19 mm) and down gauge set in lime cement mortar 1:1:6 in foundation, basement and plinth including scaffolding, raking out Joints and curing etc. complete; foundation and basement masonry up to 5 feet (1.52 Ru.m.) depth and plinth up to 4 feet (1.2 Ru.m.) height from ground level. Providing and laying 1:3:6 cement concrete solid block masonry 4 inch to 6 inch (102 mm to 152) thick using screened graded bajri	Cu.m.	60	4,655.89	279,353.40

		3/4 inch (19 mm) and down gauge set in lime cement mortar 1:1:6 in foundation, basement and plinth including scaffolding, raking out joints and curing etc. complete; foundation and basement masonry up to 5 feet (1.52 Ru.m.) depth and plinth up to 4 feet (1.2 Ru.m.) height from ground level.	Cu.m.	03	4,990.32	14,970.96
08	Code-117 Item # 06 Item # 07	Providing and laying floors of 2 inches (51 mm) thick 1:2:4 cement concrete using graded screened bajri 3/4 inch (19 mm) and down gauge in ground floor laid in panels including form work, consolidation, finishing, and curing etc. complete. Providing and laying floors of 3 inches (76 mm) thick 1:2:4 cement concrete using graded screened bajri 3/4 inch (19 mm) and down gauge in ground floor laid in panels including form work, consolidation, finishing and curing etc. complete.	Sq.m. Sq.m.	112 205	328.65 461.72	36,808.80 94,652.60
09	Code-119 Item # 73	Providing and fixing doubble glazed Champagne anodized aluminium Sliding windows as per British standard manufactured by Lucky, Alcop, Krudson, Pakistan Cables and A.C.P. (fixing through their approved fabricators), Executive model section dubble or single glazed 101mm x 37mm and 1.6mm thick including the cost of aluminium netting ,fitting, with all accessories cutting hole etc. and making good damages to walls etc. complete as required in any floor as per direction of engineer-in-charge, but excluding the cost of glass pans.	Sq.m.	63	7,359.45	463,645.35
10	Code-122 Item # 151 Item # 162	**<u>Ceiling</u>** Distempering with vinyle distemper (ICI) Dulux Paintex of approved make and shade in two coats over and including the cost of one priming coat of lime wash including sand papering, dusting, and filling the holes, cracks and inequalities, if any, at any height in any floor. **<u>Internal Walls</u>**	Sq.m.	550	113.40	62,370.00

	Item # 172	Painting with (ICI) Dulux plastic emulsion paint VIP of approved shade two coats over and including the cost of one priming coat complete over plastered surface at any height in any floor. **External paint** Painting three coats with weather shield paint deluxe (ICI) make of approved shade on plaster surface (External) and including the cost of cleaning the surface, sand papering etc. complete at any height in any floor.	Sq.m. Sq.m.	550 650	295.15 151.44	162,332.50 98,436.00
					Total Amount	1,517,638.84
					Add Premium	
					Gross Amount	

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Extension of Cowasjee Material Testing Lab

Bill of Quantity (Non Schedule Items)

Architectural & Civil Works

Sr. No.	PWD Schedule 2012 Ref. No.	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
11	-	**Cleaning of Site** Cleaning of site as required like removal of tree plants, pavers, disposal of garbage as directed.	Job.	01		
12	-	**Termite Proofing** Providing and applying termite control pesticide solution of termite as approved brand including foundation pits external plinth protection, under floor complete in all respect as per manufacture and specification measurement will be made on covered area bases of ground floor only.	Sq.m.	140		
13	-	**C.C PLASTER** **Internal Ceiling & Walls** Providing and applying plaster with cement sand mortar on masonry and concrete surfaces, at any height, as shown on the drawings with 8" wide G.I expended metal of 18 SWG at the interfaces of different material plaster stopper corner beds, channel for making Groves and drip course etc. where required or directed by the architect including scaffolding, hacking complete in all respect as directed by the Architect. i. Celling ½" Thick ii. Internal Walls ¾" Thick	Sq.m. Sq.m.	242 550		
14	-	**External Plaster** **i. Kacha plaster** Providing and applying ¾" thick kacha plaster on external with 1: 6 cement sand mortar complete in all respect as directed by the Architect. **ii. Fair Plaster** Providing and applying ¾" thick smooth finish pergola & grove external plaster with 1:4 cement sand mortar as directed by the Architect.	Sq.m. Sq.m.	420 650		

15	-	**HAND RAIL** **M.S Handrail for walk way (3'-0")** Fabricating & fixing of M.S railing with spray painting and 01 coat of anti-rust paint of approved brand burger / ICI at any height and floor using 2½" dia. Horizontal hollow pipe of 18 SWG, and 1½" dia. vertical Hollow pipe of 18 SWG, & ¾" square pipe pattern design. As per drawing and as directed by the Architect.	R.mtr.	37		
16	-	**M.S Rolling Wheel Door Shutter** Providing and fixing rolling wheel sliding type M.S shutters of approved make, made of required size, 16 SWG. M.S sheet laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side heavy duty wheel guides rail top and bottom and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing and M.S. including cost of 03 coat of approved brand enamel paint over coat of primer, complete in all respect as per drawing and as directed by the engineer	Sq.m.	16		
17	-	**ROOF Treatment** **Roof Screed** Providing and laying 1:2:4 Roof Screed in required slope minimum 2" thick including making ridges, valleys, chamfered and making gola, leveling, curing etc. As required directed by the Architect. **Expansion Joint** Providing and fixing G.I sheet in 20 swg. On expansion joint 35" wide bending acute angle at upper corner & obtuse angle at lower corner as per drawing and site condition fixed with steel nails 2" long with washer @ 12" c/c both side with cost of lapping at least 9" where necessary complete as per drawing both on roof parapet and on walls and as directed by the architect. One layer of local jute felt of 70 lbs/roll of 10m² including coat of primer as per manufacture's specifications and side conditions bonding coat of bitumen at 35 lbs/m² final sealing of edges etc. Complete in all respect. **Pre-Cast Rain Water Spout**	Sq.m. R.mtr. Sq.m.	140 16 148		

		Provide and fix in position pre-cast rain water spout from 1:2:4 of the required dimension, design and detail, complete with chamfers, rounding of edges drip mold, including making opening in wall etc. Complete in all respect.	Nos.	04		
18	-	**Plinth Protection** Providing and laying plinth protection complete with pudlo plaster 3'-0" wide (1:4 cement plaster finish) with cost of 6" thick block masonry in required height, cc 1:3:6, 2" thick bed, excavation, backfilling and curing etc. Complete in all respects and as directed by the Architect.	R.mtr.	12		
19	-	**Filling of Joint** Providing and laying of flexible grout filling in the construction joint 1" thick between new construction and old block in both vertical and horizontal directions where required or directed by the architect including covering the joint with stainless steel sheet cover, scaffolding, cleaning, etc complete in all respect as directed by the Architect.	R.mtr.	45	Rate Only	
					Total Amount	

Summary of Architectural Works

Total amount of schedule items (with premium) = Rs

Total amount of schedule items = Rs._____

Gross Amount = Rs.

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Extension of Cowasjee Material Testing Lab

Bill of Quantity (Schedule Items)

Structural Work

Sr. No.	PWD Schedule 2012 Ref. No.	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
01	Code-103 Item # 01	**EXCAVATION** Excavation for foundation trenches and drains in all kinds of soil (except gravelly and murum soil, wet silt, clay or mud conglomeration of gravel and boulders, soft, sandy or disintegrated sandy and hard rock) and back filling the excavated material in foundation, plinth or under floor including breaking clods, watering, consolidation by ramming in layers not exceeding 9 inches (229 mm) in depth to full compaction, dressing and disposal of surplus excavated stuff as directed, lead upto one chain (30.5 R.m) and lift upto 5 feet (1.52 m)	Cu.m.	156	188.96	29,477.76
1.1	Item # 05	Excavation for foundation trenches and drains in strata of conglomeration of gravel and boulders by hammering, chiselling and jumper work including stacking of serviceable and unserviceable materials separately, lead upto one chain (30.5 R.m) and lift upto 5 feet (1.52 m).	Cu.m.	67	851.39	57,043.13
02	Code-104 Item # 09	**EARTH FILLING** Supplying stacking and filling sand of approved quality from outside sources in foundation, trenches, plinth or under floor, etc. including dressing, watering and consolidation by ramming in layers not exceeding 9 inches (229 mm) in depth to full compaction and lift upto 5 feet (1 .52 m).	Cu.m.	120	2,210.51	265,261.20
03	Code-105 Item # 14	**Cement Concrete 1:4:8** Providing and laying 1:4:8 (1 cement 4 sand and 8 coarse aggregate) cement concrete using graded gavel (bajri) 1 inch (25 mm) and down gauge in foundation including levelling, compacting and curing etc. complete.	Cu.m.	100	3,709.82	370,982.00

04	Code-106 Item # 12	**Cement Concrete 1:3:6** Providing and laying in situ 1:3:6 (1 cement 3 sand and 6 coarse aggregate) cement concrete using crushed graded boulders 3/4 inch (19 mm) and down gauge in foundation, basement and plinth including form work, compacting, curing and removal of form work etc. complete, foundation and basement up to 5 feet (1.52 m) depth and plinth up to 4 feet (1.2 m) height from ground level.	Cu.m.	25	6358.49	158,962.25
05	Code-114 Item # 165	**REINFORCEMENT** Providing and laying mild steel plain reinforcement bars (having minimum yield strength of 36,000 psi) with and including the cost of straightening, cutting, bending, binding, wastage, and such overlaps as are not shown over the drawings, placing in position on cement concrete 1:2:4 precast or m.s. chairs, tying with binding wire, cost of chair and wires etc. in all kinds of RCC work in foundation, basement, plinth and ground floor of building including septic tank and underground tank and in projections for future extension.	Kg.	500	99.01	49,505.00
	Item #166	Providing and laying hard grade ribbed deformed (minimum yield point 60,000 psi) reinforcement bars with & including the cost of straightening, cutting, bending, binding, wastage, and such overlaps as are not shown in the drawings, placing in position on cement concrete 1:2:4 precast or m.s. chairs, tying with binding wire, cost of chairs and wires etc. in all kinds of RCC work in foundation, basement, plinth and ground floor of building including septic tanks and underground tanks and in projections for future extension .	Kg.	26000	123.02	3,198,520.00
					Total Amount	**4,129,751.34**
					Add Premium	
					Gross Amount	

