



भारतीय राष्ट्रीय उपभोक्ता सहकारी संघ मर्यादित NATIONAL CO-OPERATIVE CONSUMERS' FEDERATION OF INDIA LTD.

(उपभोक्ता मामले, खास एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)

शाखा कार्यालय: डी-70, विज्ञानपुरी, महानगर एक्सटेंशन, लखनऊ-226006

Branch Office: D-79, Vignyanpuri, Mahanagar Extension, Lucknow-226006

Ph.: 0522-4955937, 4072415 E-mail: nccflko@gmail.com

NCCF/LKO/CONST./2023-24/894-

Date:-03.04.2023

Email Id. -nccflko@gmail.com

Mob No.- 9893270235

Tender Notice

NCCF Lucknow branch is invited the offer/rates for Construction of Multi-Storey Administrative Block, Academic Block for Health & Allied Science, Teaching & Training Block, Class Rooms (24 Nos.) S.H Civil Works, Internal & External Electrical work, Fire Fighting, Plumbing, External development and Lifts etc. at Jamia Millia Islamia, Central University, New Delhi.

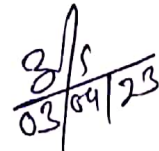
The interested registered Empanelled/Non Empanelled business associate/Construction firms who are willing to execute above work on EPC mode may submit their rates to Lucknow branch office latest by 10.04.2023 upto 12.00 PM. The details of work and conditions are attached. Non Empanelled Bidders may also participate in bidding by applying within one week of submission of bids, along with all necessary documents for empanelment. Preference for work will however be given to Empanelled Business Associates. Tender documents may be downloaded/collected from NCCF website/Lucknow Branch, for any queries please contact to Lucknow Branch.

1. **Name of Work** – Construction of Multi-Storey Administrative Block, Academic Block for Health & Allied Science, Teaching & Training Block, Class Rooms (24 Nos.) S.H Civil Works, Internal & External Electrical work, Fire Fighting, Plumbing, External development and Lifts etc. at Jamia Millia Islamia, Central University, New Delhi.
2. **Tender Cost** :- Rs. 5000/-
3. **Earnest Money**:- 8,00,000/- (By DD/Bank Guarantee in Favor of NCCF OF INDIA LTD,LUCKNOW)
4. **Estimated value of work** – 112.50 Cr.
5. **Date and Time when submission of bids is over**: -10.04.2023 up to 12.00 PM

Term & Conditions:-

The bids submitted shall consist of all pages of Tender Documents, each page signed by authorized signatory with seal of Firm, along with documents in support of eligibility criteria as per NCCF "Construction Guidelines", issued in Aug 20/Tender Specifications. All the documents shall be enclosed and sealed in an envelope labeled as "Technical Bid". Financial bid shall be submitted in a separate envelope and must have "Financial Bid" written on the envelope. Both the sealed envelopes of bids shall be enclosed in a bigger sealed envelope which must have following words written on it.

- 1 All the bidders will be bounded to accept the tender conditions along with NCCF's tender conditions/guidelines. Non compliance of this shall result into treating the tender as invalid. An affidavit duly signed by authorized signatory of the firm on Rs 100 valid stamp paper shall be submitted along with tender documents in support of this. An affidavit must consist of the following-

 Contd..2

प्रधान कार्यालय : एन.सी.यू.आई काम्पलेक्स, 3, श्री इंस्टीट्यूशन एरिया, अगस्त क्रान्ति मार्ग, हौज खास, नई दिल्ली-110 016, वेबसाइट : www.nccf-india.com
H.Office: NCUI Complex, 3, Shri Institutional Area, August Karanti Marg, Hauz Khas, New Delhi- 110 016, Website : www.nccf-india.com

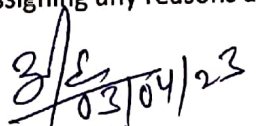
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"We accept all the tender conditions of Jamia Millia Islamia University, New Delhi and NCCF guidelines issued in Aug 2020" in regard to tender No NCCF/LKO/CONST-JMIU/2023-24/583 dated 03.04.2023 Construction of Multi-Storey Administrative Block, Academic Block for Health & Allied Science, Teaching & Training Block, Class Rooms (24 Nos.) S.H Civil Works, Internal & External Electrical work, Fire Fighting, Plumbing, External development and Lifts etc. at Jamia Millia Islamia, Central University, New Delhi.

- 2 The bid shall be accompanied by a covering letter in support of submission of bid duly signed by the authorized signatory of the bidding firm (Power of Attorney to be enclosed, if any), addressed to Regional Manager NCCF, Lucknow Branch containing Name of work, Tender No, Date, Name of signatory and firm. Non compliance shall result into tender being treated as invalid.
- 3 The bidder shall give a declaration that they have not been black listed by any Central or State Government department/PSU/Autonomous body etc.
- 4 The bidder shall also enclosed a list of their ongoing government works with cost of work, amount of work pending, date of award of work, name and address of engineer Incharge/Department etc duly signed and stamped for assessment of liability. Conditional bid will not be considered.
- 5 Based on accepted rates, margin offered to NCCF by the bidder may be submitted in sealed cover along with tender documents signed on each page. Minimum reserved margin rates are 3.0% The offer of the bidder offering highest margin shall be considered subject to fulfilling other conditions as per system improvement measured for NCCF works dated 14.08.2020/Tender Conditions.

NCCF reserves the right to reject any or all the proposals/rates received without assigning any reasons at any time.

Encl: As above.


(A.K.Singh)
Regional Manager

Place: Lucknow
Date- 03.04.2023



JAMIA MILLIA ISLAMIA

(A Central University, Act of Parliament)

Maulana Mohd. Ali Jauhar Marg New Delhi, Delhi 110025

VOLUME I

EXPRESSION OF INTEREST

FOR

CONSTRUCTION OF:-

- 1) Multi-Storey Administrative Block
- 2) Academic Block for Health & Allied Science
- 3) Teaching & Training Block
- 4) Class Rooms (24 Nos.)

AT

JAMIA MILLIA ISLAMIA, NEW DELHI-110025

- Nodal Agency

NATIONAL COOPERATIVE CONSUMERS FEDERATION OF INDIA

LIMITED, LUCKNOW BRANCH

COMPOSITE NIT

N.I.T. No. NCCF/LKO/CONST-JMIU/2023-24/583

Name of work	: CONSTRUCTION OF:- 1) Multi-Storey Administrative Block 2) Academic Block for Health & Allied Science 3) Teaching & Training Block 4) Class Rooms (24 Nos.) At Jamia Millia Islamia University, New Delhi-110025 S.H.: Civil works, Internal & External Electrical work, Fire Fighting, Plumbing, External development and Lifts etc.
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Composite Estimated Cost	: Rs. 112.50 Cr
Tender Cost	Rs. 5000/-
Earnest Money	Rs. 8,00,000/- (By DD/FDR/Bank Guarantee)
Security Deposit	2.5% of tendered value. (By DD/FDR/Bank Guarantee)
Time Allowed	24 Months

-Nodal Agency

National Cooperative Consumer Federation of India Ltd,
Lucknow Branch

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National Cooperative Consumer Federation of India Ltd,
Lucknow Branch

PART - A

ELIGIBILITY BID

INFORMATION AND INSTRUCTIONS FOR BIDDERS FOR TENDERING FORMING PART OF BIDDOCUMENT

The **National Cooperative Consumer Federation of India Ltd.**, Lucknow Branch on behalf of Vice-chancellor, JMIU invites Cost/ Percentage rates bids from reputed empaneled/ non- empaneled business associates / bidders in two bid system for the following work:

1	2	3	4	5	6	7	8	9
S	NIT No.	Name of work & Location	Estimated Cost put to bid	Earnest Money	Period of Completion	Date of starting bid	Last date and time of submission of bid, original EMD, copy of receipt for deposition of original EMD and other documents as specified in the press notice	Time & date of opening of bid
1	NCCF/LKO/CONST-JMIU/2023-24/583	CONSTRUCTION of (Administrative, Academic, Teaching & Training, Calss Rooms) Blocks at Jamia Millia Islamia University , New Delhi- 110025(S.H.: Composite Works:-Civil , Internal & External Electrical , Firefighting, & Lifts	Rs. 1,12,50,00,000/-	Rs. 8,00,000/-	24 Month	03 RD APRIL 2023 at 5 PM	Up to 10/04/2023 At 12:00 pm	Upto 10/04/2023 At 12:30 PM

- 1.1 Empaneled/ non- Empaneled Business associates / bidders who fulfill the following requirements shall be eligible to apply.
- 1.2 **Joint ventures are not accepted.**
- (a) Should have satisfactorily obtain the works as mentioned below during the last seven years ending previous day of last date of submission of bids:

- i) Three similar obtained/undergoing/completed works costing not less than **Rs.10,00,00,000** or two similar obtained/undergoing/completed works, costing not less than **Rs.15,00,00,000** or one similar obtained work of aggregate cost not less than **Rs. 25 crores.**

“Similar work shall mean “Building works.

- (b) Should have had average annual financial turnover on construction works should be **Rs.25,00,00,000** during the immediate last three consecutive financial years ending 31st March 2023 (Scanned copy of Certificate from CA to be submitted)
- (c) The bidder should not have incurred any loss (profit after tax should be positive) in more than two years during the last five years ending 31st March 2023. Declaration on 100 Rupee Stamp Paper.(to be submitted with tender)

2. The intending bidder must read the terms and conditions carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required.
3. Information and Instructions for bidders posted on website shall form part of bid document.
4. The bid document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from NCCF website via paying tender cost.
5. **Certificate of Financial Turnover:** At the time of submission of bid, bidder may submit Affidavit/ Certificate from **CA** mentioning Financial Turnover of immediate last 3 years ending previous day of last date of submission of bids or for the period as specified in the bid document and further details if required may be asked from the business associates/bidders after opening of technical bids.
6. The eligibility bid shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of bidders qualifying the eligibility bid shall be communicated to them at a later date.
7. Non-Blacklist Declaration on 100 Rupee Stamp Paper shall be submitted with the organization with the bid documents.
8. Bids will be submitted physically at NCCF Branch Office: D-79, Vigyanpuri, Mahanagar Extension, Lucknow, Uttar Pradesh 226006.
9. Signed copy of Bid document is mandatory for submission with Bid.
10. The department reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified bidders to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion

- National Cooperative Consumer Federation of India Ltd.

MILESTONES FOR CIVIL WORKS

S. No.	Description of Milestone (Physical)	Cumulative Time allowed in Months (from date of start)	Amount to be with- held in case of non-achievement of milestone (% of tendered amount of Civil component)
1	Complete excavation and disposal of 60% surplus (soil + rock)	1.5	0.30
2	Completion of 1st layer of M10, Rock Anchor i/c pull out and routine test, water proofing of raft, 2 nd layer of M10	2.0	0.30
3	Casting of rafts	4.0	0.30
4	RCC works above foundation including Column, pedestals, Beams, Slabs, Sand filling/ refilling, water proofing, Brickwork upto Basement Slab level, filling, consolidation, roof slabs & beams for the basement slab etc including form work	5.0	0.30
5	RCC works including Columns, Beams, Slabs, Staircases, Shafts etc. complete with shuttering and reinforcement for stilt floor and for Each floor (13 floors)	9.0	0.30
6	RCC works above Terrace level including Columns, Beams, Slabs, Staircases, Shafts, , etc. complete with shuttering and reinforcement for mumty, machine room and overhead tanks	10.0	0.15
7	Concreting for Staircase Head Room, Parapets, Lift Machine Room, etc.	11.0	0.15
8	Doors, Frames and shutters	12.0	0.15
9	Aluminum/uPVC Doors, Window frames & Shutters, Hinges, etc.	13.0	0.15
10	Building Hardware, glazing, Railings in Staircases, Balconies, ETC	14.0	0.15
11	Electrical Switches & Sockets, Distribution Boards, MCBs, Meter Board, Tag Blocks, Earthing, , Testing, etc.	15.0	0.15
12	Lifts: Mobilization advance, Approval of drawings, Delivery of material, Installation, testing & commissioning and handing over including NOC of competent authority	15.0	0.15
13	External Finishing Works including Painting, making Grooves, Shaft Plaster and Painting and painting of pipes, Etc.	16.0	0.15
14	Dado & Counter Tops including polishing, etc.	16.0	0.15

15	Flooring & Skirting Works including Stone wall cladding	17.0	0.15
16	Roof Terracing and Water Proofing and copings	17.0	0.15
17	Primer and Painting of Entire Works	18.0	0.15
18	Final Painting Internal	18.0	0.15
19	Sanitation Works including Plumbing Pipes including fittings and testing	19.0	0.25
20	C.P. Fittings and testing	19.0	0.25
21	Sanitary wares and Testing	20.0	0.25
22	Electrical Fittings in Common Areas	20.0	0.20
23	Misc. balance Items, solar water heating system etc.	20.5	0.30
24	Testing and commissioning and handing over of NOC/completion certificate of all works	21.0	0.30
	Total	21 Months	5.00%
<p>Withheld amounts on account of non-achievement of particular milestone shall be released if and when subsequent milestone is achieved within respective time specified. The successful bidder will ensure that electrical components of the work are executed in time without giving any chance for slippage of milestone an account of delay in execution of associated electrical works by him. However, in case milestones are not achieved by the successful bidder for the work, the amount shown against milestone shall be withheld by the Engineer-In-Charge JMIU/NCCF of the respective components.</p> <p>Note: Intending tenderer may submit phasing of activities / milestones on the basis of their resources and methodology at the time of tendering corresponding to physical milestones / stages indicated in the above table. These shall be formed part of the agreement after approval of the accepting authority, otherwise it would be assumed that agency agrees with the above-mentioned physical milestones.</p>			

Time allowed for execution of work : **24 Months Authority to decide:**

- | | | |
|-------|---|--|
| (i) | Extension of time | National Cooperative Consumer Federation of India Ltd., Lucknow Branch. |
| (ii) | Rescheduling of mile stones | National Cooperative Consumer Federation of India Ltd., Lucknow Branch. |
| (iii) | Shifting of date of start in case of delay inhanding over of site | National Cooperative Consumer Federation of India Ltd., Lucknow Branch. |

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Clause 36 (i)

Requirement of Technical Representative(s)

Requirement of Technical Staff		Minimum experience in Construction (Years)	Designation
Qualification	Number		
(For Major+ Minor Component)			
Graduate Engineer (Civil)	1	20 (and having experience of one similar nature of work)	Project Manager
Graduate Engineer Electrical	1	12 (and having experience of one similar nature of work)	Deputy Project Manager
Graduate Engineer Or Diploma Engineer	1 - Civil 1- Elect.	5 or 1 0 Respectively	Project/Site Engineer
Graduate Engineer Or Diploma Engineer	1 - Civil 1- Elect.	2 or 5 Respectively	Project/Site Engineer

Assistant Engineers retired from Government services who are holding Diploma will be treated at par with Graduate Engineers. Diploma holder with minimum 10 year relevant experience with a reputed construction company can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.

TABLE-1

Equipment's for Testing of Materials & Concrete at Site Laboratory

All necessary equipment for conducting all necessary tests shall be provided by the successful bidder at the site in the well-furnished site laboratory of minimum size 25 feet x 15 feet at his own cost. The following minimum laboratory equipment's shall be set up at site office laboratory:-

Sl. No.	Equipment's	Numbers (Minimum)
1	Balances	
(i)	7 kg to 10 kg capacity, semi-self-indicating	1
(ii)	500 gm. capacity, semi-self-indicating type-accuracy 1 gm	1
(iii)	Pan balance - 5 kg capacity - accuracy 10 gms	1
2	Ovens - electrically operated, thermostatically controlled upto 110° C -sensitivity 1° C.	1
3	Sieves as per IS 460 - 1962	
(i)	I.S. sieves - 450mm internal dia of sizes 100 mm, 80mm, 63mm, 50mm, 40mm, 25mm, 20mm, 12.5mm, 10mm, 6.3mm, 4.75mm complete with lid and pan.	1
(ii)	I.S. sieves - 200mm internal dia (brass frame) consisting of 2.36mm, 1.18mm, 600 microns, 425 microns, 300 microns, 212 microns, 150 microns, 90 microns, 75 microns, with lid and pan.	1
4	Sieve shaker capable of 200mm and 300mm dia sieves, manually operated with timing switch assembly.	1
5	Equipment for slump test – Slump cone, steel plate, tamping rod, steelscale, scoop.	1

6	Dial gauges, 25mm travel - 0.01 mm/division least count - 2 nos.	2
7	100 tonnes compression testing machine, electrical-cum manuallyoperated	1
8	Graduated measuring cylinders 200 ml capacity - 3 nos.	3
9	Enamel trays (for efflorescence test for bricks).	

(i)	300mm x 250mm x 40mm - 2 nos.	2
(ii)	Circular plates of 250mm dia - 4 nos.	4
	Field Testing Instruments	
1.	Steel tapes - 3 m	5
2.	Vernier callipers	2
3.	Micrometer screw 25 mm gauge	2
4.	A good quality plumb bob	2
5.	Spirit level, minimum 30 cms long with 3 bubbles for horizontal vertical	2
6.	Wire gauge (circular type) disc	2
7.	Foot rule	2
8.	Long nylon thread	2
9.	Rebound hammer for testing concrete	1
10.	Dynamic penetrometer	1
11.	Magnifying glass	2
12.	Screw driver 30 cms long	2
13.	Ball pin hammer, 100 gms	2
14.	Plastic bags for taking samples	2
15.	Moisture meter for timber	2
16.	Earth resistance tests	2
17.	Meggar	2

TABLE-2**PLANT AND EQUIPMENTS REQUIRED TO BE OWNED / TAKEN ON LEASE BY THE SUCCESSFUL BIDDER**

Sl. No.	Equipment	Numbers (Minimum)
1.	Mobile tower crane (wheel mounted) as per requirement at site	1
2.	Poclain	1
3.	Excavator cum loader (JCB 3D model or equivalent).	1
4.	Compressor machine minimum 200 cfm capacity	1
5.	DG set of minimum capacity 62.5 KVA.	2
6.	Needle Vibrators.	5
7.	Plate Vibrators.	3
8.	Reinforcement bending machine.	2
9.	Reinforcement cutting machine.	2
10.	Power driven earth rammer (Soil compactor).	2
11.	Total station	1
12.	Auto level & staff.	2
13.	Screener for coarse sand and fine sand	2
14.	Centrifugal monoblock water pump suitable for minimum 30 m head.	2
15.	Any other machinery required for completion of the work as per decision of NCCF	As per Actual requirement

Following items are to be executed through specialized agencies:

- a. Water proofing treatment
- b. Structural glazing
- c. Interior works viz. Wall panelling, false ceiling, wooden flooring and Acoustics works
- d. Fire check doors
- e. Stone cladding
- f. Granite & Marble stone flooring
- g. Aluminium doors & windows

FORM OF EARNEST MONEY (BANK GUARANTEE)

WHEREAS, bidder (Name of Bidder) (Herein after called “the bidder”)

Has submitted his Tender dated (Date) for the construction of (Name of work) (Herein after called “the Tender”).

KNOW ALL PEOPLE by these presents that we (Name of bank) having our registered office at (Herein after called “the Bank”) are bound unto..... (Name as Aouthrised) (Herein after called “theEngineer-in-charge”) in the sum of Rs. (Rs. In words) for which payment well and truly to be made to the saidEngineer-in-Charge the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this day of 20.....

THE CONDITIONS of this obligation are:

- (1) If after Tender opening the bidder withdraws, his Tender during the period of validity ofTender (including extended validity of Tender) specified in the Form of Tender;
- (2) If the bidder having been notified of the acceptance of his Tender by the NationalCooperativeFederation of India Ltd.
 - (a) fails or refuses to execute the Form of Agreement in accordance with the Instructions tobidder, if required; OR
 - (b) fails or refuses to furnish the Performance Guarantee, in accordance with the provisions ofTender document and Instructions to bidder, OR

- (c) fails or refuses to start the work, in accordance with the provisions of the contract and Instructions to bidder, OR
- (d) fails or refuses to submit fresh Bank Guarantee of an equal amount of the Bank Guarantee, against Security Deposit after award of contract.

We undertake to pay to the **National Cooperative Consumer Federation of India Ltd. either** up to the above amount or **part thereof** upon receipt of the first written demand, without the Engineer-in-Charge having to substantiate his demand, provided that in his demand the Engineer-in-Charge will note that the amount claimed by him is due to him owing to the occurrence of one or any of the above conditions, specifying the occurred condition or conditions.

The Guarantee will remain in force up to and including the date* after the deadline for submission of Tender as such deadline is stated in the Instructions to bidder or as it may be extended by the **National Cooperative Consumer Federation of India Ltd.**

, notice of which extension (s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

BANK WITNESS

Date:

SEAL (SIGNATURE, NAME AND ADDRESS)

*Date to be worked out on the basis of validity period of 6 months from last date or in the receipt of the Tender.

ELIGIBILITY CRITERIA

SECTION-I

BRIEF PARTICULARS OF THE WORK

4.1.1 Salient details of the work for which bids are invited are as under:

Name of work : “CONSTRUCTION OF :-

- 1) Multi-Storey Administrative Block
- 2) Academic Block for Health & Allied Science
- 3) Teaching & Training Block
- 4) Class Rooms (24 Nos.)

at Jamia Millia Islamia University, NewDelhi-110025” (S.H.:
Civil works, Internal & External Electrical work, Fire
fighting & Lifts etc.)

Composite Estimated Cost := Rs 1,12,50,00,000/-

Period of Completion : 24 Months

4.1.2 The Proposed project of **CONSTRUCTION of (Administrative, Academic, Teaching & Training, Class Rooms) Blocks** at Jamia Millia Islamia, Delhi-110025” consists of mainly one basement, ground floor and eleven floors besides landscaping work. The project is planned with modern building concepts and technology i/c Green Building.

The total plot area is 6800 Sqm .

The total height of the buildings is about 29 m.

4.1.3 This Residence Hall would consist of two RCC framed structure having ground & floors. Plinth areas of the said and floors are as under:

S. no	Description	Ground Areas (sqm)	Total Areas (Sqm)
1)	Multi-Storey Administrative Block	1200	7200
2)	Academic Block for Health & Allied Science	1280	12800
3)	Teaching & Training Block	340	2040
4)	Class Rooms (24 Nos.)	570	3412
	Grand Total		25452

Besides, provisions of structural Cladding, Structural Glazing, Landscaping, Internal & External Electrical Installations, Lifts, Fire Fighting System and Sewage Treatment Plant etc. have been made along with building management system.

- 4.1.4 Work shall be executed according to General Conditions of Contract 2021 (with upto date correction slips) for Central PWD works.

SECTION-II**GENERAL GUIDELINES FOR BIDDERS****GENERAL:**

- 4.2.1 Letter of transmittal and forms for deciding eligibility are given in Section III.
- 1.3 All information called for in the enclosed forms should be furnished against the relevant columns in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even if no information is to be provided in a column, a "nil" or "no such case" entry should be made in that column. If any particulars/query is not applicable in case of the bidder, it should be stated as "not applicable". The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms or deliberately suppressing the information may result in the bid being summarily disqualified. Bids made by telegram or telex and including those received late will not be entertained.
- 1.4 The bidder may furnish any additional information which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information. No information shall be entertained after of eligibility criteria document unless it is called for by the NCCF.
- 1.5 It is desirable that the applicant does not have any litigation(s) in process. The applicant must submit information of on-going litigations and litigations had in the past seven years. In the event that the applicant has no litigations either in process or in the past Seven years, an affidavit to this effect, duly notarized must be submitted in original.
- 1.6 The credentials submitted in respect of prequalification of tender by the first lowest bidder after opening of the financial bid shall be verified before award of work. Any information furnished by the bidder found to be incorrect either immediately or at a later date, would render him liable to be debarred from tendering/taking up of works in NCCF. If such bidder happens to be enlisted bidder of any class in CPWD, his name shall also be removed from the approved list of bidders.
- 1.7 The bidder should not have been black listed by any State/Central Department or PSU or Autonomous bodies. The applicant must submit a duly notarized affidavit to this effect. Applications received without this declaration in original shall stand automatically rejected.
- 1.8 Overwriting should be avoided. Correction, if any, should be made by neatly crossing out, initiating, dating and rewriting, pages of the technical bid document are numbered. Additional sheets, if any added by the bidder, should also be numbered by him. They should be submitted as a package with signed letter of transmittal.

2.0 DEFINITIONS:

2.1 In this document the following words and expressions have the meaning hereby assigned to them:

2.2 **BIDDER:** Means the individual, proprietary firm, firm in partnership, limited company (private or public) or corporation. Joint ventures, consortium and Special Purpose Vehicles are not accepted as bidders.

2.3 "Year" means "Financial Year" unless stated otherwise.

3.0 METHOD OF APPLICATION:

3.1 If the bidder is an individual, the application shall be signed by him above his full type written name and current address.

3.2 If the bidder is a proprietary firm, the application shall be signed by the proprietor above his full typewritten name and the full name of his firm with its current address.

3.3 If the bidder is a firm in partnership, the application shall be signed by the partner of the firm above their full typewritten names and current address, or, alternatively, by a partner holding power of attorney for the firm. In the later case a certified copy of the power of attorney should accompany the application. In both cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.

3.4 If the bidder is a limited company or a corporation, the application shall be signed by a duly authorized person holding power of attorney for signing the application accompanied by a copy of the power of attorney. The bidder should also furnish a copy of the Memorandum of Articles of Association duly attested by a Public Notary.

4.0 FINAL DECISION MAKING AUTHORITY

NCCF reserves the right to accept or reject any bid and to annul the process and reject all bids at any time without assigning any reason thereof or incurring any liability to the bidders.

5.0 PARTICULARS PROVISIONAL

The particulars of the work given in Section-I are provisional. They are liable to change and must be considered only as advance information to assist the bidders.

6.0 SITE VISIT

The bidder is advised to visit the site of work at his own cost and examine it & its surroundingsto satisfy himself and collect all relevant information's that he considers necessary for proper assessment of the prospective assignment and for quoting his rates judiciously.

7.0 CRITERIA FOR ELIGIBILITY BID

<p>Bidder should have experience of successfully obtained/undergoing/completed works during the last Seven years ending previous day of last date of submission of bids.</p> <p>Three similar obtained/undergoing/completed works each costing not less than Rs.10,00,00,000</p> <p style="text-align: center;">OR</p> <p>Two similar obtained/undergoing/completed works each costing not less than Rs 15,00,00,000</p> <p style="text-align: center;">OR</p> <p>one similar obtained/undergoing/completed work costing not less than Rs.25,00,00,000.</p> <p>(i) similar work shall mean “Building works</p>
<p>Value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to the last date of submission/ uploading of applications for tenders</p>
<p>Bidder should have had average annual financial turnover (gross) of Rs. 25,00,00,000 on civil/electrical construction works during the immediate last three consecutive years balance sheet duly audited by Chartered Accountant. Year in which no turnover is shown would also be considered for working out the average.</p>
<p>The bidder should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder shall have to submit a list of these employees stating clearly how these would be involved in this work within 15 (fifteen) days of award of work.</p>

8.0 Evaluation Criteria for Eligibility Bid

<p>The Eligibility details submitted by the bidders will be evaluated in the following manner.</p>	
<p>8.1.1</p>	<p>The initial criteria prescribed in para 7.0 above in respect of experience of eligible similar works, loss, financial turn over etc. will first be scrutinized and the bidder’s eligibility for the work be determined.</p>
<p>8.1.2</p>	<p>The bidders qualifying the initial criteria as set out in para 7.0 above will be evaluated for the financial criteria by Lowest - L1 method .</p>
<p>The Department, however, reserves the right to restrict the list of such qualified bidders to any number deemed suitable by it.</p>	

9.0 FINANCIAL INFORMATION

Bidder should furnish the following financial information

10.0 EXPERIENCE IN WORKS HIGHLIGHTING EXPERIENCE IN SIMILAR WORKS**11.0 ORGANISATION INFORMATION**

Bidder is required to submit the information in respect of his organization (in form “E”).

13.0 LETTER OF TRANSMITTAL

The bidder should submit the letter of transmittal attached with the document.

14.0 OPENING OF THE FINANCIAL BID

After evaluation of eligibility documents, a list of short listed agencies qualified in eligibility criteria will be prepared. Thereafter, the financial bids of only the qualified and technically acceptable bidders shall be opened at the notified time, date and place in the presence of the qualified bidders or their representatives. The bids shall remain valid for Ninety

(90) days from the date of opening of the Eligibility Bids.

15.0 AWARD CRITERIA

15.1 The NCCF reserves the right, without being liable for any damages or obligation to inform the bidder, to:

- (a) Amend the scope and value of contract to the bidder.
- (b) Reject any or all of the applications without assigning any reason.

15.2 Any effort on the part of the bidder or his agent to exercise influence or to pressurize the NCCF would result in rejection of his bid. Canvassing of any kind is prohibited.

Letter of Transmittal

From :

To,

**The Regional Manager/ Project In-charge
,NCCF of India Ltd,Lucknow-226006**

Sub: **“CONSTRUCTION of (Administrative, Academic, Teaching & Training, Calss Rooms) Blocks at Jamia Millia Islamia new Delhi 110025 S.H.: Civil works, Internal and External Electrical work, Fire Fighting,& Lifts etc.**

Sir,

Having examined the details given in Tender Notice and Bid document for the above work,I/We hereby submit the relevant information.

1. I/We hereby certify that all the statement made and information supplied in the enclosed bid are true and correct.
2. I/We have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
3. I/We submit the experience certificates as per the requirements in support of our suitability, technical knowledge and capability for having successfully
4. Eligibility Document and Earnest money amounting to Rs...../- in the prescribed forms is submitted herewith under sealed envelope.
5. Tender document is submitted to NCCF Lucknow Branch.

Enclosures:

Seal of bidder

Date of submission

SIGNATURE(S) OF BIDDER(S)

FORM 'E'

STRUCTURE & ORGANISATION

1.	Name & Address of the bidder	
2.	Telephone No. / Email Id /Telex No./Fax No.	
3.	Legal status of the bidder (attach copies of original document defining the legal status).	
	a) An Individual	
	b) A proprietary firm	
	c) A firm in partnership	
	d) A limited company or Corporation	
4.	Particulars of registration with various Government bodies (attach attested photo-copy).	
	ORGANIZATION / PLACE OF REGISTRATION	
	1.	
	2.	
	3.	
5.	Names and Titles of Directors & Officers with designation to be concerned with this work.	
6.	Designation of individuals authorized to act for the organization.	
7.	Was the bidder ever required to suspend construction for a period of more than six months continuously after commencing the construction? If so, given the name of the project and reasons of suspension of work.	
8.	Has the bidder, or any constituent partner in case of partnership firm, ever abandoned the awarded work before its completion? If so, give name of the project and reasons for abandonment.	
9.	Has the bidder, or any constituent partner in case of partnership firm ever been debarred/black listed for tendering in any organization at any time? If so, give details.	
10.	Has the bidder, or any constituent partner in case of partnership firm, ever been convicted by a court of law? If so, give details.	
11.	In which field of Civil Engineering Construction the bidder has specialization and interest?	
12.	Any other information considered necessary but not included above.	

Signature of bidder(s) with stamp

PART-B
(Composite Works)

**SPECIAL, ADDITIONAL CONDITIONS
& PARTICULAR SPECIFICATIONS**

SPECIAL CONDITIONS

- 1.1 GENERAL:** The Bidders are advised to inspect and examine the site and its surroundings and satisfy themselves with the nature of site, the means of access to the site, the constraints of space for stacking material / machinery, labor etc. constraints put by local regulations, if any, weather conditions at site, general ground / subsoil conditions etc. or any other circumstances which may affect or influence their tenders. The site is available for work. The Bidder shall carry out survey of the work area, at his own cost, setting out the layout and fixing of alignment of the building as per architectural and Structural drawings in consultation with the Engineer-in-Charge and proceed further ensuring full structural continuity and integrated and monolithic construction. Any discrepancy between the architectural drawings and actual layout at site shall be brought to the notice of the NCCF It shall be responsibility of the Bidder to ensure correct setting out of alignment. Nothing extra shall be payable on this account. No claims, whatsoever, shall be entertained at a later date for any errors found, on plea that the information supplied by the Department in the tender is insufficient or is at variance with the actual site conditions.
- 1.2 Drawing:** The Bidder shall, if required by him, before submission of the tender, inspect the drawings in the **office of** National Cooperative Consumer Federation of India Ltd. New Delhi/Lucknow Branch Office. The Department shall not bear any responsibility for the lack of knowledge and also the consequences, thereof to the Bidder. The information and data shown in the drawings and mentioned in the tender documents have been furnished, in good faith, for general information and guidance only. The Engineer-in-Charge, in no case, shall be held responsible for the accuracy thereof and/or interpretations or conclusions drawn there from by the Bidder and all consequences shall be borne by the Bidder. No claim, whatsoever, shall be entertained from the Bidder, if the data or information furnished in tender document is different or in- correct otherwise or actual working drawings are at variance with the drawings available for inspection or attached to the tender documents. It is presumed that the Bidder shall satisfy himself for all possible contingencies, incidental charges, wastages, bottlenecks etc. likely during execution of work and acts of coordination, which may be required between different agencies. Nothing extrashall be payable on this account.
- 1.1.1** The several documents forming the tender are to be taken as mutually complementary to one another. Detailed drawings shall be followed in preference to small scale drawings and figured dimensions in preference to scale dimensions.
- 1.1.2** The work shall be carried out in accordance with the approved architectural drawings, structural drawings, and service drawings to be issued from time to time, by the NCCF Before commencement of any item of work the bidder shall correlate all the relevant architectural and structural drawings, nomenclature of items and specifications etc. issued for the work and satisfy himself that the information available from there is complete and unambiguous. The figure and written dimension of the drawings shall be superseding the measurement by scale. The discrepancy, if any, shall be brought to the notice of the Engineer-in- charge before execution of the work. The bidder alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and or incomplete information and no claim whatsoever shall be entertained by the department on this account.
- 1.1.3** Before taking up the work, the bidder shall be provided with integrated drawings for various civil and electrical services showing details of lay out plan including sectional elevations and bidder shall plan and mobilize his resources as per the Integrated drawings and as per the site conditions to facilitate convenient execution, installation as well as maintenance of these services. Nothing extra shall be payable on this account.
- 1.3 Nomenclature:** The nomenclature of the item given in the schedule of quantities gives in general the work content but is not exhaustive i.e. does not mention all the incidental works required to be carried out for complete execution of the item of work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/or described in the specifications, provided that the same can be reasonably inferred there from may be several incidental works, which

are not mentioned in the nomenclature of each item but will be necessary to complete the item in all respect. All these incidental works / costs which are not mentioned in item nomenclature but are necessary to complete the item shall be deemed to have been included in the rates quoted by the bidder for various items in the schedule of quantities. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation / change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of NCCF Nothing extra shall be payable on this account.

- 1.4 Specifications:** The work shall generally be carried out in accordance with the “CPWD Specifications 2021 Vol. I & II” with up to date correction slips, additional/Particular Specifications, relevant architectural/structural drawings and as per the guidelines of NCCF Any additional item of the work, if taken up subsequently, shall also confirm to the relevant CPWD specifications as mentioned above.
- 1.5 Order of Preference:** In case of any difference or discrepancy between the description of items as given in the schedule of quantities, particular specifications for individual items of work (including special conditions) and I.S. Codes etc., the following **order of preference** shall be observed.
- (i) Description of items as given in Schedule of quantities
 - (ii) Particular specifications
 - (iii) Special conditions
 - (iv) Additional condition
 - (v) Tender drawings attached
 - (vi) CPWD Specifications including upto date correction slips.
 - (vii) General Conditions of Contract 2021 for CPWD Works with upto date correction slips.
 - (viii) Indian Standards Specifications of B.I.S.
 - (ix) ASTM, BS, or other foreign origin code mentioned in tender document.
 - (x) Manufacturer’s specifications and as decided by the NCCF
 - (xi) Sound Engineering practices or well established local construction practices.
- 1.6** The works to be governed by this contract shall cover delivery and transportation up to destination, safe custody at site, insurance, erection, testing and commissioning of the entire works.
- The works to be undertaken by the bidder shall inter-alia include the following:
- (i) Preparation of detailed SHOP drawings and AS BUILT drawings wherever applicable.
 - (ii) Obtaining of Statutory permissions where-ever applicable and required.
 - (iii) Pre-commissioning tests as per relevant standard specifications, code of practice, Acts and Rules wherever required.
 - (iv) Warranty obligation for the equipment’s and / or fittings/fixtures supplied by the bidder. Bidder shall provide all the shop drawings or layout drawings for all the coordinated services before starting any work or placing any order of any of the services etc. These shop drawings/layout drawings shall be got approved from Engineer-in- charge before implementation and this shall be binding on the bidder. The bidder shall submit material submittals along with material sample for approval of Engineer-in-Charge prior to delivery of material at site.
- 1.7 Stacking of Material** The Bidder(s) shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed. The stacking shall take place as per stacking plan however, if any change is required, the same shall be done with the approval of NCCF
- 1.8 Specialised agency:** The bidder shall engage specialized agencies for the execution of the specialized items such as Water proofing treatment structural glazing, Interior works viz. Wall panelling, false ceiling, wooden flooring, Acoustics work, Fire check doors, stone cladding, Granite & Marble stone flooring Aluminium doors & window stone cladding etc. as mentioned in the tender document covered under Part-C of the schedule of Quantity for Civil component. Before engaging such specialized agency, the bidder shall submit for the approval of Engineer- in-charge, the names of

the agencies along with their relevant working experience, presentation on method statement and materials being used for execution of such items etc.

- 1.9 Performance Test:** The bidder shall give performance test of the entire installation(s) as per the specifications in the presence of the Engineer-in-charge or his authorized representative before the work is finally accepted and nothing extra what-so-ever shall be payable to the bidder for such test.
- 1.10 Licensed Plumber:** Water tanks, taps, sanitary, water supply & drainage pipes, fittings & accessories should conform to bye-laws of local body/corporation, where CPWD specifications are not available. The Bidder should engage approved, licensed plumbers for the work and get the materials (fixtures/fittings) tested, by the municipal Body/ Corporation authorities wherever required at his own cost. The Bidder shall submit for the approval of the Engineer- in-Charge, the name of the plumbing agency (along with their working experience in recent past) proposed to be engaged by him.
- 1.11 Maintenance of Register:** All test registers and MAS registers issued by the engineer-in- charge shall be maintained by the bidder which will be reviewed by the officers of Engineer- in- charge at regular intervals. Frequency of tests will be governed by the CPWD specifications 2009 Volume I & II with upto date correction slips.
- 1.12 Prevention of nuisance and pollution control:** The bidder shall take all necessary precautions to prevent any nuisance or inconvenience to the owners, tenants or occupiers of adjacent properties and to the public in general and to prevent any damage to such properties from pollutants like smoke, dust, noise. The bidder shall use such methodology and equipment so as to cause minimum environmental pollution of any kind during and minimum hindrance to road users and to occupants of the adjacent properties or other services running adjacent/near vicinity. The bidder shall make good at his cost and to the satisfaction of the Engineer-in-Charge, any damage to roads, paths, cross drainage works or public or private property whatsoever caused due to the execution of the work or by traffic brought thereon by the bidder. All waste or superfluous materials shall be carried away by the bidder, without any reservation, entirely to the satisfaction of the NCCF. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the nearby occupants/users of building(s), if any.
- 1.13 Compliance of NGT Orders:** As per the directives of Hon'ble National Green Tribunal in O.A. No.21 of 2014 and O.A. No. 95 of 2014 and MoEF guidelines 2014 on Air Pollution for Construction and Demolition activity.
- (A) NGT order dated 04.12.2014:** 'No government, authority, bidder, builders or any person would be permitted to store/dump construction material or debris on metalled road. 'Beyond the metalled road the area where such the construction material or debris can be stored shall be physically demarcated by officers of all the concerned Authorities/Corporation ensuring that it would not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured that no accidents occur on account of such permissible storage.

Every builder, bidder or person shall ensure that the construction material is covered by tarpaulin and all other precaution should be taken to ensure that no dust particles are permitted to pollute air quality as a result of such storage. It shall also be ensured that appropriate protection measures are taken by raising wind breakers of appropriate height on all sides of the plot area using plastic and f or other similar material to ensure that no construction material dust fly outside the plot area and it will be the builder/bidder responsibility to ensure that their activity does not cause any air pollution during course of construction and for storage of material or construction activity. This condition shall be strictly adhered to by every builder, bidder, person or authority. In the event of default they shall be liable to be prosecuted under the law in force, as well as for causing environmental pollution and will be liable to pay compensation which would be determined by Tribunal in accordance with law.

All the trucks or vehicles of any kind which are used for construction purposes f or are carrying construction material like cement, sand and other allied material should be fully covered. The vehicles should be properly cleaned, should be dust free and every necessary precautions is to be taken to

ensure that enroot their destination, the dust, sand or any other particles eLre not permitted to be released in air/contaminate air. Any truck not complying with the above directions would not be permitted to enter NCR, Delhi.

- (B) **NGT order dated 10.04.2015:** Every builder or owner shall put Tarpaulin on scaffolding around the area of construction and the building. No person including builder, owner can be permitted to store any construction material particularly sand on any part of the street, roads in any colony. The construction material of any kind that is stored in the site will be fully covered in all respects so that it does not disperse in the Air in any form. All the construction material and debris shall be carried in the trucks or other vehicles which are fully covered and protected so as to ensure that the construction debris or the construction material does not get dispersed into the air or atmosphere, in any form whatsoever.

The dust emissions from the construction site should be completely controlled and all precautions taken in that behalf. The vehicles carrying construction material and construction debris of any kind should be cleaned before it is permitted to ply on the road after unloading of such material. Every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris shall be provided with mask to prevent inhalation of dust particles. Every owner and or builder shall be under obligation to provide all medical help, investigation eind treatment to the workers involved in the construction of building and carry of construction material and debris relatable to dust emission. It shall be the responsibility of every builder to transport construction material and debris waste to construction site, dumping site or any other place in accordance with rules and in terms of this order. All to take appropriate measures and to ensure that the terms and conditions of the earlier order and these orders should strictly comply with by fixing sprinklers, creations of green air barriers, compulsory use of wetjet in stone cutting. Wind breaking walls around construction site.

All the builders who are building commercial, residential complexes which are covered under the EIA Notification of 2006 shall provide green belt around the building that they construct. All Authorities shall ensure that such green belts are in existence prior to issuance of occupancy certificate. All builders shall ensure that C&D waste is transported in terms of this order to the C & D Waste site only and due record in that behalf shall be maintained by the builders, transporters and NCR of Delhi. Even if constructions have tree started after seeking Environmental Clearance under the EIA notification 2006 and after taking other travel but is being carried out without taking the preventive and protective environmental steps as stated in this order and MoEF guidelines, 2010, the State Government, SPCB and any officer of any department. as afore stated shall be entitled to direct stoppage of work.

- (C) **Environmental Impact Assessment Guidance Manual for Building Construction. Township:** February 2010 envisages the following guidelines for mitigation measures in respect of dust control from Building. Construction projects: "Adopting techniques like, airextraction equipment, and covering scaffolding, hosing down road surfaces and cleaning of vehicles can reduce dust and vapour emissions. Measures include appropriate containment around bulk storage tanks and materials stores to prevent spillages entering watercourses." Theother measures to reduce the Air pollution on site are: 'Sprinkling of water and fine spray from nozzles to suppress the dust. 'On-Road-Inspection should be done for black smoke generating machinery. Promotion of use of cleaner fuel should be done. All DG sets should comply emission norms notified by MoEF 'Vehicles having pollution under control certificate may be allowed to ply. 'Use of covering sheet to prevent dust dispersion at buildings and infrastructure sites, which are being constructed 'Use of covering sheets should be done for trucks to prevent dust dispersion from the trucks, implemented by district offices. 'Paving is a more permanent solution to dust control, suitable for longer duration projects. High cost is the major drawback to paving. 'Reducing the speed of a vehicle to 20 kmph can reduce emissions by a large extent. Speed bumps are commonly used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, it may be necessary to divert traffic 1-o nearby paved areas. Material storages / warehouses - Care should be taken to keep ail material storages adequately covered and

contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions. Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust.

- 1.14 Security & traffic arrangements:** The bidder(s) shall give to the local body, police and other authorities all necessary notices etc. that may be required by law and obtain all requisite licenses / permissions for temporary obstructions, enclosures etc. and pay all fee, taxes and charges which may be leviable on account of these operations in executing the contract. He shall make good any damage to the adjoining property whether public or private and shall supply and maintain lights either for illumination or for cautioning the public at night.

Proper temporary barricading by fencing with profile sheets shall be carried out by the Bidder at the start of work to physically define the boundaries of the plot for restricted entry to only those involved in the work and also to prevent any accidents, at the same time without causing any inconvenience to the traffic and the neighbours / users of the buildings in the adjacent plots. It shall be done by providing, erecting, maintaining **temporary protective barricading of minimum 6.0 metres in height**, made in panels, with each panel having MS frames / MS scaffolding/pipes etc. of suitable size and stiffness shall be fixed on frames. Such panels shall be suitably connected to each other for stability with nuts and bolts, hooks, clamps etc. and fixed firmly to the ground at about 2 metres spacing, for the entire duration till completion of the work. He shall also provide and erect temporary protective barricades within the plot, if required, to prevent any accident. Temporary protective roofing near the Entrance to the building, under construction, shall be made to protect the visiting officials from getting hurt by falling debris etc. Also, one or more coat of enamel paint of shade as approved and directed by the Engineer-in- Charge shall be applied on the panels and "CPWD" shall be painted over that in suitable sizes, shapes and numbers as directed by the NCCF **It shall be dismantled and taken away by the Bidder after the completion of work at his own cost** with the approval of the Engineer-in- Charge. Nothing extra shall be payable on this account.

The bidder shall maintain it during the complete period of execution and realign it if required, for execution of works. A penalty of Rs. 5000/- (Rupees Five Thousand) per day shall be levied for not maintaining the barricading in good condition or breach of any of the above conditions as per the directions of NCCF

The Bidder(s) shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night. In case of any accident of labours/ contractual staffs the entire responsibility will rest on the part of the bidder and any compensation under such circumstances, if becomes payable, shall be entirely borne by the bidder.

In the event of any restrictions being imposed by the Security agency, CPWD, Traffic or any other authority having jurisdiction in the area on the working or movement of labour / material, the bidder shall strictly follow such restrictions and nothing extra shall be payable to the bidder on such accounts. The loss of time on these accounts, if any, shall have to be made up by augmenting additional resources whatever required.

The bidder shall be responsible for the **watch and ward/guard of the buildings**, safety of all fittings and fixtures including all equipments, services provided by him against pilferage and breakage during the period of Installations and thereafter till the building is physically handed over to the Client Department. No extra payment shall be made on this account and no claim shall be admissible on this account.

- 1.15 Labour Hut:** If as per the rules of the local authority, the huts for labour are not to be erected at the site of work by the bidders, the bidder is required to provide such accommodation as is acceptable to local bodies and nothing extra shall be paid by NCCF/JMS on this account. No accommodation is available at the site of work. He shall make his own arrangements for stores, field office etc. Before tendering, he shall visit the site and assess the manner in which he is able to arrange the above

facilities. The Engineer-in-Charge shall in no way be responsible for any delay on this account and no claim, whatsoever, on this account shall be entertained.

- 1.16 Natural Calamities:** No payment shall be made for any damage caused by natural calamities viz. rain, snowfall, fog, earthquake, storm, floods etc. whatsoever during the execution of the work. The bidder shall be fully responsible for any damage to the govt. property and the work for which payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The bidder shall be fully responsible for safety and security of his material and T&P/Machinery etc. brought to the site by him.
- 1.17 Responsibility till completion:** The Bidder shall maintain all the work in good condition till the completion of entire work. The Bidder shall be responsible for and shall make good, all damages and repairs, rendered necessary due to fire, rain, traffic, floods or any other causes. The Engineer-in-Charge shall not be responsible for any claims for injuries to person/workmen or for structural damage to property happening from any neglect, default, want of proper care or misconduct on the part of the Bidder or of any other of his representatives, in his employment during the execution of the work. The compensation, if any, shall be paid directly to the Department / authority / persons concerned, by the Bidder at his own cost.
- 1.18 Godown:** The bidder may construct suitable godowns, yard etc. at the site of work for storing all other materials so as to be safe against damage by sun, rain, fire, theft etc. at his own cost and also employ necessary watch & ward establishment for the purpose at his cost.
- 1.19 Material check before use:** All construction materials brought to site by the bidder shall be got checked by the representative of Engineer-in-Charge on receipt of the same at site before use.
- 1.20 Royalty:** Royalty at the prevalent rates shall have to be paid by the bidder on all the boulders, metals, shingle sand and bajri etc. collected by him for the execution of the work, direct to the Revenue authority or authorized agent of the State Government concerned or Central Government.
- 1.20.1 Royalty** at the prevalent rates shall be paid by the Bidder or the ready mix concrete (RMC) supplier as per the terms of supply between them, on all materials such as boulders, metals, all sizes stone aggregates, brick aggregates, coarse and fine sand, moorum, river sand, gravels and bajri etc. collected by him for the execution of the work, directly to the revenue authority of the state government concerned. Further, bidder needs to submit proof of submission of full royalty to the state government or local authority. Nothing extra shall be payable on this account.
- 1.21** The Bidder shall keep himself fully informed of all acts and laws of the Central & State Governments, all orders, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work. All rules, regulations & bye-laws laid down by the Collector / DDA / North Delhi MCD and any other statutory bodies shall be adhered to, by the bidder, during the execution of work. The Bidder shall also adhere to all traffic restrictions notified by the local authorities. The extra sewerage charges (one time charges for commencement of work) required to be paid to the Municipal Corporation/ other statutory bodies shall be paid by the department and need not be considered by the bidder. All statutory taxes, levies, charges (including water and sewerage charges, charges for temporary service connections and / or any other charges) payable to such authorities for carrying out the work, shall be borne by the Bidder. The water charges (for municipal water connection as well as tanker water) shall be borne by the bidder. Also, if the bidder obtains water connection for the drinking purposes from the municipal authorities or any other statutory body, the consequent sewerage charges shall be borne by the bidder. The clause 31A of the General conditions of contract for CPWD works is not applicable to the tender. The Bidder shall arrange to give all notices as required by any statutory / regulatory authority and shall pay to such authority all the fees that is required to be paid for the execution of work. He shall protect and indemnify the Department and its officials & employees against any claim and /or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. Nothing extra shall be payable on these accounts. The fee payable to statutory authorities for obtaining the various

permanent service connections and Occupancy Certificate for the building shall be borne by the Department.