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Extension of Cowasjee Material Testing Lab

Bill of Quantity (Non Schedule Items)

Structural Work

Sr. No.	PWD Schedule 2012 Ref. No.	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
06	-	P/L R. C. C. for all structural works including foundation, basement walls, columns, beams, slabs, etc. as specified using graded screened crushed stone ¾" down gauge and approved sand including form work matching with architectural details vibrating, compacting finishing and curing etc. complete as per drawingand instructions.				
		(a) 5000 psi concrete (Cylindrical)	Cu.m.	15		
		(b) 4000 psi concrete (Cylindrical)	Cu.m.	180		
07	-	P/L and fixing of 2.5 in. diameter MS steel pipein concrete slab, The work includes all grindings, finishing, red lead primer, etc. complete in all respect.	Nos.	250		
08	-	providing and laying 50mm thick c.c 1:2:4 with hardonate toping on surface complete in all respect as directed by the Engineer.	Cu.m.	06		
09	-	provide and fix monkey ladder consisting of 50mm x 15 mm MS flat to be fixed with wall through 100 mm long rowel bolts with 100x100 x5 mm MS plate every 600mm height c/c. 25 dia. MS horizontal bar @ 300mm c/c intervel. complete in all respect, as per drawing and spacification / directed by the Engineer.	Job.	01		
10	-	Providing and Fixing M.S Man Hole Cover clear size 2'-6"x2'-6" comprising of 1 1/2"x 1 1/2" x 3/16" MS angle iron outer frame and 14 swg. MS Sheet cover with 1 1/4" x 1 1/4" x 3/16" flat iron supports complete with all accessories and pint as directed by the Engineer.	No.	01		

Summary of Structural Works

Total amount of schedule items (with premium) = Rs.

Total amount of schedule items = Rs._____

Gross Amount = Rs.

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Extension of Cowasjee Material Testing Lab

Bill of Quantity (Non Schedule Items)

Electrical Works

S/ N	PWD Sch. 2012 Ref. No.	Description Of Item	UNIT.	Qty.	Rate	Amount
1	**WIRING ACCESSORIES:** All wiring shall be done with 450/750 volt Grade PVC insulated cables.					
1.1	-	Providing and wiring of the single light point with 3x1.5mm^2 Single core Cu, PVC insulated cable. Recessed in 25mm dia PVC pipe with all accessories, control by 1 gang switch, MS back box and front cover. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	30		
1.2	-	Providing and wiring of the double light point with 3x1.5mm^2 Single core Cu, PVC insulated cable. Same as item # 01. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	06		
1.3	-	Providing and wiring of the light and fan circuit with 2x4mm^2 + 1x2.5mm^2 stranded single core Cu, PVC insulated cable, recessed in 25mm dia PVC conduit with all accessories. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	08		
1.4	-	Providing and wiring of the power point 6Amp with 2x4mm^2 + 1x2.5mm^2 stranded Single core Cu, PVC insulated cable recessed in 25mm dia PVC conduit with all accessories 02 Nos., of 6Amp 3 Pin out let, MS box. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	08		
1.5	-	Providing and wiring of 15Amp power point with 2x6mm^2 + 1x2.5mm^2 stranded Single core Cu, PVC insulated cable, recessed in 25mm^2 PVC conduit with all accessories also provide 15Amp power outlet, MS back box. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	06		
1.6	-	Providing and wiring of telephone point with cat-6 cable, recessed in 25mm dia PVC conduit with all accessories, also providing and fixing RJ-11 socket 1 gang shutter, MS back box. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	04		
1.7	-	Providing and wiring of data point with cat-6 cable, recessed in 25mm dia PVC conduit with all accessories, also providing and fixing RJ-45 computer socket 1 gang shutter, MS back box. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	02		

2	**LIGHT FIXTURES, FAN & EXHAUST FAN:** Providing, installation and testing of following type of light fixture with all accessories such as electronic driver,LED Lights and holders. Complete in all respect and as per drawing and as approved by the Consultant.					
2.1	-	Providing and fixing of 8" dia surface mount flood light fixture LED Type 80W. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	08		
2.2	-	Providing and fixing of LED light fixture 04 feet long 40W/TMS-240. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	10		
2.3	-	Providing and fixing 12" dia sweep exhaust fan metallic type/polymer frame. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	04		
2.4	-	Providing and fixing of 24" sweep bracket fan plastic body with all accessories. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	08		
4	**-**	**MDB, DB, CABLING & EARTHING SYSTEM:**				
4.1	-	Providing and wiring of DB with 3x25mm^2 + 2x16mm^2 stranded single core, Cu, PVC insulated cable recessed in 1½" dia PVC conduit with all accessories, connect to MDB with Cu lugs. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Mtr.	20		
4.1	-	Providing and wiring of DB with 3x35mm^2 + 2x25mm^2 stranded single core Cu, PVC insulated cable recessed in 1½" dia PVC conduit with all accessories connect to MDB with Cu lugs. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Mtr.	15		
4.2	-	Providing and laying of 120mm^2 4 Core Cu, PVC insulated, armored PVC sheathed cable direct in the ground, including excavation, sand Cushing, Red bricks covering and refilling the trench, route marker etc, as required. However, actual cable length may be determined at site before procurement and paid at actual measurement. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Mtr.	50		
4.3	-	Providing, installation, testing & commissioning of concealed type **Distribution Board** of 18 SWG MS Sheet make. Complete with doors & front safety plate, locking arrangement, internal wiring with lugs, Cu, bus bars (earth & Neutral Terminal) painted with off-white powder coated paint having enough space. D.B will have all MCB, MCCB of **Terasaki** Malaysia make and comprising of. **Incoming:** 40A/10KA TP MCCB 01 No. Indicating Lamps LED 03 Nos. **Outgoing:** 20 A SP MCB (6KA) 04 Nos. 15 A SP MCB (6KA) 04 Nos. 10 A SP MCB (6KA) 04 Nos. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Job.	02		

4.4	-	Supply, installation, testing & commissioning of **Main Distribution Board** concealed type fabricated with 18 SWG MS Sheet housing. Complete with doors & front safety plate, locking arrangement, internal wiring with lugs, Cu bus bars, painted with off-white powder coated paint having enough space. D.B will have all MCB, MCCB of **Terasaki** Malaysia and comprising of. **Incoming:** 250A/25KA TPN MCCB COS (02 Nos.) 01 Set. TPNE Cu, bus bar 400Amp. (05 Nos.) 01 Set. Indicating Lamps (06 Nos.) 02 Set. Amp, Voltmeter, CT & Selector Switch.01 Set. **Outgoing:** 100A TP MCCB (10KA) 02 No. 80A TP MCCB (10KA) 01 No. 40A TP MCCB (05KA) 03 Nos. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Job.	01		
4.5		Providing and fixing of100A TP MCCB/10KA LED of **Terasaki** Malaysia make,including MS box with ceramic connector for neutral. Complete in all respect as per drawing and as approved by the Consultant/ Directorate of Services.	Nos.	02		
4.6		Providing Preparation, Testing & Commissioning of Electrical **Earthing System** (Less than **1Ω** rating) having copper rod (99% conductivity), of 02 meter in length and 20mm in dia, with flat head at drive end and hard conical head at driven end. 02 Nos, of brass clamps should be provided. Boring of 100mm dia and 15meter depth. 01 meter of **UPVC** pipe of 04" dia should be provided with 4"/5" **UPVC** socket at the bottom of earth chamber, Connect to Earth Terminal by 06 SWG Cu solid **HDBC** cable 20 meter with brass nut bolt and washer. Earth Terminal should be 12x50x300mm Cu, connect to MDB, with 16mm^2 single core Cu PVC insulated cable 15 meter in length. Inspection chamber of RCC (with 12"x12" G.I. cover) shall be constructed with CC plaster. Complete in all respect, such as earth compound & cable lugs etc, as per drawing, as required & approved by the Consultant/ Directorate of Services.	Job	01		
					Total Amount	

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

Extension of Cowasjee Material Testing Lab

Bill of Quantity (Non Schedule Items)

Air Conditioning Works

S. No.	PWD Sch. 2012 Ref. No.	Description of Item	Unit.	Qty.	Rate	Amount
1.	-	Providing of Split type A/C unit having loading capacity **24,000 Btus/Hr, (2Tons)**. Single phase, complete with heat exchanger, safety devices, compressor (Reciprocating / rotary) with high static pressure, wall/roof mounted. With all controls. **Mitsubishi/Kenwood (E-Sense)/Gree** Brand, Complete with installation kit including copper tubing with Insulation tape & internal wiring etc. complete with all respects as approved by the Consultant/Directorate of Services.	No.	01		
2.	-	Providing & Installation of 01no unit with 10 ft copper tubing & 10 ft of additional copper tubing, insulation, internal wiring, PVC drain pipe concealed in the wall and floor, angle brackets have duty including making cuts, holes in the wall and floor etc, and making good the same as required, sealing the holes with sealant etc. complete with all respects as approved by the Consultant/Directorate of Services.	job.	01		
3.	-	providing & fixing durra duct/UPVC channel 60x60mm of **Adamjee/ Hitachi/ KSS** Taiwan make, on copper tubing of 01 unit, complete with all respect as shown in drawing and as approved by the Consultant/ Directorate of Services.	Ft.	20		
4.	-	Providing & laying of drain line UPVC pipe 3/4" of **Pak Arab/ Dadex/ AGM** make for 01 unit on wall, joint with solution of **AGM** or **Dadex** make. Complete with all respect, as shown in drawing and as approved by the Consultant/ Directorate of Services.	Ft.	20		
					Total Amount	