- 1.22 De-watering:** For works below ground level the bidder shall keep the area free from water. If dewatering or bailing out of water is required the bidder shall do the same at his own cost and nothing extra shall be paid on this account.
- 1.23 Survey:** The Bidder shall carry out survey of the work area, at his own cost, setting out the layout of building in consultation with the Engineer -in-Charge & proceed further. Any discrepancy between the Engineer-in-charge, architectural drawings and actual layout at site shall be brought to the notice of the Engineer -in-charge. It shall be responsibility of the Bidder to ensure correct setting out of alignment. Total station survey instruments only shall be used for layout, fixing boundaries, and centre lines, etc., Nothing extra shall be payable on this account.
- 1.23.2** The Bidder shall establish, maintain and assume responsibility for grades, lines, levels and benchmarks. He shall report any errors or inconsistencies regarding grades, lines, levels, dimensions etc. to the Engineer -in-Charge before commencing work. Commencement of work shall be regarded as the Bidder's acceptance of such grades, lines, levels, and dimensions and no claim shall be entertained at a later date for any errors found.
- 1.23.3** If at any time, any error appears due to grades, lines, levels and benchmarks during the progress of the work, the Bidder shall, at his own expense rectify such error, if so required, to the satisfaction of the Engineer -in-Charge. Nothing extra shall be payable on this account.
- 1.23.4** Though the site levels are indicated in the drawings the Bidder shall ascertain and confirm the site levels with respect to benchmark from the concerned authorities. The Bidder shall protect and maintain temporary/ permanent benchmarks at the site of work throughout the execution of work. These benchmarks shall be got checked by the Engineer-in-Charge or his authorized representatives. The work at different stages shall be checked with reference to bench marks maintained for the said purpose. Nothing extra shall be payable on this account.
- 1.23.5** The approval by the Engineer-in-Charge, of the setting out by the Bidder, shall not relieve the Bidder of any of his responsibilities and obligation to rectify the errors/ defects, if any, which may be found at any stage during the progress of the work or after the completion of the work.
- 1.23.6** The Bidder shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the Bidder at his own cost to the entire satisfaction of the Engineer - in-Charge.
- 1.24 Field Laboratory:** A site field laboratory with the minimum equipments as specified in CPWD specifications/in this agreement shall be established, made functional and maintained within one month from the award of work as per Annexure-I without any extra cost to the department. In case of non compliance / delay in compliance in this, a recovery @ Rs. 2500/- per day will be imposed which will be recovered from the immediate next R/A Bill of the Bidder.
- 1.25 Tools and plants:** The bidder should have own constructions equipment required for the proper and timely execution of the work. Nothing extra shall be paid on this account.

No tools and plants including any special T&P etc. shall be supplied by the Department and the Bidder shall have to make his own arrangements at his own cost. No claim of hindrance (or any other claim) shall be entertained on this account.

- 1.26 Scaffolding:** Wherever required for the execution of work, all the scaffolding shall be provided and suitably fixed, by the Bidder. It shall be provided strictly with steel double scaffolding system, suitably braced for stability, with all the accessories, gangways, etc. with adjustable suitable working platforms to access the areas with ease for working and inspection. It shall be designed to take all incidental loads. It should cater to the safety features for workmen. Nothing extra shall be payable on this account. It shall be ensured that no damage is caused to any structure due to the scaffolding. One full set of shuttering for all columns and one complete lift set for retaining wall are to be brought at site for speedy construction.

1.27 The Bidder shall do proper sequencing of the various activities by suitably staggering the activities within various pockets in the plot so as to achieve early completion. The agency to deploy adequate equipment, machinery and labour as required for the completion of the entire work within the stipulated period specified. Also ancillary facilities shall be provided by bidder commensurate with requirement to complete the entire work within the stipulated period. Nothing extra shall be payable on this account. Adequate number/sets of equipment in working condition, along with adequate stand-by arrangements, shall be deployed during entire construction period. It shall be ensured by the Bidder that all the equipment, Tools & Plants, machineries etc. provided by him are maintained in proper working conditions at all times during the progress of the work and till the completion of the work. Further, all the constructional tools, plants, equipment and machineries provided by the Bidder, on site of work or his workshop for this work, shall be exclusively intended for use in the construction of this work and they shall not be shifted/ removed from site without the permission of the NCCF

1.28 Preservation & Conservation Measures: Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar services, if any, encountered in the course of the execution of work shall be protected against the damage by the bidder at his own expense. In case the same are to be removed and diverted, expenditure incurred in doing so shall be payable to the bidder. The bidder shall work out the cost, get the same approved by Engineer-in-Charge before taking up actual execution. The bidder shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services.

All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on project location during excavation/ construction shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation. The bidder will take reasonable precaution to prevent his work men or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer-in-charge of such discovery and carry out the official instructions of Engineer-in-charge for dealing with the same, till then all work shall be carried out in a way so as not to disturb/damage such article or thing.

The bidder will take reasonable precautions to prevent his workman and employees from removing and damaging any flora (plant/vegetation) from the project area.

1.29 Responsibility: He shall protect and indemnify the NCCF and its officials & employees against any claim and /or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. Nothing extra shall be payable on these accounts. The fee payable to statutory authorities for obtaining the various permanent service connections and Building Use Certificate for the building shall be borne by the NCCF

The Bidder shall assume all liability, financial or otherwise in connection with this contract and shall protect and indemnify the Department from any and all damages and claims that may arise on any account. The Bidder shall indemnify the Department against all claims in respect of patent rights, royalties, design, trademarks- of name or other protected rights, damages to adjacent buildings, roads or members of public, in course of execution of work or any other reasons whatsoever, and shall himself defend all actions arising from such claims and shall indemnify the Department in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.

1.30 Co-Operation With Other Bidders / Specialized Agencies/Sub-Bidders: The Bidder shall take all precautions to abide by the environmental related restrictions imposed by any statutory body having jurisdiction in Delhi as well as prevent any pollution of streams, ravines, river bed and waterways. All waste or superfluous materials shall be transported by the Bidder, entirely to the satisfaction of the Engineer-in-Charge and disposed at designated places only. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of adjoining buildings. No claim what so ever on account of site constraints mentioned above or any other site constraints, lack of public transport, , inadequate availability of skilled, semi-skilled or unskilled workers in the near vicinity, non-availability of construction

machinery spare parts and any other constraints not specifically stated here, shall be entertained from the Bidder. Therefore, the Tenderers are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their tenders. Nothing extra shall be payable on this account.

The Bidder shall cooperate with and provide the facilities to the sub-Bidders and other agencies working at site for smooth execution of the work. The bidder shall indemnify the CPWD against any claim(s) arising out of such disputes. The Bidder shall:

- (a) Allow use of scaffolding, toilets, sheds etc.
- (b) Properly co-ordinate their work with the work of other Bidders.
- (c) Provide control lines and benchmarks to his Sub-Bidders and the other Bidders.
- (d) Provide electricity and water at mutually agreed rates.
- (e) Provide hoist and crane facilities for lifting material at mutually agreed rates.
- (f) Co-ordinate with other Bidders for leaving inserts, making chases, alignment of services etc.at site.
- (g) Adjust work schedule and site activities in consultation with the Engineer-in- Charge and other Bidders to suit the overall schedule completion.
- (h) Resolve the disputes with other Bidders/ sub-bidders amicably and the Engineer-in-Charge shall not be made intermediary or arbitrator.

The work should be planned in a systematic manner so as to ensure proper co-ordination of various disciplines viz. sanitary & water supply, drainage, rain water harvesting, electrical, fire fighting, information technology, communication & electronics and any other services.

Other agencies will also simultaneously execute and install the works of sub-station / generating sets, air-conditioning, lifts, etc. for the work and the bidder shall afford necessary facilities for the same. The bidder shall leave such recesses, holes, openings trenches etc. as may be required for such related works (for which inserts, sleeves, brackets, conduits, base plates, clamps etc. shall be supplied free of cost by the department unless otherwise specifically mentioned) and the bidder shall fix the same at time of casting of concrete, stone work and brick work, if required, and nothing extra shall be payable on this account.

The bidder shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other bidder(s) or by the Engineer-In-Charge and shall as far as possible arrange his work and shall place and dispose off the materials being used or removed so as not to interfere with the operations of other bidder or he shall arrange his work with that of the others in an acceptable and in a proper co-ordination manner and shall perform it in proper sequence to the complete satisfaction of others.

1.31 Supervision of Work: The Bidder shall depute Site Engineer & skilled workers as required for the work. He shall submit organization chart along with the details of Engineers & supervisory staff. It shall be ensured that all decision making powers shall be available to the representatives of the Bidder at New Delhi itself to avoid any likely delays on this account. The Bidder shall also furnish list of persons for specialized works to be executed for various items of work. The Bidder shall identify and deploy key persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the Engineer-in-Charge is of the opinion that the deployed staff is not sufficient or not well experienced; the Bidder shall deploy more staff or better-experienced staff at site to complete the work with quality and in stipulated time limit. Principle Technical representative of the Bidder having minimum twenty years of experience in similar nature of work as mentioned in the clause 36 of the General Conditions of the Contract, shall always be available at the site during the actual execution of the work.

1.32 Specialized Agencies: The composite tender comprises of two main components: viz. civilwork and Electrical & Mechanical works. The list of specialized items for civil works is as below:

- a. Water proofing treatment.
- b. Structural glazing.
- c. False ceiling
- d. Wooden flooring
- e. Fire check doors.
- f. Rock Anchoring

The main bidder shall submit the credentials of specialized agencies well in advance to the Engineer-in-charge for approval. After verification of the same, written approval will be conveyed to main bidder in this regard. The quantum of credentials will be broadly in line with CPWD guidelines. The main bidder shall not change the specialized agency. However, if the change is warranted, he may do so, with permission of NCCF. However, before making any such change he has to enter into similar agreement as with previous agency & submit the same to Engineer-in-Charge for approval. This shall however be without any change in the accepted rates of the contract agreement and without any cost implications to the Department.

It shall be the responsibility of main bidder to sort out any dispute / litigation with the Specialized Agencies without any time & cost overrun to the Department. The main bidder shall be solely responsible for settling any dispute / litigation arising out of his agreement with the Specialized Agencies. The bidder shall ensure that the work shall not suffer on account of litigation/ dispute between him and the specialized agencies / sub-bidder(s). No claim of hindrance in the work shall be entertained from the Bidder on this account. No extension of time shall be granted and no claim what so ever, of any kind, shall be entertained from the Bidder on account of delay attributable to the selection/rejection of the Specialized Agencies or any dispute amongst them.

RATES: The rates quoted by the Bidder are deemed to be inclusive of site clearance, setting out work, profile, setting lay out on ground, establishment of reference bench mark(s), installing various signage, taking spot levels, survey with total station, construction of all safety and protection devices, MS Barricading Noise barrier/Sound Proof (Permanent Type) made out of MS channels/Angels/pre-coated GI sheets provided at site for segregating the existing adjoining Houses and the construction area. (The height of barricading shall be 6 (Six) meter from groundlevel), Nylon / Fiber net of appropriate strength and gauge, compulsory use of Helmet and Safety shoes & other appropriate safety gadgets by workers, imparting continuous training for all the workers, barriers, preparatory works, construction of clean, hygienic and well ventilated workers housings in sufficient numbers as per drawing supplied by Engineer in charge, working during monsoon or odd season, working beyond normal hours, working at all depths, height, lead, lift, levels and location, etc. and any other unforeseen but essential incidental works required to complete this work. Nothing extra shall be payable on this account and no extension of time for completion of work shall be granted on these accounts. On completion of work the bidder will have to remove the said temporary structures at his own cost. No payment shall be made on this account to the bidder. The design of the barricading shall be got approved by Engineer-in-charge before installation.

No foreign exchange shall be made available by the Department for importing (purchase) of equipment, plants, machinery, materials of any kind or any other items required to be carried out during execution of the work. No delay and no claim of any kind shall be entertained from the Bidder, on account of variation in the foreign exchange rate.

Ancillary and incidental facilities required for execution of work like labour accommodations, stores, fabrication yard, offices for Bidder, watch and ward, temporary ramp required to be made for working at the basement level, temporary structure for plants and machineries, water storage tanks, installation and consumption charges of temporary electricity, telephone, water etc. required for execution of the work, liaison and pursuing for obtaining various No Objection Certificates, completion certificates from local bodies etc., protection works, testing facilities / laboratory at site of work, facilities for all field tests and for taking samples etc. during execution or any other activity which is necessary (for execution of work and as directed by Engineer-in-Charge), shall be deemed to be included in rates quoted by the Bidder, for various items in the schedule of quantities. Nothing extra shall be payable on these accounts. Before start of the work, the Bidder shall submit to the Engineer-in-Charge, a site /

construction yard layout, specifying areas for construction, site office, positioning of machinery, material yard, cement and other storage, steel fabrication yard, site laboratory, water tank, etc.

For completing the work in time, the Bidder might be required to work in two or more shifts (including night shifts). No claim whatsoever shall be entertained on this account, not with- standing the fact that the Bidder may have to pay extra amounts for any reason, to the labourers and other staff engaged directly or indirectly on the work according to the provisions of the labour and other statutory bodies regulations and the agreement entered upon by the Bidder with them.

All material shall only be brought at site as per program finalized with the Engineer-in- Charge. Any pre-delivery of the material not required for immediate consumption shall not be accepted and thus not paid for.

The rates quoted by the Bidder are deemed to be inclusive of site clearance, setting out work (including marking of reference points, center lines of buildings), construction and maintenance of reference bench mark(s), taking spot levels, construction of all safety and protection devices, barriers, barricading, signage, labour safety, labour welfare and labour training measures, preparatory works, working during monsoon, working at all depths, height and location etc. and any other incidental works required to complete this work. Nothing extra shall be payable on this account.

The rate of items of flooring is inclusive of providing sunken flooring in bathrooms, kitchen etc. and nothing extra on this account is admissible.

The Bidder shall bear all incidental charges for cartage, storage and safe custody of materials, if any, issued by department as well as to those materials also arranged by the bidder.

Any cement slurry added over base surface (or) for continuation of concreting for better bond is deemed to have been built in the items and nothing extra shall be payable or extra cement considered in consumption on this account.

1.33 Safety Practices

1.34.1 WARNING/ CAUTION BOARDS: All temporary warning / caution boards / glow signage display such as "Construction Work in Progress", "Keep Away", "No Parking", Diversions & protective Barricades etc. shall be provided and displayed during day time by the Bidder, wherever required and as directed by the NCCF These glow signage and red lights shall be suitably illuminated during night also. The Bidder shall be solely responsible for damage and accident caused, if any, due to negligence on his part. Also he shall ensure that no hindrance, as far as possible, is caused to general traffic during execution of the work. This signage shall be dismantled & taken away by the Bidder after the completion of work, only after approval of the Engineer-in-Charge. Nothing extra shall be payable on this account.

1.34.2 SIGN BOARDS: The Bidder shall provide and erect a display board of size and shape as required and paint over it, in a legible and workman like manner, the details about the salient features of the project, as required by the NCCF The Bidder shall fabricate and put up a sign board in an approved location and to an approved design indicating name of the project, Client / Owner, Engineer-in-charges, Structural Consultants, Department etc. besides providing space for names of other Bidders, Sub-Bidders and specialized agencies within 15 days from issue of award letter. Nothing extra shall be payable on this account. In case of non compliance/delayin compliance in this, a penalty @ Rs. 500/- per day will be imposed which will be recovered from the immediate next R/A Bill of the Bidder.

Necessary protective and safety equipments shall be provided to the Site Engineer, Supervisory staff, labour and technical staff of the bidder by the Bidder at his own cost and to be used at site.

No inflammable materials including Petrol, Oil, and Lubricants (P.O.L) shall be allowed to be stored in huge quantity at site. Only limited quantity of P.O.L may be allowed to be stored at site subject to the compliance of all rules / instructions issued by the relevant authorities and as per the direction of Engineer -in- Charge in this regard. Also all precautions and safety measures shall be taken by the Bidder for safe handling of the P.O.L products stored at site. All consequences on account of unsafe handling of P.O.L shall be borne by the Bidder.

- 1.34 Quality Assurance:** The proposed building is a prestigious project and quality of work is of paramount importance. Bidder will be required to engage well-experienced supervisors, engineers & skilled labour and deploy modern T&P and other equipments to execute the work in a time bound manner. Many items like exposed finish form work, specialized flooring work, factory made door-window shutters, proper slope maintaining in toilet units, sanitary- water supply installation, textured finishing, aluminium and glass work and water proofing treatment will specially require engagement of skilled workers having experience particularly in execution of such items.

The bidder shall ensure quality construction in a planned and time bound manner. Any sub- standard material / work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-charge & bidder shall be bound to replace / remove such sub-standard / defective work immediately. If any material, even though approved by Engineer-In-Charge is found defective or not conforming to specifications shall be replaced / removed by the bidder at his own risk & cost.

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The bidder shall ensure quality construction in a planned and time bound manner. Any sub- standard material / work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-charge & bidder shall be bound to replace / remove such sub-standard / defective work immediately. If any material, even though approved by Engineer-In-Charge is found defective or not conforming to specifications shall be replaced / removed by the bidder at his own risk & cost.

In addition to the supervision of work by NCCF engineers, the Consultants / third party quality assurance representatives to be deployed by NCCF and shall also be carrying out regular and periodic inspections of the on-going activities in the work and deficiencies, shortcomings, inferior workmanship pointed out by them shall be communicated by NCCF engineers to the bidder. Upon receipt of instructions from Engineer in Charge these are also to be made good by necessary improvement, rectification, replacement upto his complete satisfaction. Special attention shall be paid towards line and level of internal and external plastering, exposed smooth surface of RCC members by providing fresh shuttering plates, rubberized linings to all the shuttering joints, accurate joinery work in wooden doors and windows, thinnest joints in stone/ tiling / cladding work, non-hollowness in floor and dado tiles work, protection of scratches over flooring by impounding layer of Plaster of Paris, water tight pipe linings, absence of hollow vertical joints in brick masonry, proper compaction of filled up earth and up keeping of quality assurance shall be of paramount importance.

The Bidder shall submit within 20 (Twenty) days after the date of award of work, a detailed and complete method statement for the execution, testing and Quality Assurance of such specialized items

of works as directed by the NCCF All the materials to be used in the work to give the finished work complete in all respects, shall comply with the requirements of the specifications and shall pass all the tests required as per specifications as applicable or such specifications / standards as directed by the NCCF However, keeping the Quality Assurance in mind, the Bidder shall submit, on request from the Engineer-in- Charge, his own Quality Assurance procedures for basic materials and such items, to be followed during the execution of the work, for approval of the NCCF

All materials and fittings brought by the bidder to the site for use shall conform to the samples approved by the Engineer-in-charge which shall be preserved till the completion of the work. If a particular brand of material is specified in the item of work in Schedule of Quantity, the same shall be used after getting the same approved from NCCF Wherever brand / quality of material is not specified in the item of work, the bidder shall submit the samples as per suggested list of brand names given in the tender document / particular specifications for approval of NCCF For all other items, materials and fittings of ISI Marked shall be used with the approval of NCCF Wherever ISI Marked material / fittings are not available, the bidder shall submit samples of materials / fittings manufactured by firms of repute conforming to relevant specifications or IS codes and use the same only after getting the approval of NCCF

The Bidder shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the tender documents, as per the item description and particular specifications for the work. The equivalent brand for any item shall be permitted to be used in the work, subject to documentary evidence produced by the contractor for non- availability of the brand specified and also subject to independent verification by the NCCF In exceptional cases, where such approval is required, the decision of Engineer-in-Charge as regards equivalent make of the material shall be final and binding on the Bidder. No claim, whatsoever, of any kind shall be entertained from the Bidder on this account. Nothing extra shall be payable on this account. Also, the material shall be procured only after written approval of the NCCF.

All materials whether obtained from Govt. stores or otherwise shall be got checked by the Engineer-in-Charge or his authorized supervisory staff on receipt of the same at site before use.

The tests, as necessary, shall be conducted in the laboratory approved by the Engineer-in- Charge. The samples shall be taken for carrying out all or any of the tests stipulated in the particular specifications and as directed by the Engineer-in-Charge or his authorized representative.

All the registers of tests carried out at Construction Site or in outside laboratories and all material at site (MAS) registers including cement register shall be maintained by the bidder which shall be issued to the bidder by NCCF All the entries in the relevant registers will be made by the designated Engineering Staff of the bidder and same should be regularly reviewed by NCCF. Bidder shall be responsible for safe custody of all the registers.

The Bidder shall at his own risk and cost make all arrangements and shall provide all such facilities including material and labour, the Engineer-in-Charge may require for collecting, preparing, forwarding the required number of samples for testing as per the frequency of test stipulated in the contract specifications or as considered necessary by the Engineer-in-Charge, at such time and to such places, as directed by the NCCF Nothing extra shall be payable for the above.

The Bidder or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Bidder. The Bidder or his authorized representative shall remain in contact with the Engineer-in-Charge or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the Bidder.

All the testing charges shall be borne by the bidder/ department in the manner indicated below:

By the bidder, if the results show that the material does not confirm to relevant specifications and BIS codes or any other relevant code for which confirmatory test is carried out.

By the department, if the results show that the material confirms to relevant specifications and BIS codes or any other relevant code for which confirmatory test is carried out.

All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested as per the design conditions before covering and their measurements in computerized measurement book duly test checked shall be deposited with Engineer in charge or his authorized representative, prior to hiding these items.

Water tanks, taps, sanitary, water supply and drainage pipes, fittings and accessories should conform to bylaws and municipal body / corporation where CPWD Specifications are not available. The bidder should engage licensed plumbers for the work and get the materials (fixtures/fittings) tested by the Municipal Body/Corporation authorities wherever required at his own cost.

The bidder shall give performance test of the entire installation(s) as per the standing specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the bidder for the test.

The bidder shall have to execute guarantee bonds in respect of water proofing and structural glazing works as per Performa enclosed.

The Bidder shall arrange electricity at his own cost for testing of the various electrical installations as directed by Engineer-in-Charge and for the consumption by the bidder for executing the work. Also, all the water required for testing various electrical installations, fire pumps, wet riser / fire fighting equipments, fire sprinklers etc. and also testing water supply, sanitary and drainage lines, water proofing of underground sump, overhead tanks, water proofing treatment etc. shall be arranged by the bidder at his own cost. Nothing extra shall be payable on this account.

A third party quality assurance agency from Govt. departments/institutes shall be engaged for this work. Bidder shall co-operate with the third party for quality assurance of the construction work. The third party will collect the samples of construction materials for necessary tests. If the samples of the construction material fail in testing, the testing charges shall be borne by the bidder and for the passed samples testing charges shall be paid by the department. The samples would be collected jointly in the presence of the representatives of bidder and NCCF All necessary test records shall be produced and maintained by the quality engineer of bidder.

1.36 Submission and Documentation: The Bidder shall display all permissions, licenses, registration certificates, bar charts and other relevant statements etc. under various labour laws and other regulations applicable to the works, at his site office. He should also keep at site at least one set of all relevant BIS and other relevant Codes at site and produce the same whenever asked for by NCCF In case of non -compliance, these codes will be purchased by the engineer -in -charge from the Market and actual cost of purchase will be recovered from the next RA Bill of the Bidder.

The Bidder shall make available minimum four (04) sets of completed Building Drawings in A-0 size hard copies as well as soft copy of the "As Built Drawings" along with relevant literatures, manuals, warranty bonds and certificates etc. of various installed fittings, fixtures and equipments for the completed project. This shall be the prerequisite for payment of final bill.

The Bidder shall make available minimum three (03) sets of all relevant drawings in A-0 size hard copies as well as soft copy of the of internal and external services i.e. Water Supply, Sanitary line and Drainage lines. This shall be the prerequisite for payment of final bill. These drawings shall have the following information:

Run off for all piping and their diameters including soil, waste pipes and vertical stacks.

Ground and invert level of all drainage pipes together with locations of all manholes and connections, up to outfall.

Run off for all water supply lines with diameters location of control valves, access panels etc.

The bidder shall make available four (04) no. sets of computerized Standard Measurement Books (SMBs) having measurement of all the permanent standing in a building.

The Performance Guarantee shall not be released to the bidder until the aforesaid drawings are submitted to the Engineer-in-Charge

The bidder will submit computerized measurement sheets for the work carried out by him for making payment . For casting of RCC members and other hidden items the corrected and duly test checked measurement sheets of reinforcement or that of other hidden items shall be deposited with Engineer in charge or his authorized representative, before casting of RCC or other hidden items. The delay in submission of corrected and duly checked measurement sheet may, therefore, delay casting of RCC or execution of hidden item for which no hindrance shall be recorded.

To avoid delay, bidder should submit all samples well in advance so as to give timely orders for procurement.

- 1.37 Program Chart:** The Bidder shall prepare an integrated program chart within fifteen days of issue of award letter including civil as well as E & M activities for the execution of work showing clearly all relevant activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfilment of the program within the stipulated period and submit the same for approval of the Engineer-In-Charge within fifteen days of the award of the work. These shall be submitted by the bidder through electronic media besides forwarding hard copies of the same. The integrated program chart so submitted should not have any discrepancy with the physical milestones attached in the contract agreement. The program chart should include the following: -

Descriptive note explaining sequence of various activities.

Construction Program prepared on PRIMAVERA Software, which will indicate resources in financial terms, manpower and specialized equipment for every important stage.

Program for procurement of all relevant materials by the bidder.

Program for arranging and deployment of manpower both skilled and unskilled so as to achieve targeted progress.

Program of procurement of machinery / equipment having adequate capacity commensurate with the quantum of work to be done within the stipulated period, by the bidder.

Program for achieving specified milestones.

In case of non- compliance / delay in compliance of details as above, a penalty @ Rs. 5000/- (Rupees Five Thousand) per day will be imposed which will be recovered from the immediate next R/A Bill of the Bidder.

If at any time, it appears to the Engineer-In-Charge that the actual progress of work does not conform to the approved program referred above, the bidder shall produce a revised program showing the modifications to the approved program by additional inputs to ensure completion of the work within the stipulated time.

The submission for approval by the Engineer-In-Charge of such program or the furnishing of such particulars shall not relieve the bidder of any of his duties or responsibilities under the contract. This is

without prejudice to the right of Engineer-In-Charge to take action against the bidder as per terms and conditions of the agreement.

Apart from the above, the bidder shall be required to submit fortnightly progress report of the work in a computerized form on 1st and 16th of every month. The progress report shall contain the following, apart from whatever else may be required as specified above:

Construction schedule of the various components of the work through a bar chart for the next two fortnights (or as may be specified), showing the relevant milestones, targeted tasks (including material and labour requirement) and up to date progress. Atleast 10 (Ten) digital photographs showing all the parts of construction site along with atleast 5 (Five) minutes video of executions of different items in soft copy has to be submitted alongwith every fortnightly progress report.

Fortnightly progress chart of the various components of the work that are planned and achieved for the fortnight as well as cumulative up to the fortnight under reckoning, with reasons for delay/ deviations, if any in a tabular format.

Plant and machinery statement, indicating those deployed in the work. Man-power statement indicating:

Individually the names of all the regular staff deployed on the work along with their designations.

No. of skilled workers (trade wise) and total no. of unskilled workers deployed on the work and their location of deployment i.e. blocks.

Financial statement, indicating the broad details of all the running account payments received up to date such as gross value of work done, advances taken, recoveries effected, amounts withheld, net payments details of cheque payments received, extra/substituted/deviation items if any, etc.

In case of non compliance / delay in compliance in submission of Fortnightly progress report, a penalty @ Rs. 5000/- per day will be imposed which will be recovered from the immediate next R/A Bill of the Bidder.

1.38 TEMPORARY WATER/ ELECTRICITY/ TELEPHONE CONNECTIONS: Arrangement of temporary telephone, water and electricity connections as required by Bidder, shall be made byhim at his own cost and also necessary permissions shall be obtained by him directly from concerned authorities, under intimation to the Department. Also, all initial cost and running charges, and security deposit, if any, in this regard shall be borne by him. The Bidder shall

Abide by all the rules / bye laws applicable in this regard and he shall be solely responsible for any penalty on account of violation of any of the rules/byelaws in this regard. Nothing extra shall be payable on this account.

The Bidder shall be responsible for maintenance and watch and ward of the complete installation and water / electricity meter and shall also be responsible for any pilferage, theft, damage, penalty etc. in this regard. The Bidder shall indemnify the Department against any claim arising out of pilferage, theft, damage, penalty etc. whatsoever on this account. Security deposit for the work shall be released only

after No Dues Certificates are obtained from the local Authorities from whom temporary electric/ water / telephone connection have been obtained by the Bidder. Nothing extra shall be payable on this account.

The Department shall in no way be responsible for either any delay in getting electric and/or water and/or telephone connections for carrying out the work or not getting connections at all. No claim of delay or any other kind, whatsoever, on this account shall be entertained from the Bidder. Also contingency arrangement of stand-by water & electric supply shall be made by the Bidder for commencement and smooth progress of the work so that work does not suffer on account of power failure or disconnection or not getting connection at all. No claim of any kind whatsoever shall be entertained on this account from the Bidder. Nothing extra shall be payable on this account.

- 1.39 CLEANLINESS OF SITE:** The Bidder shall not stack building material/malba/muck on the land or road of the local development authority or on the land owned by the others, as the case may be. So the muck, rubbish etc. shall be removed periodically as directed by the Engineer-in- Charge, from the site of work to the approved dumping grounds as per the local byelaws and regulations of the concerned authorities and all necessary permissions in this regard from the local bodies shall be obtained by the Bidder. Nothing extra shall be payable on this account. In case, the Bidder is found stacking the building material/malba as stated above, the Bidder shall be liable to pay the stacking charges/penalty as may be levied by the local body or any other authority and also to face penal action as per the rules, regulations and bye-laws of such body or authority. The Engineer -in-Charge shall be at liberty to recover, such sums due but not paid to the concerned authorities on the above counts, from any sums due to the Bidder including amount of the Security Deposit and performance guarantee in respect of this contract agreement.

The bidder shall take instructions from the Engineer-In-Charge regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed.

The site of work shall be always kept clean due to constraints of space and to avoid any nuisance to the users of buildings in the adjacent plots. The Bidder shall take all care to prevent any water- logging at site. The waste water, slush etc. shall not be allowed to be collected at site. It may be directly pumped into the creek with prior approval of the concerned authorities. For discharge into public drainage system, necessary permission shall be obtained from relevant authorities after paying the necessary charges, if any, directly to the authorities. The work shall be carried out in such a way that the area is kept clean and tidy. All the fees/charges in this regard shall be borne by the Bidder. Nothing extra shall be payable on this account.

- 1.40 INSPECTION OF WORK:** In addition to the provisions of relevant clauses of the contract, the work shall also be open to inspection by Senior Officers of NCCF & the representative of the Consultants the bidder shall at times during the usual working hours and at all times at which reasonable notices of the intention of the Engineer-in-charge or other officers as stated above to visit the works shall have been given to the bidder, either himself be present to receive the orders and instructions or have a responsible representative duly accredited in writing, to be present for that purpose.

Inspection of the work by Consultant appointed by the NCCF.

The consultant appointed by NCCF, shall be inspecting the works including workshops and fabrication factory to ensure that the works are in general being executed according to the design, drawings and specifications laid down in the contract. His observations shall be communicated by PMC/Architech engineering staff and compliance is to be reported to NCCF.

The consultant appointed by NCCF shall certify on completion of particular building that it has been constructed according to the approved drawings design and specifications.

Display Board showing details of work, fortnightly progress achieved with respect to targets, reasons of shortfall, status of manpower, wages being paid for different categories of workers.

Entrance and area surrounding this site are to be kept cleaned.

Display layout plan, key plan, Building drawings including plans, elevations and sections. Upto date displays of CPM and PERT bar charts etc.

Keep upto date details of quantities executed, balance quantities, deviations, possible Extra item, substituted Item etc.

Keep plastic / cloth mounted one sets of building drawings.

Keep minimum 10 (Ten) nos. sets of safety Helmets & safety shoes for exclusive use for officers/ dignitaries visiting at site.

- 1.41 FINAL TESTING OF THE INSTALLATION:** The Bidder shall demonstrate trouble free functioning of all the Civil and E & M installations and services. The Engineer-in-Charge or his authorized representatives shall carry out final inspection of the various Civil and E & M services and installations. Any defect(s) noticed during demonstration shall be rectified by the Bidder at his own cost to the entire satisfaction of the NCCF Nothing extra shall be payable on this account.
- 1.42 SUBMISSION OF AS BUILT DRAWINGS AND OBTAINING OCCUPATION CERTIFICATE:** The bidder shall coordinate and facilitate consultant of NCCF for obtaining occupation certificate / completion certificates from the concerned local bodies including getting the required site visits conducted by such authorities with a view to obtain the same.
- 1.43 DEALING WITH INCONSISTENT RATES:** The Bidders shall quote same rates for the identical items which may inadvertently appear in more than one place if different rates are quoted by the tenderers for such identical items, the same shall be rationalized by considering the lowest quoted rate for such items, for evaluation and acceptance of tender.

Wherever any reference to any Indian Standards occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued thereto or revisions thereof, if any, up to the date of receipt of tenders.

Unless otherwise specified in the schedule of quantities, the rates for all items of work shall be considered, as inclusive of dewatering pumping out or bailing out water, if required throughout the construction period for which no extra payment shall be made. This shall also include water encountered from any source such as rains, floods, sub soil water table being high and/or due to any other cause whatsoever.

All stone aggregates and stone ballast shall be of hard stone variety and are to be obtained from approved quarries.

Coarse sand should be obtained from approved sources. The same shall be clean and sharp angular grit type. The coarse sand shall be screened before using, if required. If the sand brought to site is dirty, it must be washed in clean water to bring the sand to the required specifications. Nothing extra shall be payable on this account.

The rates for all items of work, shall unless clearly specified otherwise will be deemed to include cost of all required operations and all inputs of labour, material, T&P, scaffolding, wastages, watch & ward, other inputs, all incidental charges, all taxes, cess, VAT, duties, levies etc. required for the execution of the work

1.44 PRODUCT DELIVERY, STORAGE AND HANDLING OF CHEMICALS: The bidder shall construct storage space for Chemicals materials to ensure that the storage conditions are as recommended by the manufactures.

All the materials shall be procured and delivered in sealed containers with labels legible and intact.

All the chemicals {Polymers, Epoxy, water proofing compound, Plasticizer, Polysulphide, all exterior and interior Paints & Polish etc.) shall be procured in convenient packs say 20 litres/Kgs. Capacity packing only or as approved by the Engineer-in-Charge, and not in bigger capacity containers, say 200 litre (Kgs.) drums unless otherwise specifically permitted by the NCCF One sample from each lot of the chemical procured by the bidder shall be tested in a laboratory as approved by the NCCF

All material required for the execution of the work shall be got approved, procured and deposited with the Departmental supervisory staff. The materials shall be kept in joint custody of the bidder and the Department. The watch and ward of such material shall, however, remain to be the responsibility of the bidder and no claim, whatsoever, on this account shall be entertained. Different containers of each chemical shall be serially numbered on packing and also consumed in that order. Day-to-Day account of receipt, issue and balance shall be regulated by the Department and proper account shall be maintained at site of work in the prescribed form as per the standard practice.

All the chemicals shall be procured by the bidder directly from the manufacturer. In exceptional circumstances, the bidder may be allowed to procure the materials from the authorized dealers of the manufacturers, if specifically permitted by the NCCF

The original copies of challan/cash memos towards the quantity of various chemicals procured shall be made available by the bidder at the request from the Engineer-in- Charge and a copy of the same shall be kept in record.

The Name of manufacturers, manufacturer's product identification and manufacturer's mixing instructions, warning for handling and toxicity and date of manufacturing and shelf life shall be clearly and legibly mentioned on the labels of the each container.

The bidder shall submit for the chemicals procured, manufacturer's and / or authorized dealer's certificate regarding supplying and verifying conformance to the material specifications, as specified.

All filled containers shall be handled in safe manner and in a way to avoid breaking container seals.

Empty containers of the chemicals should not be removed from site till the completion of work and shall be removed only with the written approval of the NCCF

All arrangements for measuring, dosing and mixing of material / chemicals at site have to be made by the bidder.

Bidder shall suitably advise his site Engineer and all the workers as regards safe handling of chemicals. Necessary protective and safety equipments in form of hand gloves, goggles etc. shall be provided by the bidder and be also used at site.

All incidental charges of any kind including cartage, storage and wastage and safe custody of material etc. shall be borne by the bidder and no claim, whatsoever, shall be entertained on this account.

The chemicals shall be tested in an independent laboratory as approved by the Engineer-in-charge at the frequency as specified. If required, more samples may have to be tested as per the directions of the NCCF Nothing extra shall be payable on this account. However, the testing charges shall be borne by the department for the samples satisfying the requirements specified in the tender.

1.45 De-watering: De-watering required, if any, shall be done conforming to BIS Code IS: 9759 (guide lines for de-watering during construction) and / or as per the scheme / specifications approved by the NCCF Design of an appropriate and suitable dewatering system shall be the Bidder's responsibility. Such scheme shall be modified / augmented as the work proceeds based on fresh information discovered during the progress of work, at no extra cost. At all times during the construction work, efficient drainage of the site shall be carried out by the Bidder and especially during the laying of plain cement concrete, taking levels etc. The Bidder shall also ensure that there is no danger to the nearby properties and installations on account of such lowering of water table. If needed, suitable precautionary measures shall be taken by the Bidder. Also the scheme of dewatering adopted shall have adequate built in arrangement to serve as stand-by to attend to repair of pumps etc. and disruption of power / fuel supply. Nothing extra shall be payable on this account. In trenches where surface water is likely to get into cut / trench during monsoons, a ring bund of puddle clay or by any other means shall be formed outside, to the required height, and maintained by the Bidder. Also, suitable steps shall be taken by the Bidder to prevent back flow of pumped water into the trench. Nothing extra shall be payable on this account.

1.46 INSURANCE POLICIES: Before commencing the execution of work, the Bidder shall, without in any way limiting his obligations and liabilities, insure at his own cost and expense against any damage or loss or injury, which may be caused to any person or property, at site of work. The Bidder shall obtain and submit to the Engineer-in-Charge proper **Bidder All Risk (CAR)** Insurance Policy for an amount 1.25 times the contract amount for this work, with Engineer-in- Charge as the first beneficiary. The insurance shall be obtained in joint names of Engineer-in- Charge and the Bidder (who shall be second beneficiary). Also, he shall indemnify the Department from any liability during the execution of the work. Further, he shall obtain and submit to the Engineer-in-Charge, a third party insurance policy for maximum Rs.10 (Ten) lakh for each accident with the Engineer-in-Charge as the first beneficiary. The insurance shall be obtained in joint names of Engineer-in-Charge and the Bidder (who shall be second beneficiary). The Bidder shall, from time to time, provide documentary evidence as regards payment of premium for all the Insurance Policies for keeping them valid till the completion of the work. The Bidder shall ensure that Insurance Policies are also taken for the workers of his Sub-Bidders / specialized agencies also. Without prejudice to any of its obligations and responsibilities specified above, the Bidder shall within 10 days from the date of letter of acceptance of the tender and thereafter at the end of each quarter submit a report to the Department giving details of the Insurance Policies along with Certificate of these insurance policies being valid, along with documentary evidences as required by the NCCF No work shall be commenced by the Bidder unless he obtains the

Insurance Policies as mentioned above. Also, no payment shall be made to the Bidder on expiry of insurance policies unless renewed by the Bidder. Nothing extra shall be payable on this account. No claim of hindrance (or any other claim) shall be entertained from the bidder on these accounts.

1.47 Training of the Personnel: The bidder shall arrange at no extra cost to the Department to train two persons from CPWD for civil and electrical works on how to operate and carry out preventive maintenance of the systems (both civil and electrical). The bidder shall arrange this training from the concerned well qualified and experienced personnel for at least seven days.

1.48 UTILISATION OF MOBILISATION ADVANCE: A separate dedicated Bank Account shall be opened by the bidder in any scheduled Bank in Delhi before release of the mobilization / tools & plants advance. Mobilization advance will not be given for any material for which secured advance is payable. T&P advance will not be given for tools & plants equipments, owned by the bidder as intimated in the eligibility documents. Instalments of Mobilization advance except the first instalment shall be released after receiving the utilization certificate supported by bank statement of the said account showing the disbursement / utilization of upto date mobilization advance by the bidder.

Bidder while applying for the mobilization advance shall inform the intended use of mobilization advance and submit the utilization certificate of the same. Any deviation from intended use shall not be accepted without the prior approval of NCCF

5.2 SPECIAL CONDITIONS FOR GREEN BUILDING: The bidder is required to execute the work in a befitting manner to keep the environment at construction site pollution free as under:-

1.1 Pre-construction Stage

Construction Vehicles, Equipment and Machinery

All vehicles, equipment and machinery to be procured for construction shall conform to the relevant Bureau of Indian Standards (BIS) norms.

Emission from the vehicles must conform to environmental norms.

Dust produced from the vehicular movement and other site activities is to be mitigated by sprinkling of water.

1.2 Construction Stage

Construction Wastes Disposal

The pre-identified dump locations will be a part of solid waste management plan to be prepared by the Bidder in consultation with NCCF

Bidder shall get approved the location of disposal site prior to commencement of the excavation on any section of the project location.

Bidder shall ensure that any spoils of material will not be disposed off in any municipality waste collection bins.

2.0 Procurement of Construction Materials: All vehicles delivering construction materials to the site shall be covered to avoid spillage of materials and maintain cleanliness of the roads.

Wheel Tyres of all vehicles used by of the bidder, or any of his sub-bidder or materials supplies shall be cleaned and washed clear of all dust/mud before leaving the project premises. This shall be done by routing the vehicles through tyre washing tracks.

Bidder shall arrange for regular water sprinkling at least twice a day (i.e. morning and evening) for dust suppression of the construction sites and unpaved roads used by his construction vehicles.

3.0 Water Pollution: The Bidder shall take all precautionary measures to prevent the wastewater during construction to accumulate anywhere.

The waste water arising from the project is to be disposed off in the manner that is acceptable to the Engineer -in-charge.

4.0 Air and Noise Pollution: Bidder shall use dust screens and sprinkle water around the construction site to arrest spreading of dust in the air and surrounding areas.

Bidder shall ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that emission levels comply with environmental emission standards/norms.

For controlling the noise from Vehicles, Plants and Equipments, the Bidder shall confirm the following:

All vehicles and equipment used in construction will be fitted with exhaust silencers.

Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.

Noise emission from compactors (rollers) front loaders, concrete mixers, cranes (movable), vibrators and saws should be less than 75 dB(A).

As per the standards/guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) sets, noise emission in dB(A) from DG Set (15-500 KVA) should be less than $94 + 10 \log 10$ (KVA). The standards also suggest construction of acoustic enclosure around the DG Sets and provision of proper exhaust muffler with insertion loss of minimum 25 dB(A) as mandatory.

5.0 Personal Safety Measures for Labour: Bidder will provide the following items for safety of workers employed by bidder and associate agencies:

Protective footwear and gloves to all workers employed for the work on mixing, cement, lime mortars, concrete etc. and openings in water pipeline/sewer line.

Welder's protective eye-shields to workers who are engaged in welding works.

Safety helmet and Safety harness/ belt Provide adequate sanitation/safety facilities for construction workers to ensure the health and safety of the workers during construction, with effective provisions for the basic facilities such as sanitation, drinking water and safety equipment's or machinery.

All the workers should be wearing helmet and shoes all the time on site.

Masks and gloves should be worn whenever and wherever required.

Adequate drinking water facility should be provided at site, adequate number of decentralized latrines and urinals to be provided for construction workers.

Full time workers residing on site should be provided with clean and adequate temporary hutment.

First aid facility should also be provided.

Overhead lifting of heavy materials should be avoided. Barrow wheel and hand-lift boxes should be used to transport materials onsite.

Tobacco and cigarette smoking should be prohibited onsite.

All dangerous parts of machinery are well guarded and all precautions for working on machinery are taken.

Maintain hoists and lifts, lifting machines, chains, ropes and other lifting tackles in good condition. Provide safety net of adequate strength to arrest falling material down below.

Use of durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.

Ensure that walking surfaces or boards at height are of sound construction and are provided with safety rails and belts. Provide protective equipment's such as helmets.

Provide measure to prevent fire. Fire extinguisher and buckets of sand to be provided in fire-prone area and elsewhere.

Provide sufficient and suitable light for working during night.

Ensure that measures to protect workers from materials of construction, transportation, storage and other dangers and health hazards are taken.

Ensure that the construction firm/division/company have sound safety policies.

Comply with the safety procedure, norms and guidelines (as applicable) as outlined in the National Building Code (NBC 2016) (BIS 2005c).

Adopt additional sound engineering practices and prescribed norms as per NBC 2005 (BIS2005).

Identify roads on-site that would be used for vehicular traffic. Update vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral type that make up the surface base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (smaller than 0.075mm) to 10 -20%. Limit vehicular speed on site 10km/h. Nothing extra will be payable for this.

All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust/particulate emissions.

Spills of dirt or dusty materials shall be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean - up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained/cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas.

Ensure that water spraying is carried out by wetting the surface by spraying water on:

Any dusty material.

Areas where demolition work is carried out.

Any unpaved main-haul road and.

Areas where excavation or earth moving activities are to be carried out.

The bidder shall ensure the following:

Cover and enclose the site by providing dust screen, sheeting or netting to scaffold along the perimeter of a building.

Covering stockpiles of dusty material with impervious sheeting.

Covering dusty load on vehicles by impervious sheeting before they leave the site.

Transferring, handling/storing dry loose materials like bulk cement and dry pulverized fly ash inside a totally enclosed system.

Spills of dirt or dusty materials shall be cleaned up promptly so that the spilled material does not become a source of fugitive dust and also to prevent seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained/cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas.

Clear vegetation only from areas where work will start right away.

Vegetate/mulch areas where vehicles do not ply.

Apply gravel / landscaping rock to the areas where mulching/paving is impractical.

Adopt measures to prevent air pollution in the vicinity of the site due to construction activities as per sound engineering practices.

Provide sheet covering/barricading of site of not less than 6m height along the site boundary, next to a road or other public area. Nothing extra will be paid for this.

The bidder shall provide experienced personnel with suitable training to ensure that these methods are implemented. Prior to the commencement of any work, the method of working, plant equipment and air pollution control system to be used on-site should be made available for the inspection and approval of the Engineer -in-Charge to ensure that these are suitable for the project.

Employ measures to segregate the waste on-site into inert, chemical or hazardous wastes. Recycle the unused chemical/hazardous wastes such as oil, paint, batteries and asbestos. The inert waste is to be disposed off to Municipal Corporation/local bodies dump yard and landfill sites.

To preserve the existing landscape and protect it from degradation during the process of construction. Select proper timing for construction activity to minimize the disturbance such as soil pollution due to spilling of the construction material and its mixing with rainwater. The construction management plan including soil erosion control management plan shall be prepared accordingly for each month. The application of erosion control measures includes construction of gravel pits and tyre washing bays of approved size and specification for all vehicular site entry/exits, protection of slopes greater than 10%. Sedimentation Collection System and run-off diversion systems shall be in place before the commencement of construction activity. Preserve and protect the existing vegetation by not-disturbing or damaging to specified site areas during construction.

The Bidder should follow the construction plan as proposed by the Engineer-in-charge / landscape consultant to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site.

Spill prevention and control plans should clearly state measures to stop the source of the spill. Measures to contain the spill and measures to dispose the contaminated material and hazardous wastes. It should also state the designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners and petroleum products.

A soil Erosion and Sedimentation Control Plan (ESCP) should be prepared prior to construction and should be applied effectively.

The bidder shall prepare and submit 'Spill prevention and control plans' before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.