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY– KARACHI

TENDER DOCUMENTS FOR

Extension of Cowasjee Material Testing Laboratory

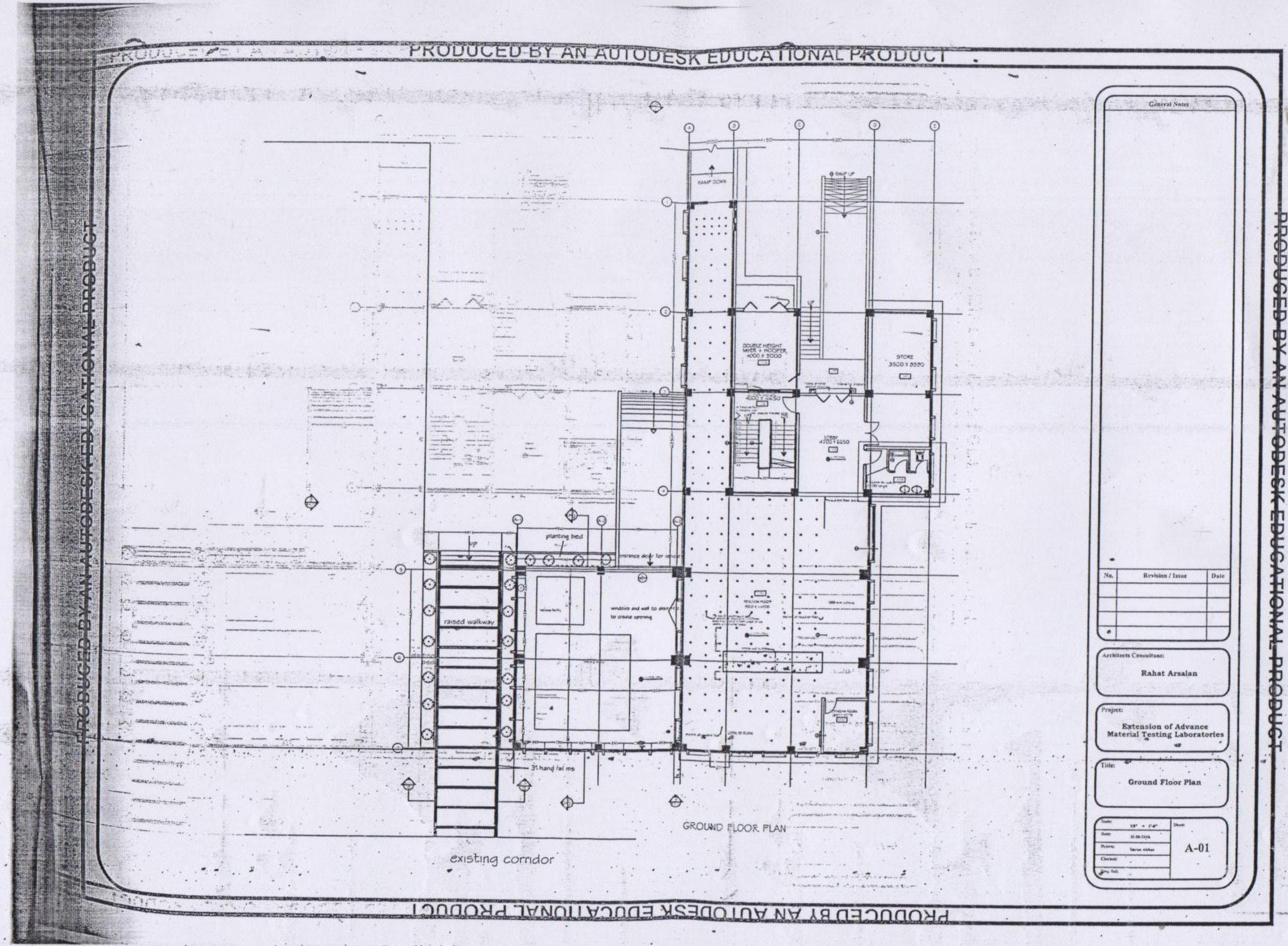
@

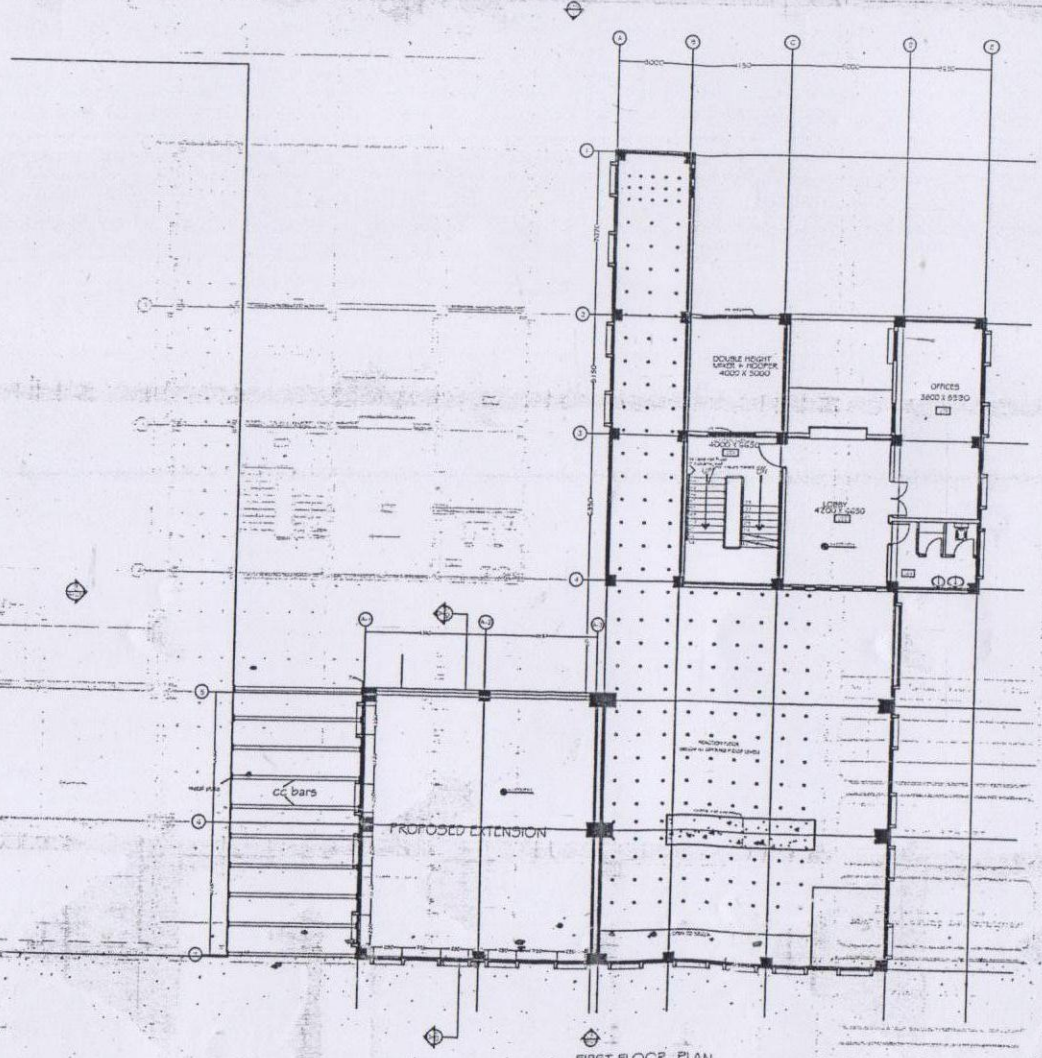
NED Main Campus

VOLUME – IV

Tender Drawings

Department of Earthquake Engineering
NED University of Engineering and Technology, Karachi-75270.


PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
General Notes
No.
Revision / Issue
Date
Architects Consultant:
Rahat Arsalan
Project:
Extension of Advance Material Testing Laboratories
Title:
Ground Floor Plan
A-01
GROUND FLOOR PLAN
existing corridor
raised walkway
planting bed
RAMP DOWN
RAMP UP
DOUBLE HEIGHT
STORE
LOBBY