The bidder shall ensure that no construction leaches (except cement slurry) is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including reduction of wasteful curing processes, collection, basic filtering and reuse. The bidder shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant -laden water directly to the treatment device or facility (municipal sewer line).

All lighting installed by the bidder around the site and at the labour quarters during construction shall be CFL/ LED bulbs of the appropriate illumination levels. This condition is a must, unless specifically prescribed otherwise.

All the building materials and systems used on site must be as per the specifications and approved makes by the NCCF

All required certificates explaining the properties of the building material/system needs to be obtained from the manufacturer/vendor as required by the green building rating authority. The final certificates would be produced after the approval of green building consultant with necessary due diligence. The purchase orders of all the materials made with the manufacturers / authorized vendors should be maintained and shall be provided for the process with due diligence upon request.

Water saving measures as suggested by the consultants need to be followed on site.

The bidder shall prepare and submit a Site Management Plan (SMP) within 10 days of start, for approval by the Engineer -in-charge. This SMP shall indicate the locations of godown, stockpiles, barricading, waste storage, offices, vehicular movement routes etc. The bidder will be penalized @ Rs. 5000 (Rupees Five Thousand only) per day of delay on non-submission of SMP beyond due date to be recovered from next RA bill.

Any other site management measures suggested by the Engineer-in-charge / green building consultant shall be followed on site.

The bidder shall submit to the Engineer-in-Charge after construction of the buildings, a **detailed as built quantification** of the following within ten days of recording of completion. Bidder will be penalized @ Rs. 5000 (Rupees Five Thousand only) per day of delay of non-submission of **detailed as built quantification** beyond due date to be recovered from the Final bill:

5.3 PARTICULAR SPECIFICATIONS

- 1.1 Excavation / Strutting / shoring / planking:** Excavation shall be undertaken to the width of the Basement / Retaining wall footing including necessary margins for construction operation as per drawing or directed otherwise. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the bidder at his own expense shall put up the necessary shoring, strutting and planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer, Measurement of plan area of excavation for payment as per item shall be permitted only.

All the major excavation shall be carried out by mechanical excavator. No extra payment shall be made for that. Minimum two number poclairn with bracker is to be deployed on the work.

Bidder shall quote the credit of salvage value of surplus earth/ rocks disposed out from the site in the specified item of Schedule of Quantities.

- 2.1 DEWATERING:** Sub-soil water table at work site is reported to be about approx 2.5 to 3 meter below general ground level. The water level may rise 1 to 2 m during rainy season.

Dewatering shall be carried out by suitable means with adequate stand-by arrangements and the disposal of water shall be done as per the direction of the NCCF

The subsoil water from dewatering may be required to be connected to the raw water grid in the area for use in horticultural purpose or bidder will make his own arrangement for disposal of sub soil water, if any approval from local body is required the bidder will get the same for which no extra payment will be made. However, only the cost of providing and laying pipe line beyond site boundary shall be paid. The de-watering scheme shall be installed for the entire building area including the area where raft slab is completed.

Sub-soil water level shall be maintained at least 50cm below the P.C.C level, till the laying of water proofing treatment over PCC, laying of basement raft and retaining wall & filling of earth/sand under the basement floor & behind retaining wall. The water table shall be controlled until the RCC structure is completed upto roof level, completion of outer retaining wall, water proofing of vertical surfaces of walls and back filling behind the walls upto ground level. The Bidder may give his proposal for the level at which water level is to be maintained during various stages of construction without affecting the stability of the structure already completed duly supported by design calculations and other relevant details for approval of NCCF

The rates quoted by the bidder shall be inclusive of working in or under water conditions and including pumping or bailing out water encountered from any source such as rains, floods, leakage from sewer and water mains, sub soil water table being high or for reasons of stability of structure or any other cause whatsoever. The extent and decision of pumping or bailing out of water shall be as per requirements of site and stability of structure and decision of Engineer-in-charge in this regard shall be final and binding on the bidder. Nothing extra shall be payable on this account.

The dewatering scheme shall be got designed by a specialized agency and approved from NCCF Suggestive dewatering scheme shall be made available after award of work and the bidder has to satisfy himself and check the scheme and get approved before implementation.

The bidder shall carry out detailed hydrological survey, if required.

The safety & stability of adjacent structure of adjoining buildings and roads etc. shall be ensured during entire period of construction.

3.1 WATER PROOFING:

3.1.1 Water Proofing of Raft Slab and Retaining Wall: The work shall be executed as per manufacturer's specifications and executed through authorized applicator by manufactures specialized agency approved by NCCF

Clean, dry, smooth, free of sharp fins, loose or foreign materials, oil, and grease condition is to be ensured before applying the EPDM membrane.

Membrane should be loosely laid over a layer of Geotextile mat of 150gsm. This is placed over the prepared PCC surface which is smooth, hard and dry. EPDM sheet should have maximum width and maximum length to have minimum number of joints. The adjacent sheet spliced with 100mm laps is to be placed.

Minimum 500mm of membranes (all the three membranes) viz: 150 gsm Geotextile, EPDM Rubber Guard and 300 gsm Geotextile) is left extra throughout above the PCC to facilitate final positioning and overlap of Horizontal treatment to vertical treatment. All these extra membrane rests over the base PCC.

The area of lap i.e. 100mm shall be cleaned using Primer and then lapped using Quick Seam Splice Tape.

Rubber Guard membrane everywhere shall be protected by a layer of 300 gsm Geotextile. Over this a protection cement screed of minimum 50mm thickness (maximum aggregate size 6mm) is poured to protect damage of EPDM Rubber Guard against reinforcement and site traffic. The protection screed is required everywhere on the EPDM Rubber Guard. The area of the membrane laid at any one time should not exceed that which can be protected by screed in the same period. Care should be exercised in the sequence of laying screed to ensure that the membrane laid is not damaged due to site traffic or other trade works or any other reason.

Apply Bonding Adhesive on the RCC retaining wall as well as on the Rubber Guard and fully adhere EPDM membrane to RCC wall. The adjacent sheets should have 100mm overlap. Vertical section should be extended min. 500mm above the ground level. The vertical edge should be filled with water block sealant and terminated with Aluminium termination bar and fasteners. The gap between the fasteners shall be 200mm. The termination bar edge shall be filled with Lap sealant.

Protect Waterproofing system with Protection Layer which is HDPE Protection Board, spot bonded to the EPDM membrane with compatible adhesive. The HDPE drainage board shall be fixed above the waterproofing layer at a distance of 100mm. This HDPE layer will act as sacrificial layer.

Once the waterproofing treatment has been finished there should be no activity which may damage the treatment. The back fill soil should be free from any sharp stones or Boulders. While the compaction of back filling soil the pressure should not bring the membrane down.

4.1 Membranes Splicing: Position the sheets at the splice area with an overlap of min. 100 mm. Once both membranes are in place, mark the bottom sheet 10 to 15 mm from the edge of the seam every 300 mm with the white crayon provided.

Tack the top sheet back with Quick Prime Plus at 1.5 m centers and at factory seams, this holds it in place during the splicing operation.

Remove excess of dust and dirt on the sheet and at factory seams, using a stiff broom. Pre-scrubbing is required at all areas that have excess amounts of dust, mica and Bonding Adhesive and at all factory seams. Dip the Quick Scrubber or Quick Scrubber Plus stand-up tool into the Quick Prime Plus, keeping the scrubber horizontal and flat so that no primer drips out prematurely.

Apply the Quick Prime Plus using long back and forth scrubbing strokes, parallel to the seam along the length of the splicing area, until the surface becomes dark grey in colour with no streaking or puddling. Scrub both surfaces at the same time to allow the same flash off time, start on the folded overlap. Make sure to overlap the guide marks on the bottom sheet and go beyond the edge of the top sheet.

Allow the Quick Prime Plus to flash off completely. To test for dryness, use the touch-push test at the back of the splice area by pushing straight down onto the Quick Prime Plus with a clean, dry finger. Push forward on the primer in an angle. The primer should feel tacky but not string to the finger.

Position the 76 mm (3") Splice Tape on the bottom sheet with the release paper facing upwards. Align the edge of the release paper with the marks. Roll the tape immediately using the Quick Roller or a 50 mm wide silicone rubber hand roller, applying firm pressure across the tape to remove any air that may be trapped between primer and tape. Hand pressure is not sufficient to seal the seam, since it does not provide uniform compression.

Un tack the top sheet and allow it to fall freely onto the tape. Trim the top sheet back as necessary at all areas where the release paper on the tape does not extend 5 to 15 mm past the seam edge.

To remove the release paper from the tape, first fold back the top sheet and peel the paper off the Splice Tape, by pulling it away from the seam at a 90° angle to the tape. Pull the paper at a steady pace and keep it low to the roof surface as it is removed to reduce air pockets. Mate the entire length of the seam by hand, when the release paper is being removed.

Roll the seam with the Quick Roller or with a 50 mm wide silicone rubber hand roller, both across the seam and along its entire length above both edges of the tape.

When the seam is longer than the tape, the adjoining roll of tape must overlap a minimum of 25 mm at these areas a Quick Seam patch should be installed as illustrated. Apply Lap Sealant around all exposed cut edges of the Quick Seam Form Flash.

Whenever 3 membranes meet at one place, it forms a T joint. Quick Seam patch is required at that place to avoid any capillary action.

- 5.1 Membrane Termination above Ground Level:** The required height for the EPDM flashing should be determined by local regulations. For situations where this condition cannot be satisfied, Firestone requires that the flashing height exceeds the potential water level of a blocked drain. Suitable substrates for a Termination Bar are concrete, smooth bricks, blocks or masonry. A termination bar may never be mounted to a wooden substrate.

Keep a minimum space of 5 mm between two adjoining bars. The termination bar must be installed directly to the wall surface, not to existing flashings, sheet metal, etc. Pre-drill holes into the brick, masonry or concrete and not into the soft mortar joint. A Termination Bar must be cut at inside and outside corners. Do not bend the bar around the corners. Prior to installation of the Termination Bar, pull back the topside of the membrane flashing 20 mm and apply a bead of Water Block between the membrane and the wall.

Install the Termination Bar with an acceptable hammer plug system at 200 mm o.c. A continuous compression is required and may need additional fastening. Each Termination Bar must be fastened a maximum of 25 mm from the end. Apply a bead of Lap Sealant on the topside of the bar. At all locations where base flashings end, install the Termination Bar vertically. Apply Lap Sealant to both sides of the bar.

6.1 Lift Pits or other pits: Lift pits or any other type of pit will be treated with EPDM membrane and Tema HDPE Protection Board.

7.1 Temporary Closure: Temporary closures which ensure that moisture does not damage any completed section of the new waterproofing system are the responsibility of the waterproofing bidder. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

9.1 EPDM Roofing Membrane: Roof slope should be a minimum of 2% to allow for adequate drainage of the roof taking into account the deflection of the roof. The roof surface will be made clean, dry, smooth and free of contaminants such as grease, animal fats, coal tar and oil based products. All sharp edges, fins and rough surfaces that could damage the membrane will be removed or if they can't be removed, isolated from the membrane with a leveling layer. It is essential that the roof structure is capable of supporting the imposed load of the new roofing system. When necessary, the advice of a Structural Engineer should be sought in this respect.

Place the Rubber Gard EPDM membranes (without stretching) over the acceptable substrate as close to its final position as possible and allow to relax a minimum of 30 minutes before attachment or splicing. Install the Rubber Gard EPDM single-ply roofing membrane fully bonded to the substrate with solvent or water based Bonding Adhesive. Each panel shall overlap the adjoining one by 100mm minimum.

The membrane is joined with a 75mm wide, self-adhesive Quick Seam™ Splice Tape and bonded using Quick Prime Plus. Roll seams with a 50mm silicone rubber roller or the Quick Roller. Layout the Rubber Guard EPDM membranes in a fashion so that field and flashing seams are installed to shed water.

Internal and external corners are to be flashed using self-adhesive Quick Seam Form Flash with Quick Prime Plus. All in accordance with specifications. When the height of the up stand is limited, in site corners can also be executed by folding and restraining the excess of EPDM membrane.

Membrane to be terminated based on site conditions and as per Direction of NCCF

Over the membrane a coat of Acrylic Top PC-100 will be applied. Prior to the application of the Acrylic Top PC-100 coating, the EPDM membrane surfaces shall be exposed to the weather a minimum of two weeks. The substrate needs to be clean, dry and free of foreign material and contaminants. The coating can be spray-applied in one coat or roller applied in a two-coat procedure. Allow the coating to dry to the touch before traffic is allowed on the surface.

Work shall be carried out as per the manufacturer's / applicators method statement of waterproofing as approved by the NCCF Work shall be guaranteed for 10 years against any leakages.

The bidder shall ensure that the basement of the building shall be absolutely water tight and seepage/leak proof. In case any seepage/leakage is noticed the bidder shall make it water tight & seepage/leak proof at his own cost.

11.1 Guarantee Bond: Ten (10) years guarantee bond in prescribed proforma shall be submitted by the bidder which shall also be signed by both the specialized agency and the bidder to meet their liabilities under the guarantee bond. However, the sole responsibility about efficiency of water proofing treatment shall rest with the building bidder.

Separate guarantee bonds shall be submitted by the Bidder for different type of water proofing work.

Ten (10) per cent of the cost of water proofing work shall be retained as security deposit and the amount so withheld would be released after ten years from the date of expiry of maintenance period under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the bidder within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended within the specified period, the same will be got done from other agency at the risk and cost of bidder.

The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

12.1 TEMPORARY EARTH RETAINING STRUCTURES: The space for movement of heavy construction machineries or the space for open earth excavation by benching, in steps or in slope may not be available at the site of work. The temporary earth retaining structures shall be required for the safety of existing nearby building and trees before taking up deep basement excavation work for the construction of basement. The bidder shall be solely responsible for the safety of men, material and stability of existing, adjoining structure and trees.

The information and details given herein, in the architectural, structural drawings, preliminary soil investigation report and elsewhere in the tender documents are only indicative and for general information and guidance only. The Bidder shall inspect the site of work and get familiar with the actual site conditions.

The department shall not be responsible if soil is found to be of different character and properties during actual execution of work or testing of soil. The Department shall not be responsible for the inaccuracy thereof or any interpretation or conclusion drawn from them by the bidder.

The bidder may carryout detailed soil investigation at his own cost if he considers so.

The work is to be carried out as per the drawings attached in tender document and as per the directions of Engineer- in -Charge. This work shall be carried out in continuation with the temporary earth retaining structures already executed at site.

Bidder shall provide basic equipment's / devices for measurements of deformations / settlements to measure ground water table, Settlement gauge etc. to check settlement of adjoining buildings/structures. The equipment's will be installed as per direction of NCCF Calibration and measurements of all equipment's shall be performed by the bidder and shall be checked by independent agency. Results from each measurement shall be recorded & submitted to Engineer-in-charge expeditiously.

The work of providing temporary earth retaining structures shall be carried out by the bidder either himself if he has the requisite experience of executing such works **or through experienced associated agency having satisfactory completed similar work of earth retaining structures.**

TMT bars & appurtenant materials shall be certified to meet the specified chemical, mechanical and sectional properties requirement prior to delivery to site, as per relevant IS code.

The work of earth retaining structures shall be carried out strictly in accordance with the sequence, specifications, and procedure as per direction of Engineer in Charge.

The Bidder shall submit the layout plan showing alignment arrangement of proposed temporary earth retaining structure clearly indicating the clear distance from the existing buildings /trees and the proposed basement.

The safety of the adjacent existing buildings is to be ensured so that no settlement or any damage due to settlement, land slide etc. because of deep basement excavation work is caused. For the safety, the Bidder shall install required apparatus / equipment's for close monitoring any settlement or crack development, damages in the nearby buildings at his own cost. The bidder shall provide all necessary equipment's/gauges for measurements of deformation/settlement in the adjacent buildings as directed by NCCF Monitoring instruments are to be maintained in good working conditions till the backfilling in completed is the responsibility of bidder. Daily reading of instruments shall be recorded and got checked by the authorized representative of NCCF Checking operations (at least once in a week) shall be done by an experienced independent agency appointed by bidder with approval of NCCF All expenditure incurred on this independent agency shall be borne by the bidder. The Bidder shall be held liable for all damages on any account including defective installation, execution and removal of earth retaining structure.

The modification in drawing/ design to suit the localized requirement shall be carried out and the work is to be executed accordingly as per direction of Engineer-in-Charge and nothing extra shall be paid on this account.

13.1 PERMANENT SOIL ANCHORS & TESTING: Rock anchoring is required to be executed through specialised agencies as mentioned in the approved list.

Rock anchoring shall be done by drilling holes upto specified depth as per design and as per pull out load test to be carried out at site. The rate is inclusive of drilling equipment, compressor and other necessary equipment, drilling upto specified depth, providing Fe 500 D grade TMT bar conforming to IS: 1786 upto bond length and grouting of holes with Epoxy RE 500 (HILTI). Cost of Epoxy shall be paid separately.

14.1 CONDITIONS FOR WATER: The bidder shall make his own arrangement for providing water for construction and drinking purpose. Water charges shall not be recovered on account of it. Bidder shall get the water tested from any laboratory approved by the Engineer-in- charge at regular interval as per the CPWD specifications 2021 .All expenses towards collection of samples, packing transportation except testing charges, etc. shall be borne by the bidder.

15.1 FORM WORK: The work shall be done in general as per CPWD Specifications 2021, Vol-I &Vol-II with upto date correction slip.

Only M.S. centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from bidder to be approved by the NCCF

Double steel scaffolding having two sets of vertical supports shall be provided for external wall finish, cladding etc. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding platform shall be fixed. Scaffolding shall have steel staircase for inspection of works at upper levels.

Nothing extra shall be paid for the centering and shuttering, circular in shape whenever the form work is having a mean radius exceeding 6m in plan.

In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of R.C.C. shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Bidder.

As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept 12 to 20mm lower than general floors as required. Shuttering should be adjusted accordingly. Nothing extra is payable on this account. Steel shuttering as approved by the Engineer-in-Charge shall be used by the bidder. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required completing the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.

The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or de-bonding compound shall be applied on the surface of the shuttering plates in the requisite quantity before assembly of steel reinforcement.

For the execution of centering and shuttering, the bidder shall use propriety. Reebole Chemical mould release agent of FOSROC or equivalent as shuttering oil as approved by Engineer-in-charge and nothing extra shall be paid on this account.

Concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days but form work and reinforcement can be taken up after the concrete has set at least for three days.

All existing formwork that fail to meet the specifications mentioned above or do not qualify to meet the minimum standards in the view of Engineer-in-Charge shall have to removed and stacked.

The bidder will arrange shuttering such that one lift of complete retaining wall, slab of one basement and columns can be casted in one go to achieve the milestone.

16.1 REINFORCEMENT: The reinforcement shall be done as per CPWD Specifications 2021, Vol-I & Vol-II with upto date correction slip.

The rate of item of reinforcement of RCC work includes all operations including straightening, cutting, bending, welding, binding with annealed steel or welding and placing in position at all the floors with all leads and lift complete as per CPWD Specifications 2021, Vol-I & Vol-II with upto date correction slip.

The bidder shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for in the drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. To ensure proper cover, factory made round type cover blocks will be used to avoid displacement of bars in any direction.

Reinforcement TMT bars Fe 500D to be used in this work.

17.1 Bar bending Schedule: The agency shall prepare bar bending schedule drawings as per the structural drawings issued and submit to Engineer-in-Charge in advance for approval. The bar bending schedule shall conform to Indian Standard IS 2502 – Code of Practice for Bending and Fixing of bars for Concrete Reinforcement. Before execution of work, five copies of these drawings each including for revision will be submitted to Engineer-in-Charge for approval. Keeping in view the quantum of the work, the BBS shall preferably be prepared with software and one person acquainted with preparing BBS with software shall be deputed at site to speed up the work. One software shall also be installed in the office.

18.1 Brick work: Fly ash bricks/ as per BOQ shall be machine moulded and prepared in plant by appropriate proportion of fly ash and lime. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

Water Absorption: The bricks when tested in accordance with the procedure laid down in IS 3495 (parts 1 to 4): after immersion in cold water for 24 hours water absorption shall not be more than 25 percent by weight.

19.1 MARBLE / GRANITE WORK: The execution of work shall be in general as per CPWD Specifications 2009 Vol-I & II with upto date correction slips.

The types of marble / granite proposed, but not limited to, for the scope of work are:

Karnataka Rubby Red Granite : 18mm thick in Leather & flamed finish

Composite Marble / Quartz: Engineered Quartz Grit base, Baby composed marble grey/coffee white baby pattern, engineered quartz sand stone white of thickness 12-18mm.

18mm thick imperial Black Granite

25mm thick one side polished Kota Stone

The sample shall remain at the designated place till ordered to be removed by Engineer-in-Charge and shall be the reference point for quality check.

Inspection or any other action by the Engineer-in-Charge shall not be taken as approval until it is confirmed in writing.

Sequence of execution for cladding work shall be suggested by the bidder for approval of NCCF/PMC/ARCHITECT.

The cladding shall be secured to the RCC/Brick surfaces by means of stainless steel cramps and stainless steel rings of the specified sizes. A proposal for fixing arrangement shall be submitted by the bidder to the Engineer-in-charge for his approval.

Anchor bolts and other mechanical fixing devices which will show on the face of the stones shall not be permissible.

Whenever necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these into correct positions, care being taken that the corners of the stone are not damaged. Stones shall be covered with gunny bags, before trying chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work.

The bidder shall only employ experienced and specialized workmen for carrying out the stone work. It is the sole responsibility of the bidder to provide and fix the stone securely and to ensure that no stone shall fall and/or get disturbed from its position after fixing.

The work shall include making necessary joints, recesses / notches / holes /grooves etc. to anchor cladding stones, accommodate stainless steel cramps/ pin, to house wooden rough

ground, socket outlet boxes, trunking for cables, etc. for which nothing extra is payable to the bidder. However, cost of stainless steel cramps, pins metallic channels for cable trunking, wooden rough ground, dash-fasteners are to be paid for separately.

20.1 Flamed Finish: A Flamed finish is produced when an intense flame is fired at the stone, causing the surface to burst and become rough. This finish is used primarily for exteriors applications where slip-resistance is extremely important. A flamed finish cannot be applied to all stones; however, most granite and certain hard limestone are preferred.

21.1 Leather Finish: "Leathering" is the process of texturing granite or marble to appear less glossy. This process amplifies the natural characteristics of granite or marble, resulting in an exquisite surface. It is easy to clean and maintain, as well as, pleasing to the touch - a perfect balance between style and practicality. A leathered countertop is a fresh and innovative way of adding a subtle elegance to your decor.

22.1 FLOORING: All the work in general shall be carried out as per CPWD Specifications 2021, Vol-I & Vol-II with upto date correction slip.

The tiles shall be as specified in the item. The tiles shall be of specified colours as shown in the drawings and will be laid in pattern as per architectural drawings. Nothing extra shall be paid for laying tiles in specific pattern. The tiles shall be of first quality of approved make.

Proper gradient shall be given to flooring for toilets, verandah, kitchen, courtyard etc. so that the wash water flows towards the direction of floor trap. Any reverse slop if found, these shall be made good by the bidder by ripping open the floor/grading concrete and nothing shall be paid for such rectifications.

The flooring and skirting will be executed as per pattern shown in the Architectural drawings and as per approval of Engineer-in-Charge and nothing extra shall be payable on this account.

Samples of flooring material are to be deposited well in advance to the Engineer-in-Charge for approval. Approved samples should be kept at site with the Engineer-in-Charge and the same shall not be removed except with the written permission of NCCF No payment whatsoever will be made for these samples.

The rate shall include the cost of all materials and labour involved in all the operations. Nothing extra shall be paid for use of cut/sawn tiles in the work.

23.1 COMPOSITE MARBLE / GRANITE FLOORING: All work in general shall be carried out as per CPWD Specifications 2009.

Whenever flooring is to be done in patterns of stones, the bidder shall get samples of each pattern laid and approved by the Engineer-in-charge before final laying of such flooring. Nothing extra shall be payable on this account.

The rate of item of flooring is inclusive of providing patterns of required shaped and nothing extra will be paid on this account.

24.1 WOOD WORK: The wood work in general shall be carried out as per CPWD Specifications 2021, Vol-I & Vol-II with upto date correction slip.

The samples of species of timber to be used shall be deposited by the bidder with the Engineer in Charge before commencement of the work. The bidder shall produce cash vouchers and certificates from standard kiln seasoning plant operator about the timber to be used on the work having been kiln seasoned by them, failing which it would not be accepted as kiln seasoned.

Specified timber shall be of good quality and well-seasoned. It shall have uniform colour, reasonably straight grains and shall be free from knots, cracks, shakes and sapwood.

Wood work shall not be painted, oiled or otherwise treated before it has been approved by the NCCF

All portion of timber including architrave abutting against masonry concrete stone or embedded in ground shall be painted with approved wood preservative or with boiling coal tar.

All fittings and fixtures shall be got approved from the Engineer-in-Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.

25.1 Wall Panelling: Acoustical Wall Panelling' with square edges made of fibre glass substrate 25mm thick and wrapped on the front side with an acoustically transparent and fire-resistant fabric of approved colour as per direction of Engineer- in-charge and of size 1200x600 or 600x600 mm to provide a minimum sound absorption level of 0.90 NRC to be affixed to wall using Wall panel impalers and construction adhesives.

26.1 FINISHING: The work shall be carried out as per CPWD specifications 2021 Vol-I & II with upto date correction slips.

The Primer, Synthetic Enamel paint, distemper etc., of makes as approved by the Engineer in charge and of low VOC (as specified in para 11.2.20 of Additional Conditions), shall only be used and brought to the site of, work in the original sealed containers. The material brought to the site of work shall be sufficient for at least 60 days of work. The material shall be kept under the joint custody of bidder and representative of the NCCF The empty containers shall not be removed from the site till the completion of the work without permission of the NCCF

27.1 CONSTRUCTION JOINTS: The work shall be carried out as per CPWD specifications 2021 Vol-I & II with upto date correction slips.

The bidder shall provide suitable hydrophilic, polymer/butyl rubber based water stop at all construction joints.

Except where shown otherwise on the drawing, reinforcement shall continue through construction joints. The foreign matter and laitance shall be cleaned properly by compressed air before starting further work.

The bidder shall not provide construction joints other than approved by NCCF If done so nothing extra shall be paid

5.4 ADDITIONAL CONDITIONS FOR STEEL

1.1 REINFORCEMENT BARS: The bidder shall procure TMT bars of Fe 500 D grade from primary producers such as SAIL, TISCON, RINL, Jindal Steel & Power Ltd. and JSW Steel Ltd. The TMT bars procured from the primary producers shall conform to manufacturer's specifications/ BIS specifications.

The specifications of TMT bars procured from primary producers shall meet the provisions of IS 1786: 2008 pertaining to Fe 500D grade of steel as specified in the tender.

The bidder shall have to obtain and furnish factory test certificates to the Engineer - in-charge in respect of all supplies of steel brought by him to the site of work.

Samples shall also be taken and got tested by the Engineer -in-Charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the bidder does not conform to the specifications as defined, the same shall stand rejected, and it shall be removed from the site of work by the bidder at his cost within a week time of written orders from the Engineer-in-Charge to do so. Else the department shall remove it and recover double the cost of removal from the bidder.

The steel reinforcement bars shall be brought to the site in bulk supply of 20 tonnes or more, or as decided by the Engineer -in-charge.

The steel reinforcement bars shall be stored by the bidder at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

For physical and chemical tests, specimens of sufficient length shall be cut from each size of the bar at random and at frequency not less than that specified below:

Size of Bar	For Consignment below 100 tonnes	For consignments above 100 tonnes
Under 10mm dia bars	One sample (Three specimen) for each 25 tonnes or part thereof	One sample for each 40 tonnes or part thereof
10 mm to 16mm dia bars	One sample (Three specimen) for each 35 tonnes or part thereof	One sample for each 45 tonnes or part thereof
Over 16 mm dia bars	One sample (Three specimen) for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

The bidder shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the bidder/ Department in the manner indicated below:

By the bidder if the results show that steel does not conform to relevant BIS Codes. By

the Department if the results show that steel confirms to relevant BIS Codes.

The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by the conditions laid therein. In case, the consumption is less than theoretical consumption including permissible variations, recovery at the rate so prescribed shall be made. In case of excess consumption no adjustment shall be made.

The steel brought to site and the steel remaining unused shall not be removed from site without the written permission of the NCCF

For the purpose of payment, the actual weight of steel reinforcement / structural steel sections/ plates / bolts and nuts shall be measured as below:

Unit weight for reinforcement bars: The actual weight per meter of the reinforcement of various diameters shall be measured for three random samples collected (for each diameter of steel reinforcement) from each lot of particular diameter of steel reinforcement brought to the site for use in the work. For this, each sample (one sample consisting of three specimens) for each diameter of steel reinforcement shall be cut to require lengths and weighed and average weight calculated and recorded. The average weight for each type of steel section and steel reinforcement of each diameter shall be taken as the actual weight

per metre for that steel section and that diameter of steel reinforcement.

In case actual unit weight is less than standard unit weights mentioned in CPWD specifications 2009 Volume 1, but within variation, in such cases payment shall be made on the basis of actual unit weight. However, if actual unit weight is more than standard unit weights mentioned in CPWD specifications 2021 Volume 1, then payment shall be made on the basis of standard unit weight in such cases. In such case nothing extra shall be paid for difference in actual weight and standard weight.

Bidder to submit Bar Bending Schedule (BBS) for reinforcement steel work for approval. The RCC work should commence only after getting the BBS approved and signing of pour card by NCCF/PMC.

The work shall be carried out as per the relevant CPWD specifications.

5.5 ADDITIONAL CONDITIONS FOR CEMENT

The bidder shall procure 43 grade ordinary Portland Cement (OPC) [conforming to IS: 8112 (Part-I)]. There shall be no bar on use of FACC in RCC structures subject to following conditions.

Fly ash shall have its chemical characteristics and physical requirements etc. conforming to IS 3812 (Part I & II) and shall be duly certified.

To ensure uniform blending of fly ash with cement in conformity with IS 456, a specific facility needs to be created at site with complete computerized automated process control to achieve design quality or with similar facility from Ready Mix Concrete (RMC) plants.

As per IS 1489 (Part-I) maximum 35% of OPC by mass is permitted to be substituted with fly ash conforming to IS 3812 (Part-I) and same is reiterated.

Separate storage for dry fly ash shall be provided. Storage bins or silos shall be weather proof and permit a free flow and efficient discharge of fly ash. The filter or dust control system provided in the bins or silos shall be sufficient size to allow delivery of fly ash maintained at specified pressure to prevent undue emission of fly ash dust, which may interfere weighing accuracy.

Cement from reputed manufacturers to be procured having a production capacity of one million tonnes or more per annum, as approved by ADG for this sub region and holding licence to use ISI certification mark for their product whose name shall be got approved from NCCF. Supply of cement shall be taken in 50 Kg. bags bearing manufacturer's name and ISI marking.

Every delivery of cement shall be accompanied by producer's certificate confirming that the supplied cement conforms to relevant specifications. These certificates should be endorsed to Engineer-in-charge for his record.

For each grade, cement bags shall be stored in two separate godowns, one for tested cement and the other for fresh cement (under testing) constructed by the bidder at his own cost as per sketch given in General Conditions of Contract for CPWD 2014 with weather proof roofs and walls. The actual size of godown shall be as per site requirements and as per the direction of the Engineer in charge and nothing extra shall be paid for the same. The decision of the Engineer-in-charge regarding the capacity required/needed will be final. However, the capacity of each godown shall not be less than 250 tonnes or as decided by NCCF

Each godown shall be provided with a single door with two locks. The keys of one lock shall remain with CPWD Engineer-in-charge or his authorized person and that of other lock with the authorized agent of the bidder at the site of work so that the cement is issued from godown

according to the daily requirement with the knowledge of both the parties. The account of daily receipt and issue of cement shall be maintained in a register in the prescribed Performa and signed daily by the bidder or his authorized agent in token of its correctness. The bidder shall be responsible for the watch & ward and the safety of the cement godown. The bidder shall facilitate the inspection of the cement godown by the Engineer-in-charge any time.

The bidder shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. Samples of cement arranged by the bidder shall be taken by the Engineer-in-charge and got tested in accordance with provisions of relevant BIS codes. The cement shall be used on the work only after satisfactory test results have been received. In case the test results indicate that the cement arranged by the bidder does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the bidder at his own cost within a week's time of written order from the Engineer-in-charge to do so.

The cost of tests shall be borne by the bidder/Department in the manner indicated below: By the bidder, if the results show that the cement does not conform to relevant BIS codes. By the Department, if the results show that the cement conforms to relevant BIS codes.

The concrete mix design shall be done as "Design Mix Concrete" as prescribed in clause-9 of IS 456 mentioned above. Concrete shall be manufactured in accordance with clause 10 of above mentioned IS:456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.

Minimum M 25 or as specified grade of concrete shall be used in all structural elements of RCC, both in load bearing and framed structure.

The mechanical properties such as modulus of elasticity, tensile strength, creep and shrinkage of concrete using Flyash blended cements (PPCs) are not likely to be significantly different and their values are to be taken same as those used for concrete made with OPC.

To control higher rate of carbonation in early ages of concrete in PPC based concrete, water/binder ratio shall be kept as low as possible, which shall be closely monitored during concrete manufacture. If necessitated due to low water/binder ratio, required workability shall be achieved by use of chloride free chemical admixtures conforming to IS:9103. The compatibility of chemical admixtures and super plasticizers with each set PPC received from different sources shall be ensured by trials.

In environment subjected to aggressive chloride or sulphate attack in particular, PPC based concrete is recommended. In case, where structural concrete is exposed to excessive magnesium sulphate, fly ash content shall be limited to 18% by weight. Special type of cement with low C3A content may also be alternatively used. Durability criteria like minimum binder content and maximum water/binder ratio also need to be given due consideration in such environment.

Wet curing period shall be minimum of 14 days.

Subject to General Guidelines detailed out as above, PPC manufactured conforming to IS:1489 (Part-I) shall be treated at par with OPC for manufacture of Design Mix Concrete for structural use in RCC.

Till the time, BIS makes it mandatory to print the %age of fly ash on each bag of cement, the certificate from the PPC manufacturer indicating the same shall be supplied by the bidder.

While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions therein. No payment for excess consumption of cement will be allowed. However for consumption lesser than permissible theoretical variation, a recovery shall be made in accordance with conditions of contract of schedule A to F without prejudice to action for acceptance of work/item of reduced rate or rejection, as the case may be.

For non-schedule items, the decision of the Engineer-in-charge or successor thereof regarding theoretical quantity of cement which should have been actually used shall be final and binding on the bidder.

Cement brought to site and cement remaining unused after completion of work shall not be removed from site without written permission of the NCCF

Damaged /settled/expired cement shall be removed from site immediately by the bidder on receipt of notice in writing from the NCCF. If he does not do so within three days of receipt of such notice, the Engineer-in-charge shall get it removed at the cost of the bidder.

5.6 APPROVED MAKES OF MATERIALS

Note:

1. The Bidder shall obtain prior approval from the Engineer-in-charge before placing order for any specific material or engaging any of the specialized agencies. The Bidder shall make a detailed submittal with catalogues and highlighted proposed specifications, as well as full details of the works executed by the specialized agency, as specified.
2. Wherever applicable, the engineer-in-charge may approve any material equivalent to that specified in the tender subject to proof being offered by the Bidder for equivalence to his satisfaction.
3. Unless otherwise specified, the brand / make of the material as specified in the item nomenclature, in the particular specifications and in the list of approved materials attached in the tender, shall be used in the work.

In case of non-availability of the brand specified in the contract the Bidder shall be allowed to use alternate equivalent brand of the material subject to submission of documentary evidence of non-availability of the specified brand. The necessary cost adjustments (if alternative brand is not equivalent) on account of above change shall be made for the material.

PART - C
(Electrical Work)

**Additional Conditions
&
Technical Specifications
(For Electrical Components)**

6.1 General Commercial & Technical Conditions:

All the works shall be carried out as per CPWD General Specification for Electrical Works, Part-I (Internal)-2013 Part-II (External)-1994; Part-IV (Sub-Station)-2013, amended up to date and should also comply with relevant provisions of the Indian Electricity Rules and Acts as applicable, amended up to date.

The bidder is advised to visit the site of work to have an idea of the execution of work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

1.1 Rates:

- i) The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work (except the materials, if any, stipulated for supply by the department) inclusive of all taxes (including works contract tax, if any), duties, and levies etc. and all charges for items contingent to the work, such as packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the bidder, watch and ward of all materials (including those supplied by the department, if any) for the work at site etc.
- ii) Prices quoted shall be firm.

1.2 Taxes and Duties:

- i) Being an indivisible works contract, Sales Tax, Excise Duty etc. are not payable separately. However, service tax paid if any against this agreement will be reimbursed separately by the ENGINEER-IN -CHARGE on production of documentary proof.
- ii) The works contract tax shall be deducted from the bills of the bidder as applicable in the State in which the work is carried out, at the time of payments.

1.3 Completeness of Tender:

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

1.4 Works to be arranged by the department:

Unless and otherwise specified in the tender documents, the following works shall be arranged by the Department:

- (i) Supply of materials to the bidder as stipulated in the tender documents.

1.5 Works to be done by the bidder:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the bidder, and therefore their cost shall be deemed to be included in their tendered cost:-

- (i) Foundations for equipment's and components where required, including foundations bolts. Cutting and making good all damages caused during installation and restoring the same to their original finish. Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.
- (ii) Painting at site of all exposed metal surfaces of the installation other than pre-Painted, items like fittings, fans, switchgear / distribution gear items, cubicle switch board etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the NCCF

- (iii) Testing and commissioning of completed installation.
- (iv) Storage space for all equipment's, components and materials for the work.

1.6 Storage and Custody of Materials:

The bidder has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till the same is handed over to the department. No extra payment will be made on this account. The storage space shall however be arranged by the department at site, if available.

The main bidder shall arrange for proper storage of the electrical fans and fittings at site and that double lock system shall be arranged for the fans and fittings after receipt at site until the time they are taken for installation. The bidder shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

1.7 Electric Power Supply and Water Supply:

Power and water supply will be arranged by the bidder at the site for installation purpose. However, for testing purpose after complete installation of the electrical items, electricity supply will be made available free of cost to the bidder. Bidder will take due care to ensure safety of electrical installation during execution of work.

1.8 Tools for handling and Erecting:

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the bidder.

1.9 Payment Terms:

Payment shall be made as per the forming part of the tender documents.

1.10 Co-ordination with other agencies:

The bidder shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

1.11 Care of buildings:

Care shall be taken by the bidder to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

1.12 Structural Alterations to Buildings:

- (i) No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-in-charge. Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these required modifications, or fresh provisions are required to be made, such contingent works shall be carried out by the contract at his cost.
- (ii) All such openings in floors provided by the department shall be closed by the bidder after installing the cables/conduits/rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.
- (iii) All chases required in connection with the electrical works shall be provided and filled by the bidder at his own cost to the original architectural finish of the buildings.

1.13 Addition to an installation:

Any addition, temporary or permanent, to the existing electrical installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

1.14 Work in occupied buildings:

- (i) When work is executed in occupied buildings, there would be minimum of inconvenience to the occupants. The work shall be programmed in consultation with the Engineer-in-charge and the occupying department. If so required, the work may have to be done even before and after the office hours.
- (ii) The bidder shall be responsible to abide by the regulations or restrictions set in regard to entry into, and movement within the premises.
- (iii) The bidder shall not tamper with any of the existing installations including their switching operations or connections there to without specific approval from the NCCF

1.15 Drawings:

- (i) The work shall be carried out in accordance with the drawings and the tender documents and also in accordance with modification thereto from time to time as approved by the NCCF
- (ii) All wiring diagrams shall be deemed to be 'Drawings' within the meaning of the term of the conditions of contract. They shall indicate the main switch board, the distribution boards (with circuit numbers controlled by them), the runs of various mains and sub mains and the position of all points with their controls.
- (iii) All circuits shall be indicated and numbered in the wiring diagram and the points shall be given the same number as the circuit to which they are electrically connected.
- (iv) After award of the work, the firm will be required to submit the drawings for the proposed work including layout plan, conduit routes etc. Work will be carried out as per the approved drawings.

1.16 Conformity to IE act, IE Rules, and standards:

All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date (Date of call of tender unless specified otherwise). List of rules of particular importance to electrical installations under these General Specifications .

1.17 General requirements of components:

Quality of material: All materials and equipments supplied by the bidder shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

1.18 Inspection of materials and equipments:

- a) Materials and equipments to be used in the work shall be inspected by the departmental officers. Such inspection will be of following categories:
 - (i) Inspection of materials / equipments to be witnessed at the Manufacturer's premises in accordance with relevant BIS /Agreement Inspection Procedure.
 - (ii) To receive materials at site with Manufacturer's Test Certificate(s).
 - (iii) To inspect materials at the authorized dealer's go downs to ensure delivery of genuine materials at site.

- (iv) To receive materials after physical inspection at site.
- b) Adequate care to ensure that only tested and genuine materials of proper quality are used in work shall be ensured by firm. The firm shall ensure that:
 - (i) Material will be ordered & delivered at site only with the prior approval of the department to ensure timely delivery.
 - (ii) As and when the order is placed for the fittings/ fixtures, cables, switchgears, poles, rising main, other main items etc, its copy shall be endorsed to the NCCF
 - (iii) The firm will be required to procure material like exhaust fans, MCB's & DB's, switches & sockets, wires & cables, conduits and switchgears etc directly from the manufacturer/ authorized dealers to ensure genuineness & quality and as per the approved makes only. Proof in this regard shall be submitted by the bidder if required by the department.
 - (iv) Inspection at factory or at go down of the manufacturer, as required, shall be arranged by the firm for a mutually agreed date. Certificate for genuineness of the fittings shall have to provided duly signed by the manufacturer's officer not below the rank of Regional Manager.
 - (v) Delivery of material shall be taken up only with the consent of department, after clearance of the material.
 - (vi) Department shall reserve the right to waive inspection in lieu of suitable test certificate, at its discretion.
- c) Similarly, for fabricated equipment, the bidder will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.
All the inspection of materials and equipments should be done immediately.

1.19 Ratings of components:

- (a) All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.
- (b) All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

1.20 Conformity to standards:

- a) All components shall conform to relevant Indian Standard Specifications wherever existing. Materials with ISI certification mark shall be preferred.
- b) Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

1.21 Interchangeability:

Similar parts of all switches, lamp holders, distribution fuse boards, Switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

1.22 Workmanship:

- a) Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.
- b) Proper supervision/skilled workmen: The bidder shall be a licensed electrical bidder of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors /

Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.

- c) Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.
- d) Fabrication in reputed workshop: Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel. These shall be as per make / item approved.

1.23 Testing:

All testes prescribed in this General Specification, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Engineer-in-charge in prescribed Performa, forming part of the Completion Certificate.

1.24 Commissioning on completion:

After the work is completed, it shall be ensured that the installation is tested and commissioned.

1.25 Completion plan and completion certificate:

- a) For all works completion certificate after completion of work as per CPWD Specification shall be submitted to the NCCF
- b) Completion plan drawn to a suitable scale in tracing cloth with ink indicating the following, along with three blue print copies of the same shall also be submitted.
 - (i) General layout of the building.
 - (ii) Locations of main switchboard and distribution boards, indicating the circuit numbers controlled by them.
 - (iii) Position of all points and their controls.
 - (iv) Types of fittings, viz. fluorescent, pendants, brackets, bulk head, fans, exhaust fans etc.
 - (v) Name of work, job number, tender reference, actual date of completion, names of Division/ Sub-division and name of the firm who executed the work with their signature.

1.26 Guarantee

The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the bidder will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 12 months from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the NCCF The firm will be required to submit guarantee of fans and fittings from the manufacturer to the department.

1.27 Supply of fittings, fixtures & other material:

The procurement of material for the works will be programmed as per the progress of work in consultation with NCCF The firm will be required to submit a detailed programme and prior to the procurement will seek approval of the department. The direction of the department regarding timing & necessity of getting such material will be final & binding on the firm.

6.2 Additional Conditions For Electrical Works

- 1.1 The main bidder should either himself meet the eligibility criteria as defined in the bid document or he will have to associate agency for E&M package after award of work and has to submit details of such agency(s) confirming eligibility condition as defined in the bid document in Form 'C' to Engineer-in-charge of minor component within prescribed time. Name of the agency(s) to be associated shall be approved by Engineer-in-charge of minor component.
- 1.2 Normally, there shall be no change in associated bidder for minor component work during the execution of the work. If at all, a change is necessitated, the same should be acceptable to the department and such acceptable bidder shall fulfil the conditions laid down for the selection of the associated bidder in the tender document.
- 1.3 The materials shall be procured only from the manufacturers and their authorized dealers and documentary proof for such procurement and supply shall be produced by the bidder.
- 1.4 In respect of specialized items of HVAC, Sub-station equipment's, Lift, DG sets, Fire Alarm System, UPS, Solar Photovoltaic Power Generation System, Data Networking etc. the materials shall be procured only from the original equipment manufacturers. The Bidder shall submit all documentary proof of this conditions regarding procurement of materials.
- 1.5 The department reserves the right to send such materials to the manufacturers / authorized test laboratory to verify the genuineness and quality of the product.
- 1.6 The conduit shall be laid in the RCC slab before the concreting and in walls before plastering. The actual run of conduit and size of the boxes are to be marked on drawing by the bidder and got approved from Engineer-in-Charge before erection at site.
- 1.7 Earthing shall be done in the presence of the Engineer-in-Charge or his authorized representatives.
- 1.8 The work shall be carried out in engineering like manner and bad workmanship shall be rejected summarily. For redoing the job, no claim of the bidder shall be entertained on this account.
- 1.9 The bidder or his authorized representative shall sign the site order book and comply with the remarks entered therein by the representative of the Department.
- 1.10 The bidder will ensure that all the skilled persons managed / deployed for executing the electrical work posses wireman license issued by approved authorities. Consequences arising due to the default of the bidder to comply with this condition would be bidder's responsibility only.
- 1.11 The contract shall submit the completion certificate and completion plan as per Clause 1.26 of General Specifications for Electrical Works Part-I, Internal 2013.
- 1.12 The bidder will have to arrange for insulation and other tests as per rules in the presence of the representative of Engineer-in-Charge as and when required by him and submit the test report in triplicate before the work can considered as complete.
- 1.13 The bidder shall be responsible for the safe custody of the electrical installation in the building, including fitting and fixtures till the installations handed over to the department. He should make his own arrangement for proper watch and ward at his risk and cost. No claim will be entertained on this account.
- 1.14 The work is to be carried out in workman like manner and generally in accordance with the plans. However the bidder will be bound to carry out the work with minor deviation over the plan supplied if desired by the Engineer-in-Charge of the work.