FIRST FLOOR PLAN

General Notes

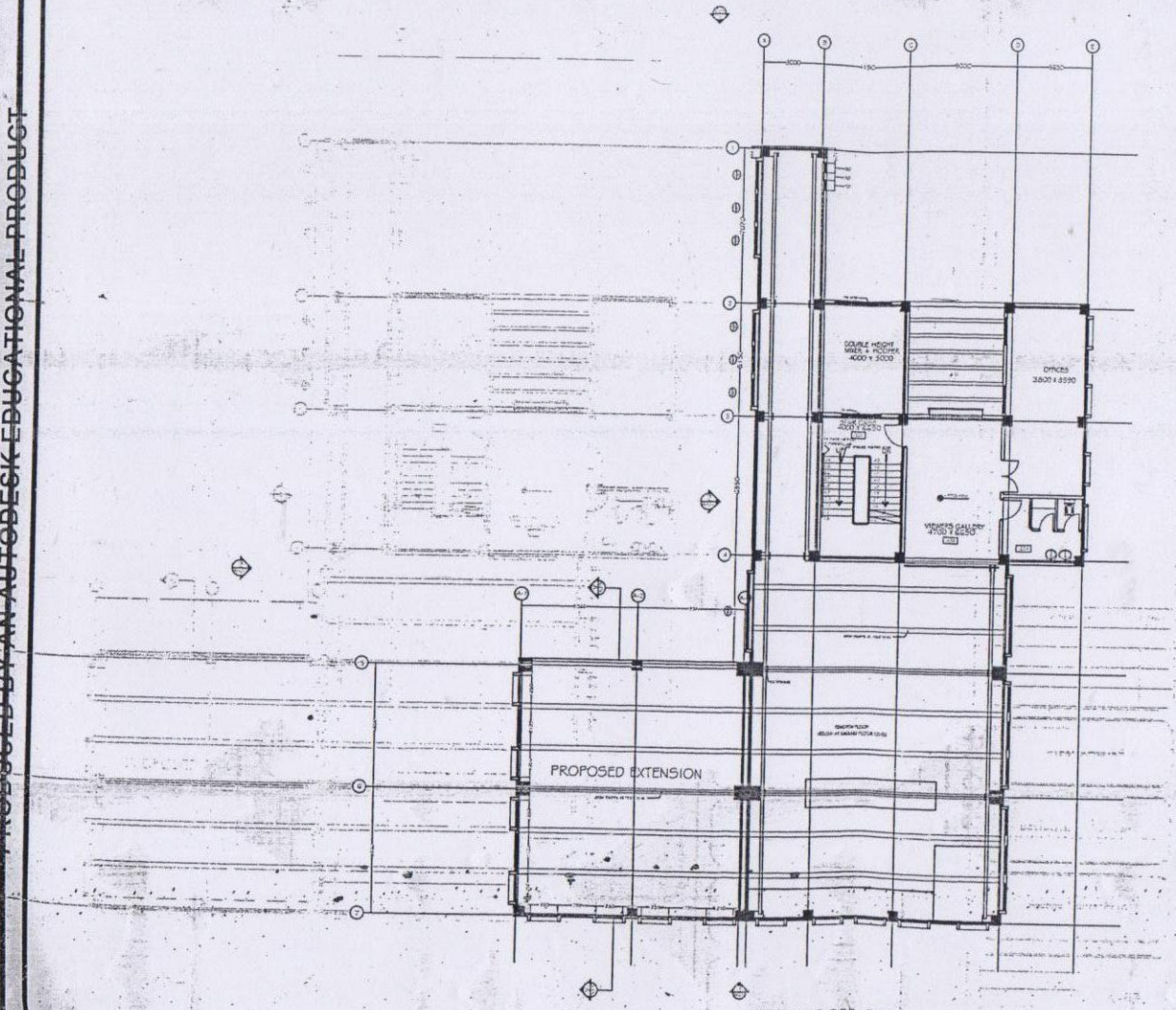
No.	Revision / Issue	Date

Architects Consultant:
Rahat Arsalan

Project:
Extension of Advance Material Testing Laboratories

Title:
First Floor Plan

Scale: 1/8" = 1'-0"
Date: 21/06/2014
Drawn: Imran Ahmed
Checked:
Dwg. Ref:
Sheet: A-02



SECOND FLOOR PLAN

General Notes

No.	Revision / Issue	Date

Architects Consultant:
Rahat Arsalan

Project:
Extension of Advance Material Testing Laboratories

Title:
Second Floor Plan

Scale:	1/8" = 1'-0"
Date:	31-08-2015
Drawn:	Imran Abbas
Checked:	
Dwg. Ref:	

Sheet: A-03

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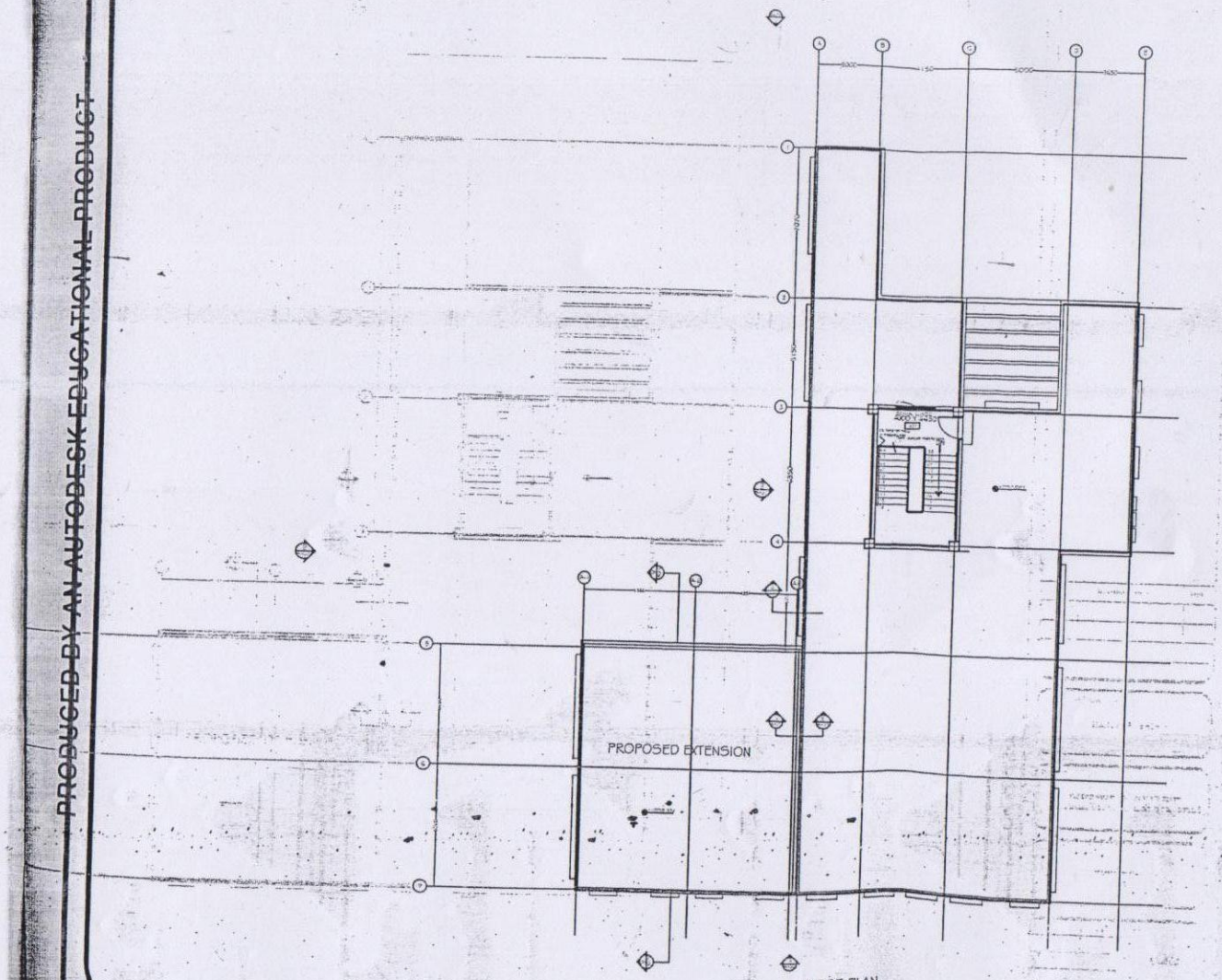
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



ROOF PLAN

General Notes

No.	Revision / Issue	Date

Architects Consultant:
Rahat Arsalan

Project:
Extension of Advance Material Testing Laboratories

Title:
Roof Plan

A-04

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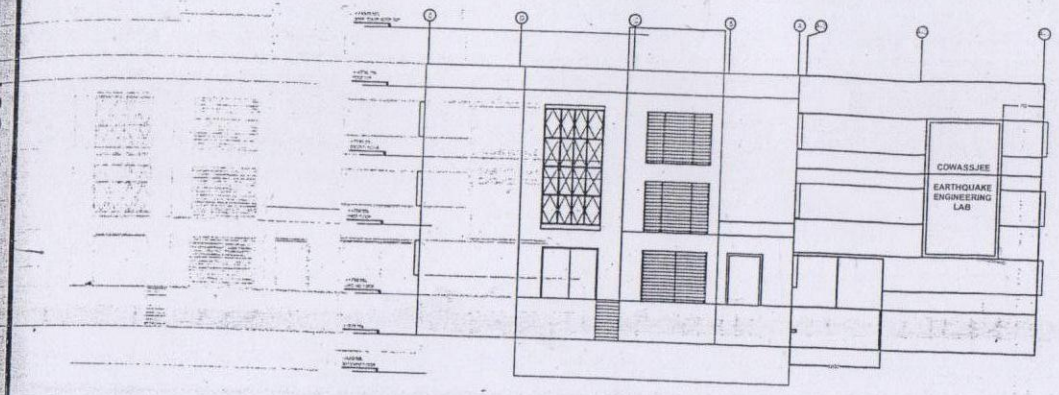
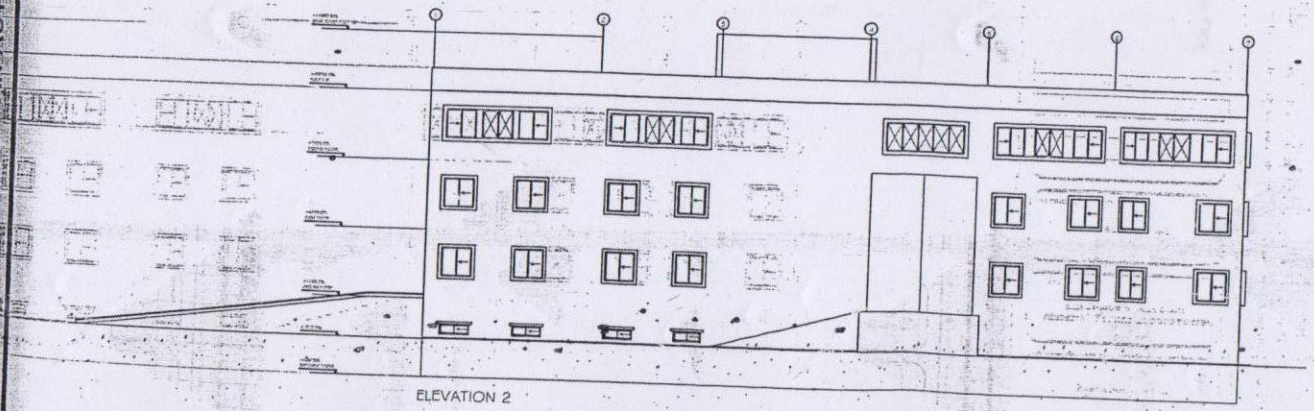


ELEVATION 1



ELEVATION 2

General Notes

No.	Revision / Issue	Date

Architects Consultant:

Rahat Arsalan

Project:

Extension of Advance Material Testing Laboratories

Title:

Elevation 01&02

Scale	1/8" = 1'-0"
Date	30-06-2016
Drawn	Imtiaz Abbas
Checked	
Dwg. Ref.	

Sheet

A-05

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

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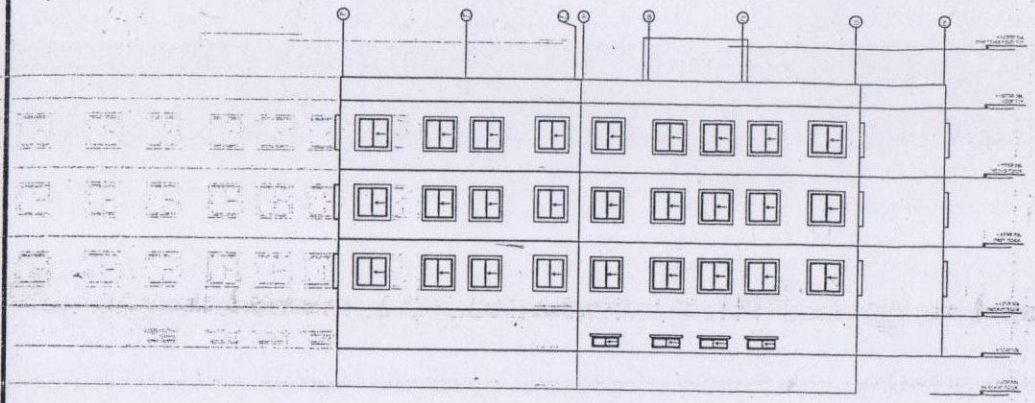

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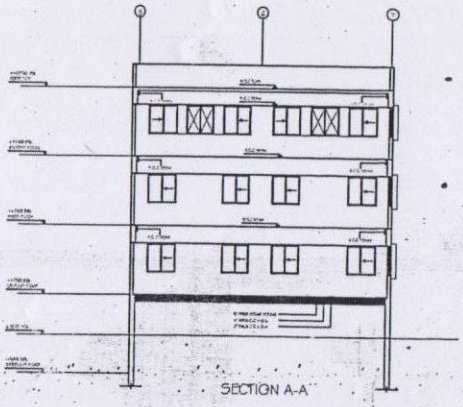


SECTION A-A

General Notes

No.	Revision / Issue	Date

Architects Consultant:

Rahat Arsalan

Project:

Extension of Advance Material Testing Laboratories

Title:

Elevation 03 & Section A-A

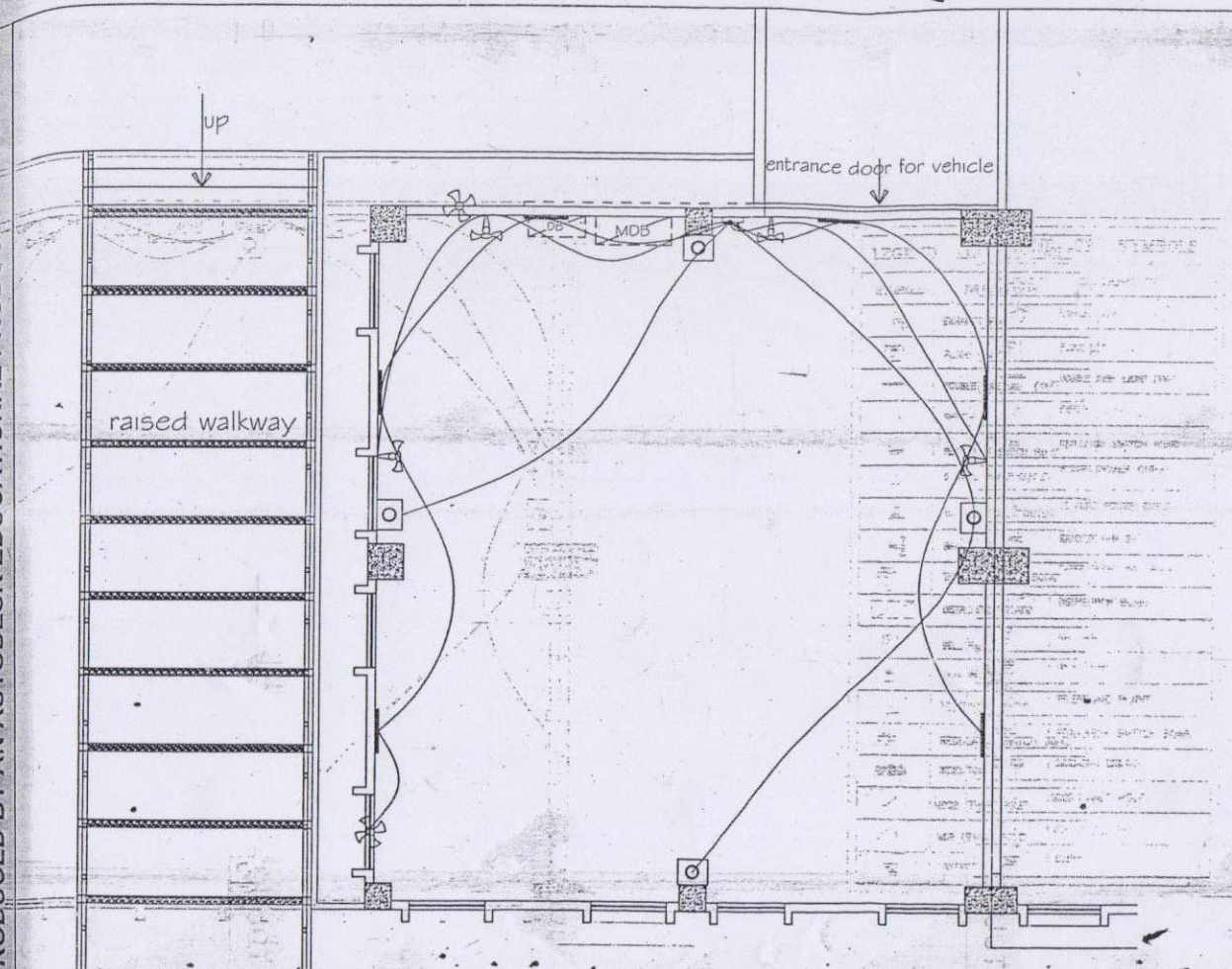
Scale:	1/8" = 1'-0"
Date:	31-05-2016
Drawn:	Imran Abbas
Checked:	
Dwg. Ref:	

Sheet:

A-06

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



GROUND FLOOR LIGHTING & FAN PLAN

LEGEND OF SYMBOLS

SYMBOLS	DESCRIPTION
	EXHAUST FAN
	FLOOD LIGHT
	DOUBLE TUBE LIGHT (1X4')
	SWITCH
	REGULATOR SWITCH BOARD
	5 AMPS POWER OUTLET
	15 AMPS POWER OUTLET
	BRACKET FAN 24"
	THREE PHASE IND. SOCKET
DB	DISTRIBUTION BOARD
	BELL PUSH
	DATA POINT
	TELEPHONE POINT
	REGULATOR SWITCH BOARD
	INDICATING LIGHTS
	MCCB (THREE POLE)
	MCB (SINGLE POLE)
	EARTHING

Note:

Revision /Issue	Date
Issued For Construction	21/07/16

Project: EXTENSION OF ADVANCE MATERIAL TESTING LABORATORY

Electrical Consultant: Dr. Muhammad Ali Memon

Architects Consultant: Rahat Arsalan

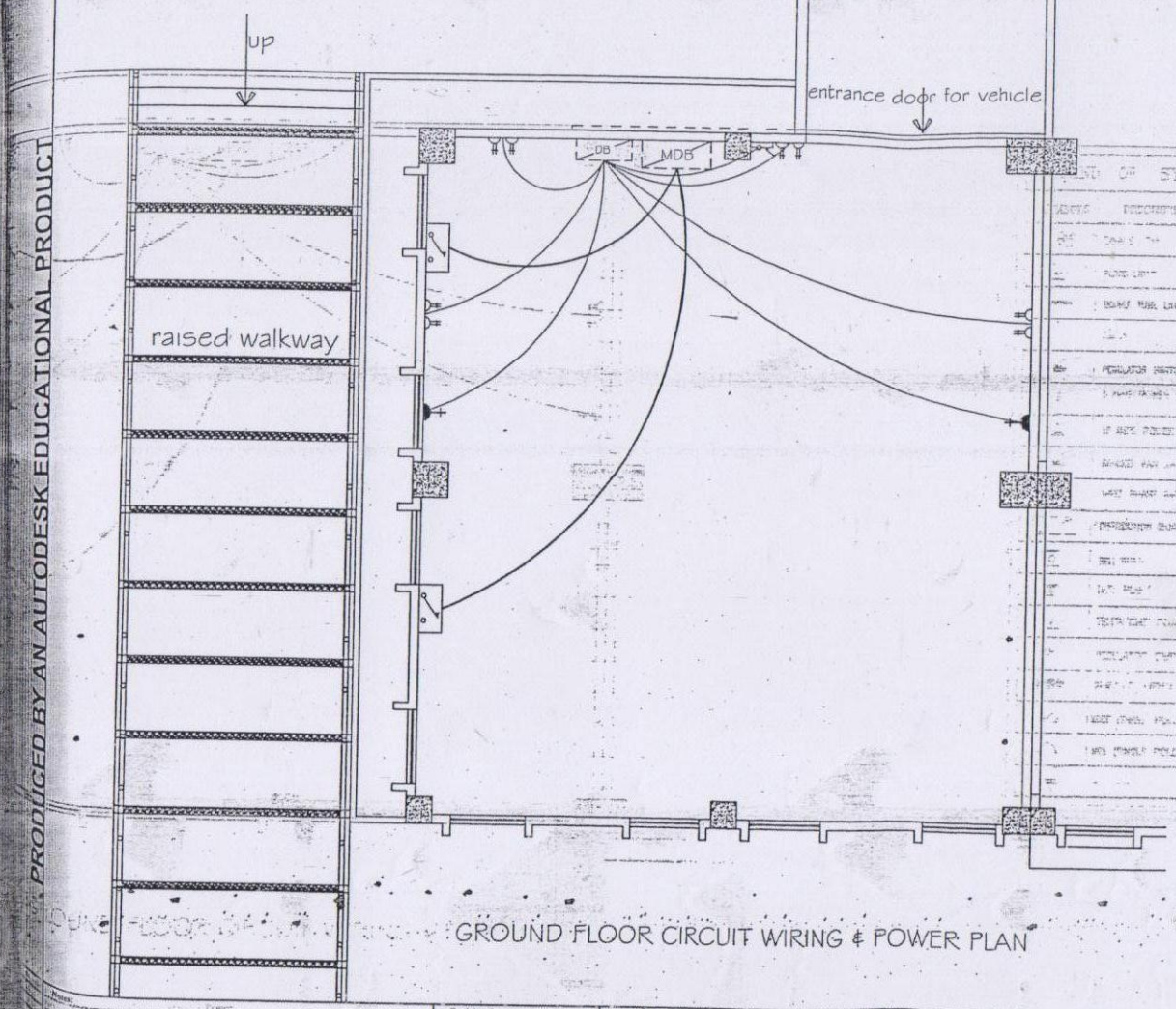
Structural Consultant: Prof. Muhammad Masood Rafi