- 1.15 The bidder has to rectify defects during defect liability period of 12 months from the date of handing over. Nothing extra shall be paid on this account.
- 1.16 Stage payment to the bidder for various minor component of work shall be regulated as per CPWD Specifications. For works for which the % payment is not specially mentioned in the specification, the rate of stage payment shall be decided by NCCF
- 1.17 Any Damage done to the building during the execution of electrical work shall be made good immediately at his own cost to the entire satisfaction of the NCCF
- 1.18 All TTA Panels shall be fabricated and tested at OEM works.
- 1.19 Lift: Spacer if required to accommodate lift in lift shaft shall be included with in the scope of work nothing extra shall be paid on this account.
- 1.20 Lift landing doors shall have a fire rating of 2 hours.
- 1.21 Transformer losses at 50% and 100% loading shall be as per ECBC.
- 1.22 The bidder shall submit all drawings of electrical works i/c conduit layouts etc. and get them approved by engineer in charge before start of work
- 1.23 All sundry fittings, accessories, foundation bolts, hardware items, termination lugs for electrical connections as required for efficient working of the various components of the work shall be deemed to have been included in the tender whether such items are specifically mentioned in the tender documents or not.
- 1.24 Works to be done by the bidder:
Unless and otherwise mentioned in the tender documents, the following works shall be done by the bidder, and therefore their cost shall be deemed to be included in their tendered cost:-
- (i) Cutting and making good all damages caused during installation and restoring the same to their original finish.
 - (ii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after original finish.
 - (iii) Painting at site of all exposed metal surfaces of the installation other than pre-painted item like fittings, fans switchgear/distribution gear items, cubical switchboard etc.
 - (iv) Storage space for all equipment's, components and materials for the work.
- 1.25 The bidder shall leave such recesses, holes, openings, etc., as may be required for the electric, air conditioning and other related works.(For this purpose any required insets, sleeves, brackets, conduits, base plates, insert plates, clamps etc. Shall be arranged by the bidder and fix the same at the time of casting of concrete, stone work & brick work, if required, and nothing extra shall be payable on this account.
- 1.26 The main bidder shall be responsible for coordinating the activities of all works and essential progress of works as per milestone and laid down programme.
- 1.27 The firm shall use only electrically operated chase cutting machine for cutting the chases in the wall for recessed conduit wiring.
- 1.28 The MCB should be same make as that of MCB DBs.
- 1.29 All the MCCB's shall be ICU = Ics = 100%

6.3 TECHNICAL SPECIFICATIONS OF INTERNAL EI WORKS

- 1.1 The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.
- 1.2 The bidder shall bring sample of materials for approval of the NCCF Sample of approved materials must be kept at site for inspection/comparison with materials to be used in work by senior officers. All materials shall be delivered with manufactures test certificates and technical catalogues, instructions manuals, wiring diagram etc. as required.
- 1.3 However, it shall be the responsibility of the Bidder to ensure that all wiring work has been carried out as per specification and till fixing of Electrical lighting fixtures it will be responsibility of the bidder that all points/ circuit wiring our in intake in position and in working order.
- 1.4 All hardware items such as screws, thimbles, connectors, earth/neutral terminals, wires etc. which are essentially required for completing any item as per specifications will be deemed to have been included in the item even when the same have not been specifically mentioned.
- 1.5 All hardware material such as nuts/bolts/screws/washers etc. to be used in the work shall be zinc/cadmium plated iron. The galvanised boxes of modular switch/sockets etc. shall be of the same make as of switch/socket etc.
- 1.6 While laying conduit, suitable minimum number of junction boxes shall be left for pulling the wires. These shall be placed in such a way that the same do not remain noticeable.
- 1.7 Multi stranded FRLS PVC insulated copper conductors wires are to be used in the work. Termination of multi-stranded conductors shall be done using crimping type copper thimbles at both the ends. Nothing extra shall be paid for the same.
- 1.8 The bidder shall follow the shortest route for circuits, submain, point wiring etc
- 1.9 The connections of switches, sensors, earthing conductors & interconnections cables shall be made by adequate rating thimbles of approved standard makes only and nothing extra on this account shall be paid.
- 1.10 Check nuts shall be provided while terminating the M.S. conduits in switch board boxes for which nothing extra shall be paid.
- 1.11 All distribution boards shall be marked with circuits controlling the rooms/area/SDB controlled.
- 1.12 Material to be used in the work shall be ISI marked. The makes of material have been indicated in the list of acceptable makes. No other make will be acceptable. The material to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the bidder to remove the material which, in his opinion, is not as per specifications.
- 1.13 While deciding the size of switch boxes for light points/fan point, exhaust fan point items, extra two modules will be provided for each fan point for fixing of regulator(s) (fan regulator is to be provided under different item). Wherever extra modules are available, the same shall be provided with blanking plates without any extra cost.
- 1.14 Modular type switches/sockets/telephone outlets/TV sockets are to be provided wherever indicated in the items. The same shall be of only one make. The modular plates of switches,

- sockets, telephone & TV sockets etc. shall be in two parts i.e. plates with frames with in quoted rates.
- 1.15 The building shall be provided with false ceiling in various areas. In order to avoid maintenance problem the bidder will not provide any ceiling rose/connector/looping box etc. above the false ceiling. The point wiring in that case will be extended up to the fitting/fan etc. directly without provisions of any termination arrangement in between. The wire from the end point up to the fixture shall be considered to be included in the point wiring. Nothing extra shall be paid for the same.
 - 1.16 Wherever it is not possible to provide rigid conduits, flexible conduit pipe shall be provided for drawing/running the wires. However, such arrangement has to be kept to the barest minimum and only with the prior approval of NCCF
 - 1.17 Earthing and all hidden items of work shall be carried out in the presence of the Engineer-in-charge or his authorized representative.
 - 1.18 The fan box cover shall be made from 3mm thick phenolic laminated sheet as per CPWD specification.
 - 1.19 The bidder shall provide only metallic junction boxes/looping boxes with cover of required sizes even in PVC conduiting and such boxes shall be measured as a part of conduit/wiring without any extra payment.
 - 1.20 The metallic junction boxes & looping boxes shall be covered with approved makes of phenolic laminated sheet. For telephone, television & fire alarm system shall be provided at all the floors within scope of work without any extra cost as per requirement & layout approved by NCCF
 - 1.21 The quantities of various items may vary from the quantities given in schedule of work. The agency shall bring the various items & materials as per actual requirement at site at the time of execution of work. Excess quantities shall not be accepted & paid by the department.
 - 1.22 The ceiling roses wherever required to be provided are included in the scope of work without extra payment and the same shall also be of modular type & of the same make as that of switches & sockets along with earthing provision.
 - 1.23 All TTA Panels shall be fabricated and tested at OEM works.

6.4 TECHNICAL SPECIFICATIONS OF ELECTRIC SUBSTATION WORKS:

The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.

The bidder shall bring sample of materials for approval of the NCCF Sample of approved materials must be kept at site for inspection/comparison with materials to be used in work by senior officers. All materials shall be delivered with manufactures test certificates and technical catalogues, technical parameters as per CPWD specifications, instructions manuals, wiring diagram etc. as required.

Substation, Panels etc. shall be compatible for IBMS and all electrical panels shall be provided. All TTA Panels shall be fabricated and tested at OEM works.

Transformer losses at 50% and 100% loading shall be as per ECBC.

1.0 MAIN LT PANEL / SUB LT PANELS

1.1 General

Main Distribution Board/Sub Distribution Boards shall be metal clad totally enclosed, rigid, floor or wall mounted as per requirement, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system and shall be fabricated as per CPWD specifications. Suitable CC foundations of minimum 200 mm height shall be constructed for floor mounted sub LT panels, cost of which is including in the scope of work and nothing extra shall be paid on account of this.

1.2 Installation

The installation work shall cover assembly of various sections of the panels lining up, grouting the units etc. In the case of multiple panel switch boards after connecting up the bus bars etc., all joints shall be insulated with necessary insulation tape or approved insulation compound.

1.3 Interlocking

Arrangement of electrical interlocking in LT panel shall be provided for transformers incomers, DG Set incomers and bus couplers.

1.4 Testing and Commissioning

Commissioning checks and tests shall include all wiring checks and checking of connections. Relay adjustment/setting shall be done before commissioning in addition to routine Megger tests. Checks and tests shall include the following:

- a) Operation checks and lubrication of all moving parts.
- b) Interlock function checks.
- c) Continuity checks of wiring, fuses etc. as reqd.
- d) Insulation test.
- e) Trip tests and protection gear test.

2.0 Air Circuit Breaker Specifications:

- I. ACB's shall be Electrical Draw Out/Manual Draw out type as specified in BOQ.

- II. The Air Circuit breakers shall 3 pole or 4 pole with minimum 50KA short circuit breaking capacity (35 MVA at 415V) conforming to IS: 13947 (part-II) . Rated current shall be as per capacities specified.
- III. ACB shall be air break, horizontal draw-out type & type tested & certified for compliance to IS:13947-2 from Indian testing authorities CPRI/ ERDA.
- IV. The ACBs should have $I_{cs} = I_{cu} = I_{cw}$ for 1 sec for Short circuit breaking capacity of minimum 50KA rms at 415V, 50Hz AC or as specified in BOQ.
- V. The protection release shall be Microprocessor based having inbuilt adjustable protections against Overload, Short circuit, Instantaneous and Earth faults. Microprocessor based release shall be EMI / EMC compatible. Protection release shall have following features:-
 - a). The release shall draw power from main breaker CTs and shall require no external power supply for its operation.
 - b). Multi state LED to indicate Power ON and micro-processor unhealthy condition. Release shall also provide separate fault indication by LEDs for each type of fault without using external power supply.
- VI "4" pole ACBs to have fully rated neutral pole.
- VII It should be possible to carry out inspection and maintenance without removing ACB from panel.
- VIII It should be possible to directly terminate Aluminium links as specified in IS: 13947.
- IX Automatically operated safety shutters shall be provided to screen the fixed isolating contacts when the breaker is drawn out from the cradle.
- X The ACBs shall be fully rated at free air ambient temperature of 40°C.
- XI Necessary set of auxiliary switches shall be provided.

3.0 Moulded Case Circuit Breaker:

- a. The MCCB should have double break, positive isolation current limiting, load line reversibility & horizontal cum vertical mounting features.
- b. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA
- c. MCCB shall comprise of Make - break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.
- d. The breaking capacity of MCCB shall be minimum 35KA for ratings upto 200A and 50KA for 250A ratings & above if the same is not specified in BOQ. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}$).
- e. All MCCB ratings up to 250A shall be provided with Thermal Magnetic release having adjustable settings for Overload and instantaneous Short Circuit Protections. For ratings above 250A protection release should be Microprocessor based having inbuilt adjustable protections against Over Load (L) and Short Circuit (S). If used as incomer then it should have earth fault protection and time delay in addition to above protection. Earth leakage modules are not acceptable.
- f. All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility.

- g. MCCB should have Spreader links & Phase barriers as standard feature.

4.0 SPECIFICATION OF CABLES:

These cables shall have individually screened cores and be manufactured and tested according to IS: 7098 (Part I) - 1973 amended up to date & latest. The conductor for these cables shall be from electrical purity Aluminum 3/4 H or H Temper. All conductors shall be compacted circular in shape. The insulation shall be high quality cross linked Polythene - obtained by chemical cross linking of polythene molecules. The armoring applied over the common covering shall be of flat steel wires.

Each and every delivery length of the cable shall be subjected to routine tests as per IS:7098 (Part I) 1973 amended up to the date. The operating characteristics of these cables shall be as under.

- | | | |
|------|---|----------------------------|
| i) | Permissible maximum continuous operating temperature | - 90 °C |
| ii) | Permissible short circuit temperature | - 250 °C |
| iii) | Di electric constant (Er) at 50 ⁰ Hz, 30°C to 90°C | - 2.4 |
| iv) | Loss factor at 50Hz, 30 °C to 90°C | - 0.5X100X-3 |
| v) | Sp.Vol. resistivity at 20 °C | ->10 ¹⁴ Ohm cm. |

1. LAYING OF CABLES:

All cables shall be laid as per C.P.W.D GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS (PART-II EXTERNAL) - 2005 with all up to date amendments.

2. TESTING THE CABLES:

All cables shall be tested as per C.P.W.D GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS (PART-II EXTERNAL) - 2005 with all up to date amendments.

DRAWINGS

The bidder shall submit six complete sets of drawings on white paper to the owner/Engineer-In-Charge after completion of the work.

These drawings must give the following information's, in addition to the information asked for in various other sections of the specifications:

- a) Location of all equipments viz. transformers, H.T. Panels, L.T. Panels, earthing stations etc.
- b) Cable routes clearly indicating the sizes & number of cables.
- c) Earthing layout - indicating the type of earth station & size of earth conductor.
- d) Wiring diagram of L.T. Panels.
- e) Complete single line diagram for Normal and Emergency supplies.
- f) Any other information the Engineer-In-Charge may deem fit.

No completion certificate will be issued until the drawings are submitted. The drawings will be prepared and submitted by the bidder without any extra charge.

APPENDIX-I

SAFETY PROCEDURE

1. The Indian Electricity Rules 1956, as amended upto date, are to be followed in their entirety. Any installation or portion of installation which does not comply with these rules should be got rectified immediately.
2. The detailed instructions on safety procedures given in B.I.S. Code No. 5216-1969-"Code of Safety Procedures and Practices in Electrical Works" shall be strictly followed.
3. No inflammable materials shall be stored in places other than the rooms specially constructed for this purpose in accordance with the provisions of Indian Explosives Act. If such storage is unavoidable, it should be allowed only for a short period and in addition, special precautions, such as cutting off the supply to such places at normal times, storing materials away from wiring and switch boards, giving electric supply for a temporary period with the permission of Engineer-In-Charge shall be taken.
4. The electrical switchgears and distribution boards should be clearly marked to indicate the areas being controlled by them.
5. Before energizing on an installation after the work is completed, it should be ensured that all tools have been removed and accounted, no person is present inside any enclosure of the switch board etc. any earthing connection made for doing the work has been removed.

6.5 TECHNICAL SPECIFICATION OF LIFT WORKS

- 1.1 The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.
- 1.2 The bidder shall bring sample of materials for approval of the NCCF Sample of approved materials must be kept at site for inspection/comparison with materials to be used in work by senior officers. All materials shall be delivered with manufactures test certificates and technical catalogues, technical parameters as per CPWD specifications, instructions manuals, wiring diagram etc. as required.
- 1.3 Lifts shall be compatible for IBMS.

2.0 GOVERNING CODES AND PERMITS

2.1 Code

Elevator equipment shall be furnished and installed in accordance with IS-14665/A.N.S.I./ A.S.M.E. A17.1/ CENEN 81-1 Japanese Codes including latest supplement. The Elevator Bidder shall inform the owning Company of any intended or required departures from the code requirements described above.

No degradation of IS-14665/ANSI/ ASME/ CENEN 81-1 requirements is acceptable simply on the basis of the local code requirement. It is acceptable only when the ANSI/ ASME/ CENEN 81-1 code is in direct conflict with local code requirements and where the latter is more stringent than the former.

The work shall be executed as per CPWD General Specifications for Electrical Works (Part Lifts & Escalators-2003) as per relevant IS and as per directions of NCCF

These additional specifications are to be read in conjunction with above and in case of variations, specifications given in this additional conditions shall apply.

However, nothing extra shall be paid on account of these additional specifications & conditions as the same are to be read along with schedule of quantities for the work.

2.2 Inspection and testing :

For item/equipment requiring initial inspection at manufacturer’s works the bidder will intimate the date of testing of equipment at the manufacturer’s works before dispatch. The departments also reserve the right to inspect the fabrication job at factory and successful tenderer has to make the arrangement for the same. The successful tenderers shall give sufficient advance notice regarding the date proposed for such tests/ inspection to the department’s representative(s) to facilitate his presence during testing/ fabrication. The Engineer-in-charge at his discretion may witness such testing/fabrication. The cost of the Engineer’s visit to the factory will be borne by the department. Also equipment may be inspected at the manufacturer’s premises, before dispatch to the site by the Bidder. The department may also authorize DGS&D for inspection and testing of material at manufacturers works and at site during erection, and final inspection for acceptance. However the inspection fees payable to DGS&D shall be borne by the department. The bidder has to extend all the help and facilities to DGS&D for inspection of material at manufactures works and at site during

installation and completion.

S. NO.	TECHNICAL PARAMETERS For (13 Passenger Lifts) (WITH MACHINE ROOM LIFT)	GIVEN
1	Type of Lift	Passenger lift, gearless type
2	Numbers of lifts required	2 Nos.
3	Load: Number of persons	13 passengers (884 Kg.)
4	Rated Speed	1.5 MPS
5	Travel in meters	42 mtr. approximately
6	Number of floors served	G+8 th Floor
7	(a) Inside size of lift well	2500 mm x 2100 mm
	(b) Pit Depth	1600 mm
	(c) Head room	4800 mm (Approx)
10	Position of counter weight	At the back of the car
11	Position of machine room	Over hoistway/ at the top of lift shaft
12	(a) Type of control	Microprocessor based simplex full selective collective with/without attendant.
	(b) Type of operation	Microprocessor based simplex full selective collective with/without attendant.
	(c) Potential free Contacts	Potential free contacts for each floor position up and down movement of the lift shall be provided in the controller which can be used for the building system at later date.
13	Car entrance door	
	(a) Number	13 Nos.
	(b) size	2000 mm (h) x 900mm (w)
	(c) Type of doors	Landing door stainless steel Moonrock
	(d) Car open in front only or open	In Front only

14	Construction design and finish of car body work	As per General specifications for electrical works (Part-III Lifts & Escalators) 2003. It should be provided with stainless steel hand rails on all the three side not less than 600mm long at a height suitable for physically challenged persons but should not be at a height more than 900mm
15	Type of signal system	a) Digital floor position indicator in the car and at all landings (to be provided above the car /landing doors)
		b) Travel direction indicator in the car and at all landings (to be provided above the car/landing doors)
		c) Gongs & Visual indication on all landings for pre arrival of the car for two or more cars
		d) Overload warning Audio & Visual indicator, inside the car (lift should not start on overload)
		e) Battery operated alarm bell and emergency light
		f) Car operating panel with fade proof luminous buttons in car and with intercom
		g) Luminous hall buttons at all landings
		h) Fireman's switch at ground floor
		i) Emergency stop switch in series with normal toggle switch inside the car so that operation of any one of them shall bring the lift to halt.
		j) Braille button in all the cars.
		k) Intercom system (flush type) in all the cars for inter-lift communication, with machine room and with control room (including wiring upto machine room and control room).
16	Landing entrance	
	a) Location of landing entrance in different floors	All doors on the same side
	b) Number	13 Nos.
	c) size	2000mm (h) x 900mm (w)
	d) type of doors	Landing door stainless steel Moonrock
	e) lift in use/ lift out of order sign	A suitable box above the lift handing with LED illuminated bilingual (in English & Hindi) sign of "LIFT OUT OF ORDER" coming up simultaneously at all floors.

17	Electric supply	a) Power: 415 V, AC, 3 phase, 50 Hz, 4 wire system b) Lighting; 230 V, AC, 50 Hz
18	Is neutral wire available for control circuits	Yes
19	Proposed dated for commencement at site	Immediate
20	Environmental condition at site of installation	Summer- 45 ⁰ C, RH-25% Winter - 4 ⁰ C , RH-80%
21	Storage space provided	Yes
22	Additional item, if any	The lift should be provided with automatic rescues device, brail type, luminous push buttons in car suitable for blind persons.
23	Approval of Engineer-in-Charge	All fittings and fixtures connected with building and interior of lifts to be got approved before fabrication.
24	Lift car interior	Flooring to be provided with black granite tiles and machinery designed for this additional load.

6.6 TECHNICAL SPECIFICATION OF DG SETS WORKS

- 1.1 The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.
 - 1.2 The bidder shall bring sample of materials for approval of the NCCF Sample of approved materials must be kept at site for inspection/comparison with materials to be used in work by senior officers. All materials shall be delivered with manufactures test certificates and technical catalogues, technical parameters as per CPWD specifications, instructions manuals, wiring diagram etc. as required.
 - 1.3 **DG SET WORKS:**
 - 2.0 **INTENT OF SPECIFICATION:**
-

This specification covers the design, manufacture, assembly, packing, dispatch, transportation to site, supply, erection, testing, commissioning, performance and guarantee testing of **Diesel Gen-Sets**, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

3.0 SCOPE OF WORK:

3.1 Scope of Supply & Services:

- 1.1.1 General Scope of work shall include design, manufacture, assembly, packing, dispatch, transportation to site, supply, storage, shifting erection, testing and commissioning of the following:
- 1.1.2 Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame, interconnecting piping and accessories, bus duct and control cable, glands and lugs etc.
- 1.1.3 DG Local/Remote control panel including all type of control cables, special cables between D.G. Set's, instrument panel, PLC control panel and Main LT panel etc.
- 1.1.4 Equipment Necessary for Engine Cooling System, **Heat Exchanger**, pumps, valves, inter connecting pipes etc.
- 1.1.5 Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), piping, pumps, valves, level indicators etc.
- 1.1.6 Exhaust piping, flexible connections and residential type silencer of Exhaust System, including Thermal Lagging, cladding etc.
- 1.1.7 Batteries with good quality iron battery stand and battery charging equipment, including their connections as necessary, along with tools & accessories for battery maintenance. (Bidder shall submit the list of tools along with Tender)
- 1.1.8 Anti Vibration Mountings etc.
- 1.1.9 Cooling Towers including fans, motors, weatherproof isolator enclosure, isolator etc.
- 1.1.10 Cooling tower pumps etc.
- 1.1.11 Cooling system piping including controls & accessories etc.
- 1.1.12 Electrical panel for local equipment, cooling tower pumps etc.
- 1.1.13 Bus duct/Power & Control cabling, cable tray etc.
- 1.1.14 Preparing all related shop drawings for approval from client/consultant and all statutory bodies as required and as applicable.
- 1.1.15 Obtaining statutory approval of the installation including permission for operation of Diesel Generators by the Electrical Inspectorate, Pollution Control bodies and any other statutory bodies as applicable.
- 1.1.16 Related civil works like chasing, grouting etc. for execution of jobs.
- 1.1.17 Carrying out performance and guarantee test at site at available load which shall not be more than the capacity of D.G. Set.

- 1.1.18 The fuel oil installation shall meet all statutory requirements of Govt. of India as amended upto the date of installation. Any approval required from statutory authorities shall be obtained by the Bidder. Nothing in this Specification Shall be construed to relieve the Bidder of These Responsibilities.

2. Inspection & Testing

Successful tenderer shall get the material & equipments inspected and tested by Engineer-in-charge or his representative before dispatch at OEM/OEA works. Load, POL and consumables for this testing shall be arranged by bidder at his own cost. Tenderer shall give sufficient notice regarding the dates proposed for such inspection. Engineer-in-charge can waive off inspection if he so desires due to urgency of work.

Copies of all manufacturer's routine and type test certificates of the equipments shall be furnished to the inspecting officer at the time of inspection.

The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangements for the same.

If it is proved that the installation or part thereof is not satisfactorily carried out then the bidder shall be liable for the rectification and retesting of the same as called for by the Engineer in charge or his authorized representative. All tests shall be carried out in the presence of Engineer in charge or his authorized representative. The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Engineer in charge or his authorized representative as per CPWD specification.

After installation, the equipment shall be tested by the bidder. The inspection at site includes operation, checks and any other test as necessary to check the performance of the set and control equipments, so as to check conformity to tender specifications.

The bidder shall provide all necessary instruments and labour for testing. The Bidder shall make adequate records of test procedures and readings and shall repeat any tests requested by the Owner / Consultant. The certificate duly signed by a authorized person shall be submitted for scrutiny.

GENERAL SPECIFICATIONS

The work of DG SETS and other connected works shall be carried out as per CPWD General Specification for electrical works (Part-VII -DG SETS) 2013 as amended up to date and CPWD General Specifications for Electrical Works (Part-I) 2013 and CPWD General Specifications for Electrical Works (Part II- External) 1995 and CPWD General Specifications for Electrical Works (Part-IV Substation) 2013 as amended up to date except the following changes. Reference to clause numbers of specifications is also given.

SCOPE

These specifications cover the following works of D.G Sets:-

- S/I/T/C of 160 KVA DG Set Silent Type → 1 Set
- M.S Day Oil Tank of 990 Litres Capacity → 1 Set
- High Exhaust Stack → 1 Set
- Supply & laying of Connecting Power Cables
- Earthing for System as per specifications
- Statutory approvals including clearance from Electrical Inspector, approval from Pollution Control Board. However, the Govt. fees shall be paid/reimbursed by the department.

The Specifications cover the equipments and materials for the DG Sets, their testing and/or inspection as may be necessary before their dispatch from their respective works, their delivery at site, all preparatory works, assembling, installation and adjustments, commissioning, final testing, putting into operation and handing over of the complete system.

The tender specifications, wherever they differ from these 'General Specifications', shall have over-riding value and shall be followed for that particular work.

TECHNICAL SPECIFICATION

The work shall be carried out as per CPWD General Specifications for Electrical Works, Part VII (DG SET works) 2013 as amended up to date along with the following changes, CPWD General Specifications for Electrical Works Part-I, II & IV, as amended up to date, relevant IE rules, and as per directions of NCCF For electrical panels, CPWD General Specifications for Electrical Works Part-VII (DG SET) shall be applicable.

1.0 SCOPE

Work covered by this contract shall conform to latest CPCB norms effective from 2004 include design, manufacture, supply, transportation, delivery, installation and commissioning of automatic start direct coupled Diesel Generator Sets suitable continuous round the clock operation at up to rated output with permissible overload with associated works. Items included (but not limited to) in the contract are abstract below.

- Diesel engines directly coupled with alternators mounted on a rigid fabricated base frame with resilient anti vibration mountings.
- AMF panels.
- DG cooling system.
- Exhaust piping with Silencer to provide 25 DBA insertion loss
- Electric starting equipment including batteries and battery chargers.
- Fuel supply system Oil Storage tank and automatically operated Transmission System.
- Acoustic Enclosure as per C.P.C.B. Norms.
- Statutory approvals including permission from Electric Supply Authority Operation of DG sets, clearance from Electrical Inspector, approval from Pollution Control Board and necessary approved from Department of Explosive for bulk oil storage.

2.0 PROPOSED OPERATIONAL SCHEME

The DG set shall be provided with the feature to take 3 Starts After an interval as per manufacturers' standards on power failure. In case DG does not start, no further attempts shall be made. Upon restoration of Board Power, the changeover from DG power to Board power will be automatically done by the AMF by switching off the DG set after a specified period of time. The AMF panel is given total manual override to take care of unexpected failure of auto start.

3.0 GENERAL SPECIFICATION

3.1 The DG set shall be capable of safe, Prime Power continuous running at variable load for unlimited number of hours and shall also be able to run for one hour period at 110% of the rated power after every 12 hours. Noise, mechanical and thermal stresses shall be within permissible limits. The equipment shall be designed with regard to ease of maintenance, cleaning and inspection.