Title: Ground Floor Lighting & Bracket Fan Plan

Scale:	N.T.S
Date:	20 July 2016
Drawn:	A.U.R
Checked:	Mazhar Imam
Dwg. Ref.:	
Job No.:	

Dwg. No.: E-01

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



GROUND FLOOR CIRCUIT WIRING & POWER PLAN

LEGEND OF SYMBOLS	
SYMBOLS	DESCRIPTION
	EXHAUST FAN
	FLOOD LIGHT
	DOUBLE TUBE LIGHT (1X4')
	SWITCH
	REGULATOR SWITCH BOARD
	5 AMPS POWER OUTLET
	15 AMPS POWER OUTLET
	BRACKET FAN 24"
	THREE PHASE IND. SOCKET
DB	DISTRIBUTION BOARD
	BELL PUSH
	DATA POINT
	TELEPHONE POINT
	REGULATOR SWITCH BOARD
	INDICATING LIGHTS
	MCCB (THREE POLE)
	MCB (SINGLE POLE)
	EARTHING

Revision /Issue	Date
Issued For Construction	21/07/16

Project: EXTENSION OF ADVANCE MATERIAL TESTING LABORATORY

Electrical Consultant: Dr. Muhammad Ali Memon

Architects Consultant: Rahat Arsalan

Structural Consultant: Prof. Muhammad Masood Rafi

Title: Ground Floor Lighting & Bracket Fan Plan

Scale:	N.T.S
Date:	20 July 2016
Drawn:	A.U.R
Checked:	Mazhar Imam
Dwg. Ref.:	-
Job No.:	

Dwg. No.: E-02

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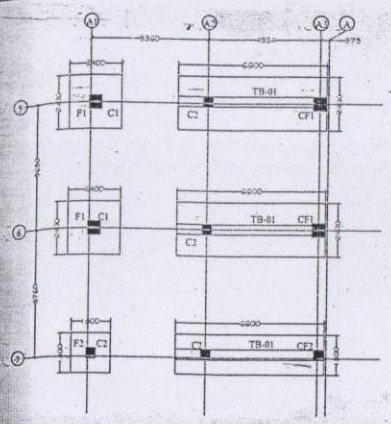
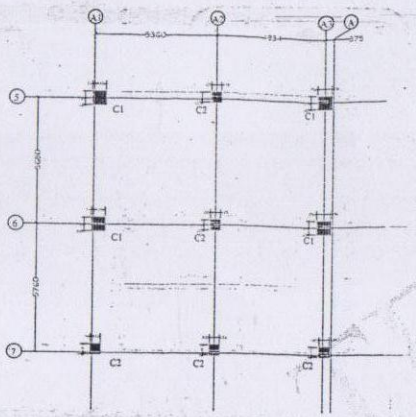
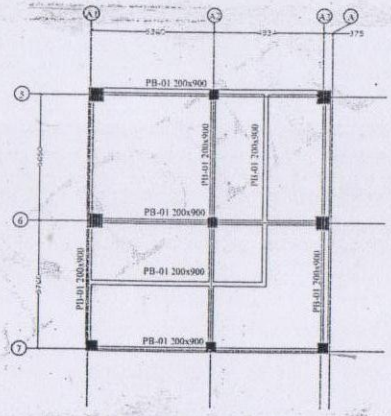


FOUNDATION PLAN

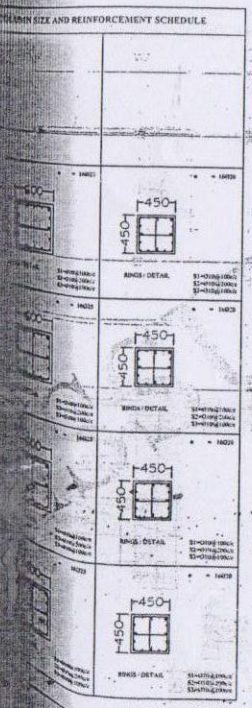


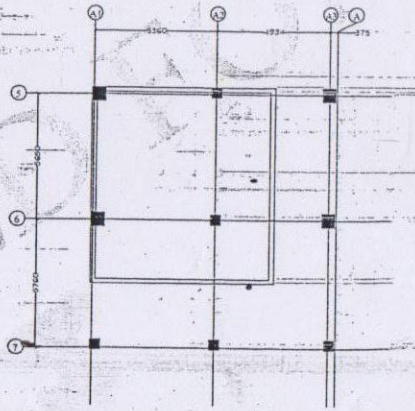
COLUMN LAYOUT PLAN



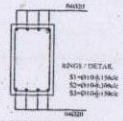
PLINTH BEAM LAYOUT PLAN

COLUMN SIZE AND REINFORCEMENT SCHEDULE

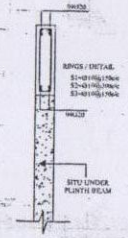




SITU LAYOUT PLAN



TYP. SECTION OF TB-01



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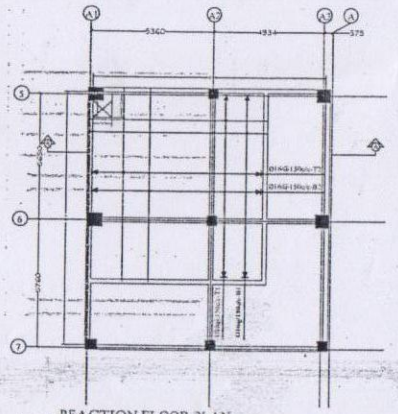


REACTION FLOOR PLAN
(TOP & BOTTOM REINFORCEMENT)

STEEL / MARKS		F-1	F-2	CF-1	CF-2
FOOTING SIZE	AREA AXB	2400x2400	1800x1800	6600x2400	15'-4"x9'-6"
	DEPTH	500	500	500	500
REIN-FOCE-MENT-	S, W	Ø16@150c/c	Ø16@200c/c	T/B Ø16@300c/c	T/B Ø16@300c/c
	L, W	Ø16@150c/c	Ø16@200c/c	T/B Ø12@125c/c	T/B Ø12@125c/c
EXTRA BARS BOTH WAY					

SCHEDULE OF R.C.C. FOOTING

General Notes

No.	Revision/Issue	Date
01	Issued For Tender	21-09-2016

Structural Consultant:

Prof. Muhammad Masood Rafi

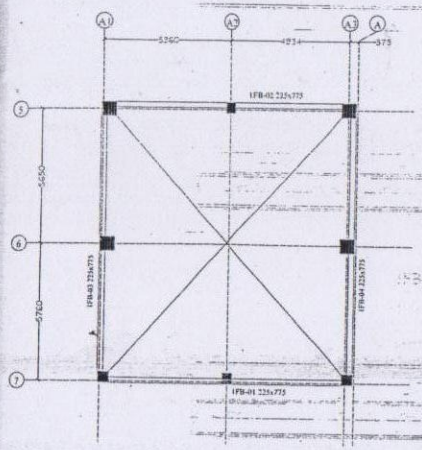
Project:

Extension Of Advance Material Testing Laboratory

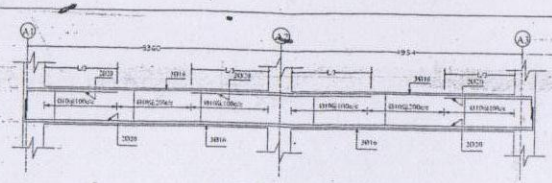
Title:

foundation plan & column

Scale:	As Shown	Sheet:
Date:	20-09-2016	S-01
Drawn:	A.U.R	
Checked:		
Dwg. Ref:		



FIRST FLOOR FRAMING PLAN



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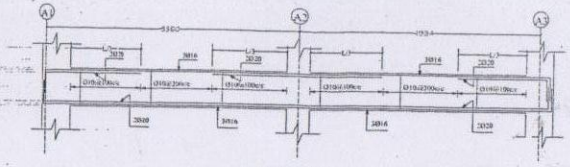

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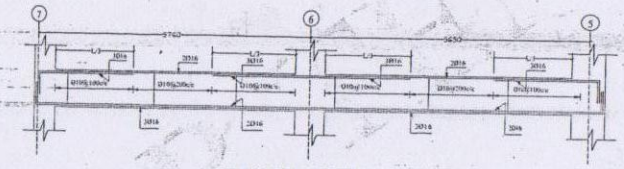
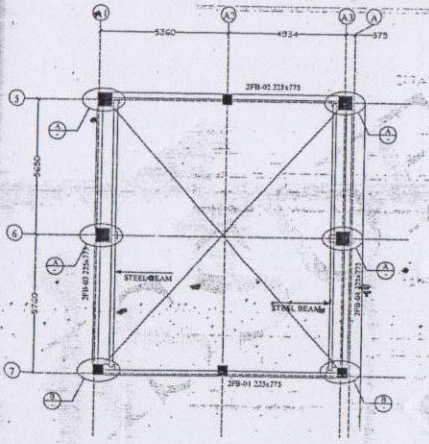
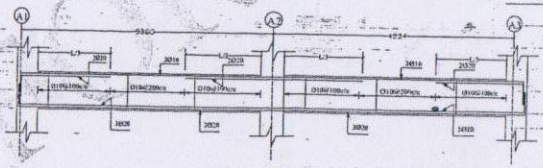


1FB-03&04 (225x775)



SECOND FLOOR FRAMING PLAN



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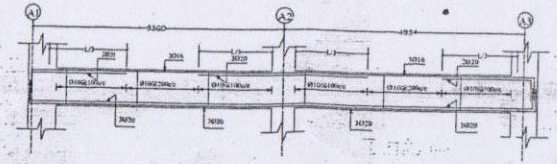

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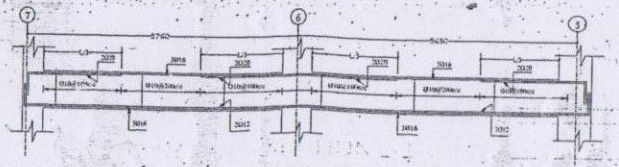

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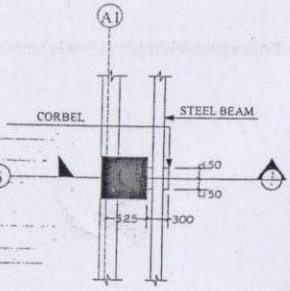
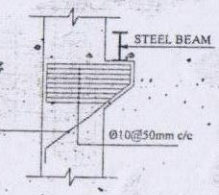


DETAIL "A"



SECTION 2-2

General Notes

No.	Revision/Issue	Date
01	Issued For Tender	21-09-2016

Structural Consultant:

Prof. Muhammad Masood Rafi

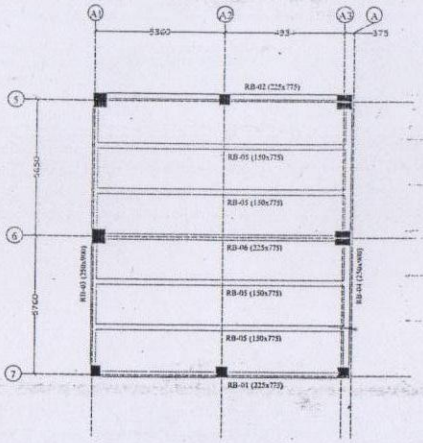
Project:

Extension Of Advance Material Testing Laboratory

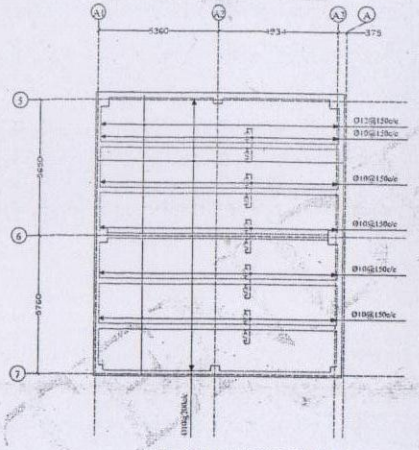
Title:

First & Second Floor Framing Plan, Beam Sectional Elevation & Corbel Detail

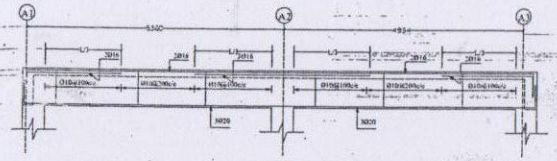
Scale: 1:5	Sheet:
Date: 20-09-2016	S-02
Drawn: A.U.R.	
Checked:	
Dwg. Ref:	



ROOF FLOOR FRAMING PLAN



ROOF REINFORCEMENT PLAN



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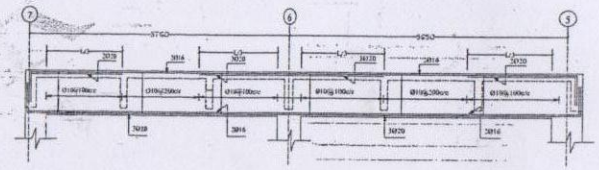
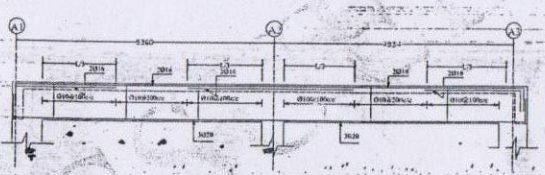
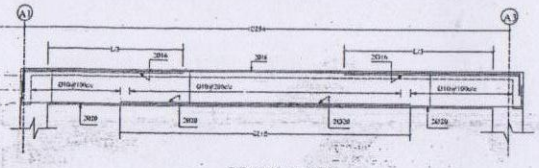


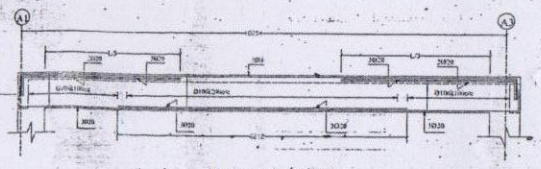
RB-03&04 (250x900)



RB-02 (225x775)



RB-05 (150x775)



RB-06 (225x775)

General Notes

No.	Revision/Issue	Date
01	Issued For Tender	21-09-2016

Structural Consultant:

Prof. Muhammad Masood Rafi

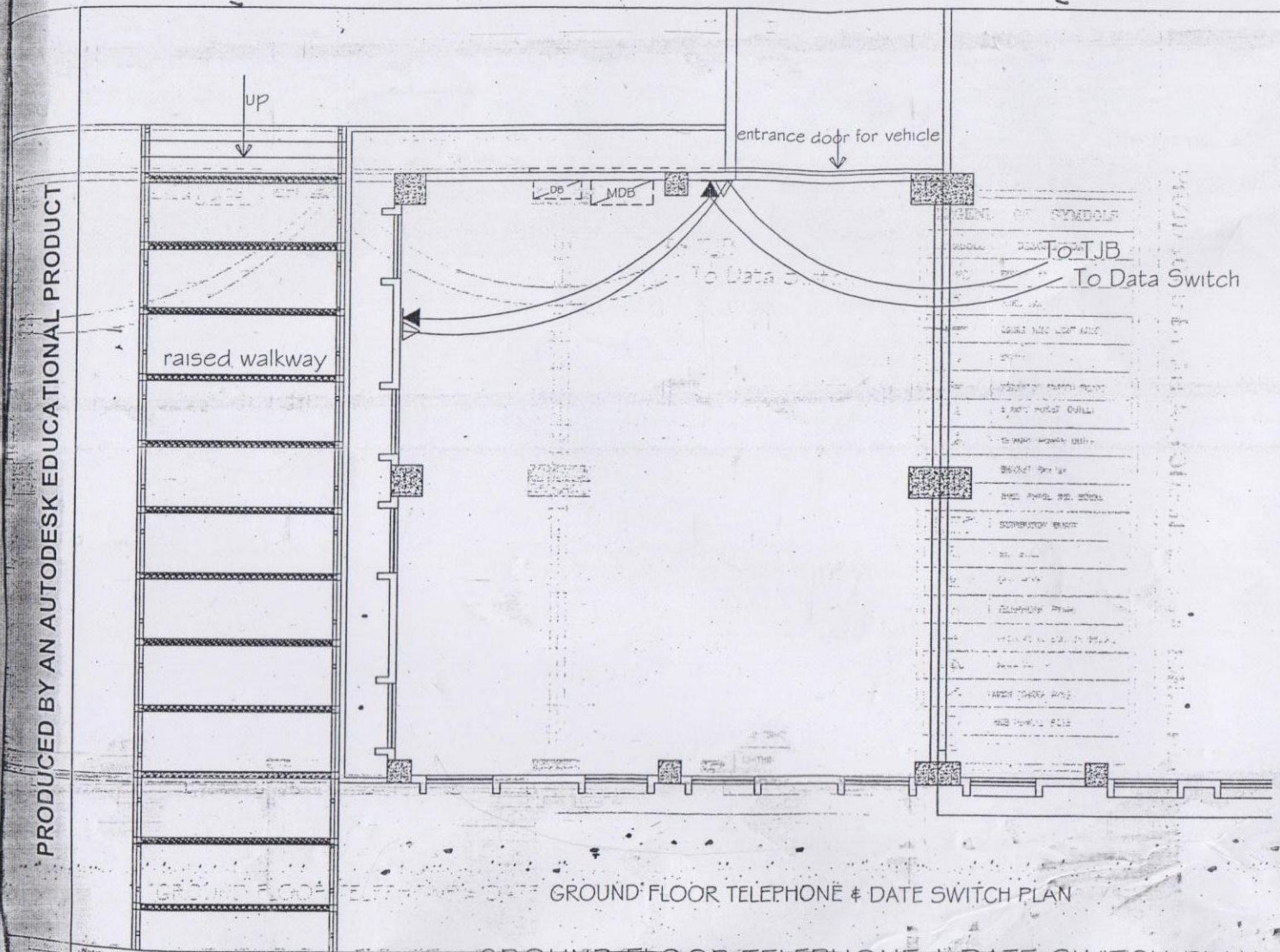
Project:

Extension Of Advance Material Testing Laboratory

Title:

Roof Framing / Reinforcement Plan & Beams Sectional Elevation

Scale: 1:5	Sheet:
Date: 20-09-2016	S-03
Drawn: A.U.R	
Checked:	
Dwg. Ref.	



LEGEND OF SYMBOLS	
SYMBOLS	DESCRIPTION
	EXHAUST FAN
	FLOOD LIGHT
	DOUBLE TUBE LIGHT (1X4')
	SWITCH
	REGULATOR SWITCH BOARD.
	5 AMPS POWER OUTLET
	15 AMPS POWER OUTLET
	BRACKET FAN 24"
	THREE PHASE IND. SOCKET
DB	DISTRIBUTION BOARD
	BELL PUSH
	DATA POINT
	TELEPHONE POINT
	REGULATOR SWITCH BOARD
	INDICATING LIGHTS
	MCCB (THREE POLE)
	MCB (SINGLE POLE)
	EARTHING

GROUND FLOOR TELEPHONE & DATE SWITCH PLAN

Notes:

Revision /Issue	Date
Issued For Construction	21/07/16

Project: EXTENSION OF ADVANCE MATERIAL TESTING LABORATORY

Electrical Consultant: Dr. Muhammad Ali Memon

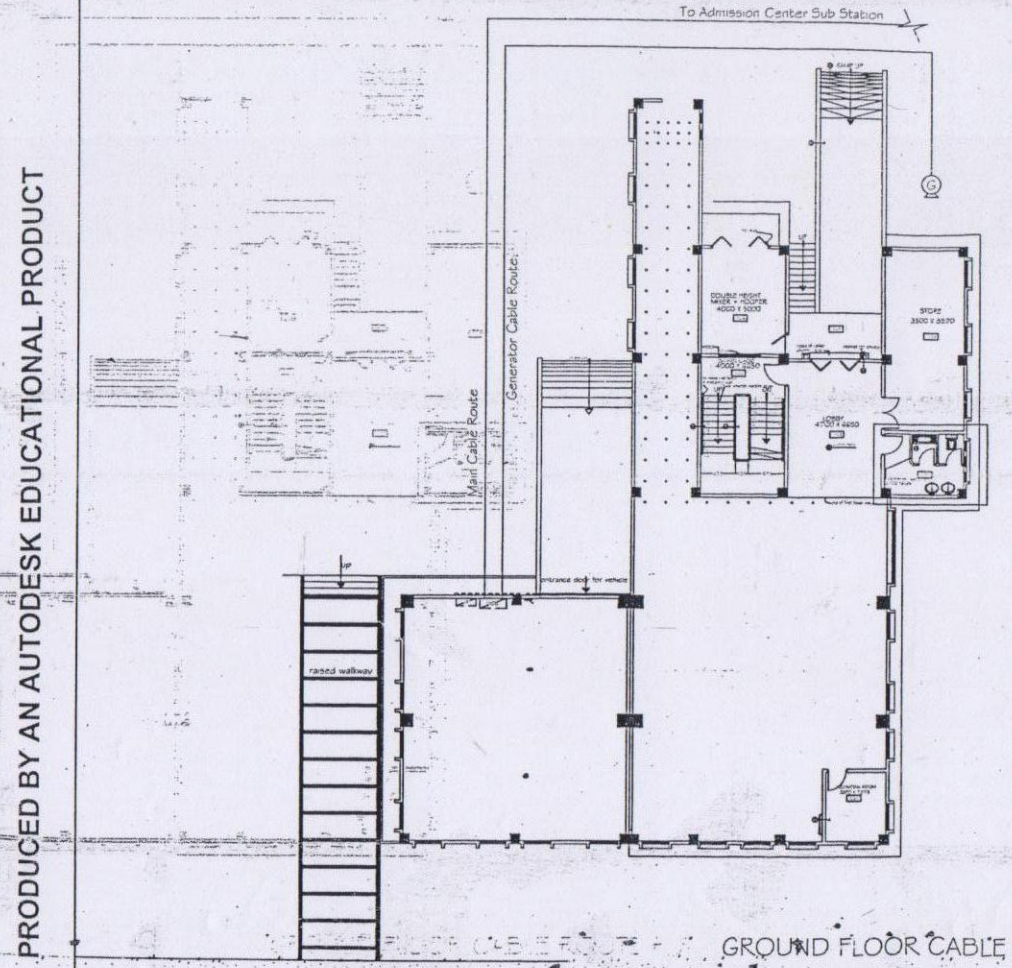
Architects Consultant: Rahat Arsalan

Structural Consultant: Prof. Muhammad Masood Rafi

Title: Ground Floor Lighting & Bracket Fan Plan

Scale:	N.T.S
Date:	20 July 2016
Drawn:	A.U.R
Checked:	Mazhar Imam
Dwg. Ref.:	
Job No.:	

Dwg. No.: E-03



GROUND FLOOR CABLE ROUTE PLAN

LEGEND OF SYMBOLS

SYMBOLS	DESCRIPTION
	EXHAUST FAN
	FLOOD LIGHT
	DOUBLE TUBE LIGHT (1X4')
	SWITCH
	REGULATOR SWITCH BOARD
	5 AMPS POWER OUTLET
	15 AMPS POWER OUTLET
	BRACKET FAN 24"
	THREE PHASE IND. SOCKET
DB	DISTRIBUTION BOARD
	BELL PUSH
	DATA POINT
	TELEPHONE POINT
	REGULATOR SWITCH BOARD
R Y B	INDICATING LIGHTS
	MCCB (THREE POLE)
	MCB (SINGLE POLE)
	EARTHING

Notes:

Revision /Issue	Date
Issued For Construction	21/07/16

Project: EXTENSION OF ADVANCE MATERIAL TESTING LABORATORY

Electrical Consultant: Dr. Muhammad Ali Memon

Architects Consultant: Rabit Arsalan

Structural Consultant: Prof. Muhammad Masood Rafi

Title: Ground Floor Lighting & Bracket Fan Plan

Scale:	N.T.S
Date:	20 July 2016.
Drawn:	A.U.R.
Checked:	Mazhar Imam
Dwg. Ref.:	-
Job No.:	-

Dwg. No.: E-04

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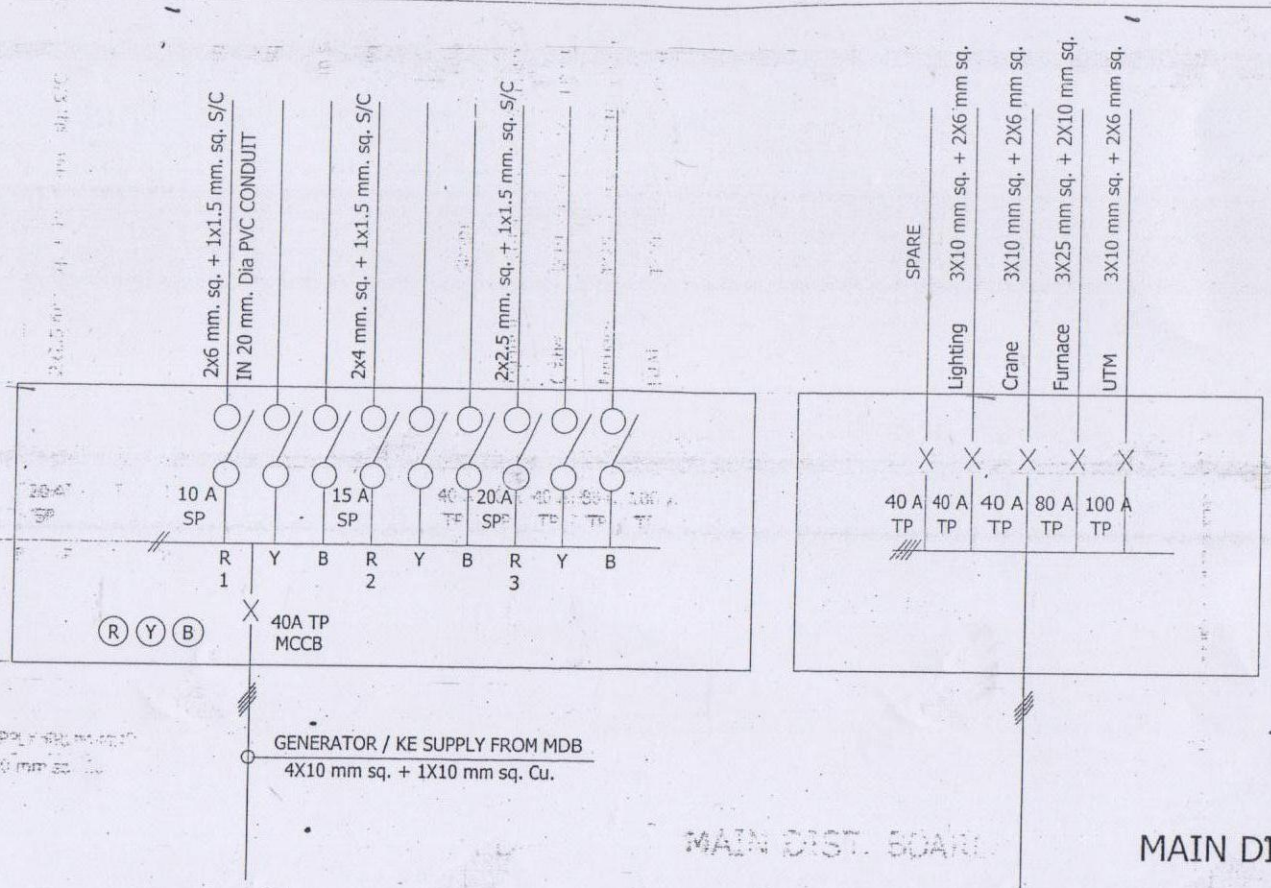

GENERATOR / KE SUPPLY FROM MDB
4X10 mm sq. + 1X10 mm sq. Cu.

MAIN DIST. BOARD

LIGHTING DIST. BOARD

COS

2X250A TPN

KE SUPPLY FROM GENERATOR
120 mm sq. 4 CORE CU/PVC/SWA/PVC

KE SUPPLY FROM S/S
150 mm sq. 4 CORE CU/PVC/SWA/PVC

Notes:	Revision /Issue	Date	Project:	Electrical Consultant:	Architects Consultant:	Title:	Scale: N.T.S	Dwg. No.:
	Issued For Construction	21/07/16	EXTENSION OF ADVANCE MATERIAL TESTING LABORATORY	Dr. Muhammad Ali Memon	Rahat Arsalan Structural Consultant: Prof. Muhammad Masood Rafi	SINGLE LINE DIAGRAM FOR MDB / DB	Date: 20 July 2016 Drawn: A.U.R Checked: Mazhar Imam Dwg Ref.: - Job No.: -	E-06

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