3.2 The DG set shall comply with latest guidelines, regulations and Central Pollution Control board norms.

3.0 ENGINE

4.1 The diesel engine shall be indoor-type, four stroke, multi-cylinder, 1500RPM inner cooled, compression ignition with Electronic Fuel Injection system complete with its self contained lubricating system.

4.2 Engine mounted radiator designed to dissipate the generated heat effectively shall be used.

4.3 High speed diesel oil shall be used as fuel for the engine.

4.4 The engine shall be coupled to the generator directly or through flexible coupling.

4.5 The engine shall be capable of producing the desired nominal output at site referred generator terminals and with machine operating under ambient conditions as special the specific requirements.

4.6 The lube oil system shall be provided with engine driven lube oil pump and lube oil-pump facility for use when the engine is not in operation.

4.0 Fuel Consumption

The engine shall be suitable for satisfactory operation on H.S.D. as locally available tenderers shall declare the guaranteed fuel consumption in liters per litres /accordance with relevant I.S. or B.S. at 25%, 50%, 75% and 100% of rated load at 0.8 consumption shall be low so as to deliver minimum 4 units per liter at 75% load.

Such guaranteed fuel consumption is also to be expressed in liters per unit supplying the requirements of auxiliaries) at 25%, 50%, 75% and 100% of rated load at 0.8.

If guaranteed fuel consumption is exceeded, the bidder shall make such modification or alterations as are necessary to bring the consumption to within the guaranteed figure.

Tolerance of + 5% as defined in BSS-649-1958 shall be allowed.

5.1 Lubricating Oil Consumption

The tenderers shall state the guaranteed lubricating oil consumption in liters per hour and shall also furnish oil consumption data.

5.2 Air Filters

The engine air intake shall be fitted with a substantial air cleaner of oil bath / paper element type.

5.3 Fuel And Lubricating Oil Filters

5.4

Filter for fuel and lubricating oil system shall be of simplex type. Lubricating oil filters be of an efficient full flow type of ample capacity and suitable for reuse with detergent. They shall be capable of removing all foreign matter above a particle size of 5 micron.

5.5 Lubricating Oil System.

The engine shall be of the totally enclosed type and fitted with a positive pressure of lubrication to all working parts. Lubricating oil shall be circulated in the engine driven pump. There shall be no moving part requiring lubrication by hand the starting of the engine or while in operation.

5.6 Safety Controls.

The engine shall be complete with all controls to render the operation of the engine and totally safe including but not restricted to the following;

Low Lubricating Oil Pressure

Pressure sensors shall be fitted such that in the event of a fall in the lub oil pressure, an alarm and indication shall be actuated. In addition, the engine shall be automatically shut down in the event of lub oil pressure dropping to a predetermined low value. Potential free contacts for conveying the signal to BMS shall be provided.

Over Speed

Speed control shall be so arranged that a 10-12% increase over normal rated speed shall cut off fuel supply, thus stopping the engine. Potential free contacts for conveying the signal to BMS shall be provided.

Overload Protection

The engine shall be adequately protected against operating under overload conditions. The requirements shall be met by the provision of a fixed overload limit stop on the fuel pump rack control rod to prevent the set being subject to a load exceeding the site rating plus 10%. Potential free contacts for conveying the signal to BMS shall be provided.

5.6 Accessories, Instruments and Safety Controls for Engine

Accessories:

- Flywheel
- Coupling with guard
- Mechanical guarding of all moving parts
- Air cleaner oil bath/paper element type
- Corrosion resistor
- Governor
- Fuel injection
- Fuel filter
- Lub oil filter
- Lead Acid Automotive type high discharge with leads and float cum boost battery charger alongwith battery stand.
 - Flexible Bellows
 - Exhaust Silencer
 - Interconnection wiring, cabling and piping as required
 - Set of standard tools
 - Anti-vibration mounting pads.

5.7 Instruments and Guages

- Lub, oil pressure gauge.
- Water temperature gauge
- Battery charging ammeter
- Hour meter to show total engine hours run 10,000 hr capacity
- R.P.M. indicator of the tachometer type.
- Starting switch

5.8 Safety Controls for

- Low lub oil pressure

- High water temperature
- Over speed
- Over Load Protection

6.0 AUXILIARIES

6.1 Governor System:

6.2 The Governor characteristic shall comply with the requirements of AIEE standard 606.

6.3 The governors shall be suitable for operation without external power supply and shall adequate speed control in the event of failure of electrical governor circuitry.

6.4 A mechanical over speed trip device shall be provided to automatically shut off fuel in the speed exceeds 110% of the rated value.

7.0 ALTERNATOR WITH ACCESSORIES:

The Alternator shall have the following characteristics

Type	-	Brushless, rotating field design alternator rated for
415 volts / 50 complying to IS 4722	-	1992, BS 5000 Part-III and IEC 34.
Excitation system	-	Permanent magnet generator (PMG) powered excitation system
Speed	-	1500 RPM
Net Site Output	-	Rated continuous at ambient conditions and as per
Schedule of quantities.		
Voltage Regulation	-	Within 0.5% of the rated voltage
Overload	-	More than 10% of the nominal for 1 hour every

12

Hours without exceeding permissible temperature rise.

Harmonics	-	Maximum 1% between phase and neutral and total Maximum 3 degree.
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- The Alternator shall be capable of delivering the rated output at rated power factor as out in specific requirement sheet.
- The Alternator shall be capable of withstanding without damage a three-phase short circuit at its terminals when operating at rated KVA and PF and at 5% over voltage with fire excitation for 3 seconds.
- The alternator shall be capable of withstanding without damage
 - a) 50% overload for 15 seconds.
 - b) 10% overload for one hour every twelve hours.
- The line and neutral leads of phase windings of the Alternators shall be in suitable terminal boxes with flexible rubber bellows wherever the outgoing is Busduct.
- The neutral shall be taken to a neutral earthing cubicle cum DG control panel, where 1 of CT shall be provided in the neutral before connecting it to ground point. The CT shall connect to an E/F relay for generator protection. The neutral shall be taken to the ground through a removable link. The relays and motors shall also be housed in the control panel. Please refer to enclosed specific requirement sheets.
- RTD/BTD shall be provided in the Alternators windings and connected to relay at the cubicle, which shall have contacts for alarm and trip.
- The neutral earthing cubicle/control panel shall be integrated into one vertical housing the switches, lamps, enunciators, relays, etc.
- The Alternator winding shall have class of insulation H class with temperature rise limited to Class H insulation.

Construction:

The alternator shall be of air ventilated screen protected drip proof design with IP 23 protection having adequate air intake / outlet areas to enable designed air quantity to flow within permissible pressure drop. Single/double bearing alternator shall be provided with suitable bedplate with engine / generator mounting pads to ensure a good base for accurate alignment. The terminal arrangement of the alternator of DG Sets shall be suitable for receiving the power cable. The termination details shall be finalized in coordination with the manufacturer and got approved from Engineer-in-Charge before execution. The Combined Engine Alternator unit shall be mounted on a common rigid fabricated base frame. The alternator shall have its windings star connected with the neutral connection brought out to a separate terminal. The alternator shall fully comply with the latest Standard BS 2613 and BS 269 in respect of winding insulation and fast response to maintain steady voltage.

Temperature Rise

The maximum temperature rises of the various components of the alternator shall not exceed those permitted under I.S. with full output and under the ambient temperature conditions specified in special conditions of contract.

Rating

The alternator shall be continuously rated to deliver the rated output at 0.8 of lagging, on a 3 phase 4 wire 415 volts 50 cycle system with neutral solidly earthed. The earthing system conforming to Indian TNS.

8.0 EXCITATION:

- 8.1 The excitation system shall be a brushless system with all accessories, and shall be capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant.
- 8.2 The exciter shall have class H insulation
- 8.3 Automatic Voltage Regulators/PCCM
The AVR/PCCM shall regulate the output voltage from generator current/voltage signals, automatic voltage regulator (AVR)/PCCM shall be high-speed dead band type with automatic manual control and mounted on control panel or on alternator as specified in the sheet. If mounted on panel it shall be flush with door, accessible on front door. The manual control shall change in excitation system while AVR is in service. Necessary motorized potentiometer manual control raise / lower PBs shall be provided.
- 8.4 Necessary equipment for field suppression and surge protection shall be provided, response time of the exciter and the generator shall be matched to avoid hunting.
- 8.5 All routine tests shall be carried out as per the various Indian standards for eng alternator and the coupled DG system. The vendor shall give 2 weeks notice for inspection.
- 8.6 Suitable measures shall be taken for field failure protection. The manufacture should specify the method adopted for the same with proper equipment specification schemes.

9.0 GOVERNING

The electronic governor of class A1 shall be provided as per standard design of the manufacturer capable of regulating the speed of the engine.

10 STARTING

11

- 10.1 The DG set shall be automatically started, once the Grid Supply has failed and should have provision given for manual starting in case the AMF system has failed.
- 10.2 The starting of the DG set shall be through a starting switch for manual start.

Batteries of suitable AH capacity with a suitable Battery Charger shall be provided starting the DG sets.

- 10.3** The battery shall be Maintenance free Lead Acid Automotive High Discharge battery sufficient for three consecutive starts without recharging battery charger shall have boost and trickles charging features. Battery shall be confirming to IS: 1651 as per clause 11.2.

11.0 STARTING BATTERY AND BATTERY CHARGER

11.1 24 Volt DC Batteries

24 volt batteries for each set shall comprise of Lead acid automotive high discharge batteries. The battery bank shall be provided with the following accessories.

- a) Battery stand
- b) Set of connectors with ends takes off suitable for connections.
- c) Cell insulator and stand insulators.
- d) Spring type hydrometer
- e) Thermometer with specific gravity correction scale
- f) Cell testing voltmeter
- g) Set of tools consisting of spanners, rubber syringe, and resisting funnel and acid resisting tube of 2 litres capacity – one set
- h) Potential free contacts for conveying signals to BMS.

11.2 Battery Charging Equipment (Trickle and Boost Charging)

Battery trickle and boost charge required capacity designed to operate on single phase 230 volts and suitable for charging current as required by the DG and shall be IGBT/THYRISTOR type. The battery charger shall be provided with the following accessories.

AC and DC "ON" and "OFF" switches with HRC fuses, Indicating lamps for indicating mains "ON" and battery charging Ballast to give charging Single phase double round (copper conductor) impregnated natural air cooled mains transformer for rectifier stack. Rotary switch to give step control. Single phase full wave bridge connected silicon rectifier stack Moving coil ammeter to indicate charging current Moving oil voltmeters with a selector switch to measure the battery/charger voltage. Silicon blocking diodes connected to a suitable tap to maintain continuity of DC supply. AC and DC contactors of suitable rating as required.

All the components for battery charger shall be adequately rated and housed in control panel with input and output terminals. Proper cable glands should provide for incoming and outgoing cables.

11.3 Mounting and Foundations

The engine and direct-coupled alternator shall be rigidly secured to a common rigidly frame fabricated from MS sections. The DG set shall be placed on the RCC Floor GERB make ant vibration mountings. A lifting hook of required capacity shall be provide above the finalized location of the DG set to facilitate installation and subsequent maintenance of the DG sets. The design of mounting arrangements with ant vibration mountings shall be as recommended by the DG manufacturers and shall be such maximum of 5% vibrations are transmitted to the building structure. The tenderer confirm the type and make of mountings offered and the vibration isolation efficiency tender. All rigid pipe / bus bar connections to the DG set shall be made through field couplings. The scope includes making of cement concrete foundation of 1:2:4, M-20 grade. About 300mm foundation height should be above the ground level. The length and breadth of foundation should be at least 300mm more than the size of enclosures. It shall be as per manufacturer specifications.

12.0 AMF PANEL

The control and power panel shall comprise of components as specified in the including meters, protection relays, switchgears, control components, control and pipe wiring etc.

The panels shall be fabricated from 2mm thick CRCA sheet. This shall be of compartmentalized and sectionalized design. The supporting framework shall be of angle iron or of heavier gauge sheet metal. The panel shall be self-supporting design, dust and vermin proof, dead front and fully inter lo with isolating switches. The panel should meet P54 or better requirements.

The panel shall be designed so as to facilitate inspection, cleaning and repairs. Clearance between phase to phase and phase to earth or metal parts shall be as relevant IS standards. The metering instruments like voltmeter, ammeter etc. shall be per B.O.Q.) Flush mounted and shall be of 0.5 class accuracy and of standard design with indication lamps.

The Panel shall be tested at site before commissioning. The panel drawings shall be first got approved from consultants before taking up for fabrication.

The panel shall have separate cable alley and a bus bar chamber. The bus bar shall be of Aluminium and insulated with colour coded with heat shrinkable sleeves, neutral bus shall be rated for capacity of half the size of phase bus unless otherwise stating in schedule of quantities / drawings. The bus bars sizes shall be as per CPWD specifications. The cables / wires shall be a minimum of 2.5 sq. mm cross-section.

13.0 AMF FEATURE

While the GRID supply is healthy, the Diesel Generating set is at rest and load supplied directly by the grid through grid circuit breaker.

- The 415V 3Ph, 4wire supply, tapped from Normal Supply Panel, will be fed as input to the AMF panel The status of the supply has to be monitored by the U/V relays provided in the AMF panel.
- When the Grid voltage fails or drops below a certain pre-set value, the automatic control system gives a starting signal to the diesel generator set after ensuring the grid CB at 415v MAIN PANEL (PMCC) is off.
- As soon as the alternator set reaches its operating speed & rated voltage, then signal shall be generated by the D.G. control panel to close the DG incomer CB 415V MAIN PANEL (PCC).
- A maximum of three attempts of starting facility for the DG set shall be provided and case the diesel engine fails to start & reach its operating speed with in stipulated time as per DG set characteristic, the feature should automatically lock out the operation DG set and further operation of DG set should be prevented in both auto & manual condition. This lockout signal shall be given to a hooter, indication lamp with reset button and two potential free contacts.
- When the main supply restored to normal value for at least one minutes then a suitable signal shall be generated and close the Main supply ACB/MCCB automatically and open the DG supply ACB/MCCB.
- The set has thus reverted to its standby condition and will only start when the main fail again.
- Selector switch shall be provided to select the following feature.
- Auto / Manual
- The system operation is Auto/Manual shall be as per CPWD patterns & specifications of DG Set work.

14.0 TESTING OF THE PANEL

On approval of the drawing the bidder shall inform at least three days in advance for inspection. The panel shall be assembled in factory and tested for the following:

Insulation resistance HV test.

Operational test with all functional inter locks.

CT secondary injections for protection and metering circuits. The bidder shall keep all the test equipment's ready at site.

15.0 DRAWING SUBMISSION:

15.1 The following drawings shall be submitted for approval for DG set :

- | | | | |
|----|---|---|--------|
| a) | Foundation drawing with loading data | : | --DO-- |
| b) | Schematic drawings | : | --DO-- |
| c) | All control & indication circuit drawings | : | --DO-- |

- d) Schematic P&I drawing for Lube oil : --DO--
- e) Component list with ratings & ranges of all items. : --DO--
- f) Design/Engineering of DG exhaust system including BOQ : --DO--
- g) Design/Engineering of automatic Fuelling system including the BOQ. : --DO--

15.2 The final drawings with erection/operation & maintenance manual and literature, write ups and description of DG set excitation system, voltage regulator governor and other auxiliaries shall be submit

16.0 TOOLS

16.1 Tenderer shall submit a list of the tools to be used for installation and operation.

16.2 TEST CERTIFICATES

Copies of all documents of routine and type test certificates of the equipments shall be furnished to the department along with the supply of equipments and these are as below.

Routine Test Certificates.

- Engine separately
- Alternator Separately

16.3 Type Test Certificates

- Engine
- Alternator
- Pumps
- Meters
- Governors
- All major components

17.0 PERFORMANCE GUARANTEE:

The performance figures quoted in the technical particular sheets shall be guaranteed within the tolerance permitted by relevant; standards. In case of failure of equipment to meet the guaranteed figures, the purchaser reserves the right to reject the equipment. The rejected equipment may be used by the purchaser till the new equipment meeting the guaranteed requirements is supplied by the vendor.

18.0 PRE-COMMISSIONING CHECKS

All standards checks including the ones elaborated in the specifications to ensure that installation of the DG sets and associated systems has been carried out satisfactorily are done on completion of installation. These shall include.

- **DG Sets**
 - Checking of piping interconnections
 - Checking electrical interconnections
 - Checking of insulation resistance
 - Checking of earthing
 - Checking of instruments and controls
 - Checking of alignment
 - Checking of vibration transmission to building a structure
 - Checking of expansion joints.
 - Any other tests required as per manufacturer specifications.
- **Fuel System**
 - Checking of automatic operation of fuel transfer pumps.
- **Exhaust System**

- Checking of Silencer operation.

19.0 PERFORMANCE TESTING AND TYPE TESTS

19.1 Performance Testing

DG sets shall be tested at varying loads at manufacturers works prior to dispatch DG sets to site. The performance tests at the works shall be carried out in present authorized representative from the NCCF Due notice for the programme performance testing at works shall be given to the Engineer-in-Charge to enable to arrange for their representatives for this inspection to be at manufacturers works to inspection and testing. The costs for the arrangement shall be borne by the Bidder.

The performance test on each DG sets shall be of minimum 12 hours duration.

All instruments, materials, consumables (fuel oil, lube oil etc.) load and labour required carrying out of the test shall be provided by the Bidder.

Following test acceptance criteria shall be applicable

1.	Fuel consumption at 25%, 50%, 75% and 100% load.	± 5% of guaranteed performance. Actual alternator efficiencies as determined in the manufacturer's works tests shall be used as the basis of calculation of specific fuel consumption ratio.
2.	Voltage regulation from no load to full load	+ 0.5%
3.	Frequency regulation from no load to full load	+ 0.5%
4.	Maximum water temperature	+ 0.5% of guaranteed performance
5.	Maximum lube oil temperature	+ 0.5% of guaranteed performance
6.	Minimum lube oil pressure	+ 0.5% of guaranteed performance

20.0 Daily Service Fuel Tank

Daily fuel tanks of 990 litres capacity shall be provided. The tank shall be fabricated from not less than 3 mm M.S. sheet. A removable cover of ample size with lock shall be provided to permit access to the tank interior. The tank shall be provided with all required appurtenances like inlet and outlet connections drain connection, overflow connection etc. Fuel level indicator with low and high level visual shall be provided. The day tanks shall be floor/wall supported on steel support 300 mm above FFL. Outlet valves from all storage tanks shall be located at easily accessible points so as to facilitate immediate shutting off of the fuel supply in case of emergency. Each tank shall also be provided with measuring scale to check the level of oil manually.

21.0 Pipes and pipe fittings

The MS pipes shall be of minimum class B (Medium gauge) type. Makes of pipes and pipe fittings shall be as stipulated in the list of approved makes and as approved by NCCF

22.0 EXHAUST SYSTEM FOR DIESEL GENERATING SETS

22.1 The scope of this section comprises of the design, supply, erection, testing and commissioning of D.G. exhaust system in accordance with the prevailing Indian standard and Central Pollution Control Board norms including support structure required for vertical as well as horizontal run of pipe.

22.2 The vendor shall study the site conditions and propose suitable system.

22.3 The scope cover design of system, all necessary calculations, piping, piping supports, foundations and necessary steel cladding as required.

22.4 The vendor should submit all necessary drawings and calculations for approval.

- 22.5** The exhaust piping shall be fitted with residential type silencer in order to limit the source level. Expansion joints shall take care of thermal deformations. The pressure drop in exhaust piping including silencer, bends, expansion joints etc., shall be compatible with exhaust gas leaving the engine. The exhaust piping shall be duly covered throughout length from engine outlet up to the outlet point with mineral wool insulation and Aluminium cladding. The exhaust piping shall be independent from each engine and shall be with minimum bends. The bending radius of the bends shall be not less than 3 times of internal diameter of chosen piping. A draw in plug shall be fitted at the lowest point of pipe for condensate extraction. Suitable support shall be provided for proper insulation exhaust pipes. The Chimney shall also be provided with insulations, supports and aluminium cladding. The exhaust/chimney piping shall be taken up in suitably designed structure in the shaft and independently steel tower for extra height of above terrace of building as per CPCB norms.
- Exhaust piping shall be connected to the engine by means of flexible section or expansion joint and shall also be graded to a drain pocket inside the building. The pocket shall be fitted with a drain cock.
- Provision of testing port shall be provided on exhaust pipe line.

23.0 MISCELLANEOUS

All allied and implied equipments and accessories required for complete operation of the system shall be supplied and installed by the vendor, whether specifically mentioned or not.

6.7 TECHNICAL SPECIFICATION OF FIRE ALARM AND PA SYSTEM WORK

FIRE ALARM & PA System

The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF. The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.

The bidder shall bring sample of materials for approval of the NCCF. Sample of approved materials must be kept at site for inspection/comparison with materials to be used in work by senior officers. All materials shall be delivered with manufactures test certificates and technical catalogues, technical parameters as per CPWD specifications instructions manuals, wiring diagram etc. as required.

TECHNICAL SPECIFICATIONS

A. FIRE DETECTION AND ALARM SYSTEM

1. BASIS OF DESIGN

An Intelligent Fire Alarm System (IFAS) shall be provided to effect total control over the life safety services required in the building. The IFAS shall be of the digital, distributed processing, real time, multi-tasking, multi-user and multi-location type.

The IFAS provided shall be able to tie-up the following Mechanical, Electrical & Low Voltage Services into an integrated system.

- a. Air Handling Units
- b. Staircase pressurization fans, Lift shafts and lift lobbies pressurization fans.
- c. Public address system.

- d. Lifts
- e. Smoke evacuation system
- f. Fire fighting system

The system shall be provided with Addressable and Analog fire alarm initiating, annunciating and control devices.

The addressable and intelligent system shall be such that smoke sensors detectors, thermal sensors, manual call points, etc., can be identified with point address. The system shall be capable of:

- a. Setting smoke sensor sensitivity remotely (from the Fire Work Station) to either high sensitivity manually or on a pre-programmed sequence e.g. occupied/unoccupied period. The FAS shall be able to recognize normal and alarm conditions, below normal sensor values that reveal trouble condition, and above normal values that indicate either a prealarm condition or the need of maintenance.
- b. Read-out or address an actual space temperature at thermal detector points. The operator shall also be able to adjust alarm and prealarm thresholds and other parameters for the smoke sensors.
- c. Provide a maintenance/pre-alert alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.
- d. Provide alarm verification of individual smoke sensors. Systems that performs alarm verification on a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the Control Station's printer to enhance system maintenance and identify possible problem areas.
- e. Provide local numeric point address and LED display of device and current condition of the point. Local annunciation shall not interfere with annunciation from the Fire Control System.
- f. Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to Logical Point Groups (Software Zones) for pre-programmed operation.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

- a. The System Alarm LED on the main fire alarm control panel shall flash.
- b. A local piezo-electric sounder in the control panel shall be sounded.
- c. The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.
- d. Printing and history storage equipment shall log the information associated with the Fire Alarm Control Panel condition, along with the time and date of occurrence.
- e. All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- f. The audio portion of the system shall direct the proper signal (tone or voice) to the appropriate speaker circuit.
- g. All lifts initiated through the systems will automatically be returned to Ground Floor.

- h. Air handling units on affected floors shall automatically be switched OFF and simultaneously respective fire dampers shall also be closed.
- j. Staircase pressurization fans shall be put on.
- k. Toilet exhaust fans on affected floors shall be put off.
- l. Pre-recorded alarm messages shall be played through interface with Public Address system.
- m. Start smoke evacuation system.

2. FIRE ALARM CONTROL PANEL (FACP)

- 2.1 The distributed Intelligent Fire Alarm Control Panel (FACP) shall function as fully stand-alone panel as well as providing a communication interface to the central station. FACP shall have its own microprocessor, software and memory and should be listed under UL864 or EN54. In the event of failure of the central or communication breakdown between the central station and the FACP, the FACP shall automatically operate on stand-alone mode without sacrificing any functions.
- 2.2 The memory data for panel configuration and operation shall reside in non-volatile memory (EEPROM). Removal of the board shall not cause loss of memory. If such removal can cause loss of memory, then the card containing the memory shall have battery back-up for upto 100 hours on the board itself.
- 2.3 FACPs shall supervise detection circuits and shall generate an alarm in case of abnormal condition.
- 2.4 FACPs shall provide general purpose inputs for monitoring such functions as low battery or AC power failure. FACPs shall provide tamper protection and commandable outputs, which can operate relays or logic level devices. Output commands shall take any of, but not limited to, maintained command, Momentary Command, Alarm Follow, or Alarm latch as required. Any relay in the FACP which is intended to be removable shall be supervised against removal.
- 2.5 Smoke detectors shall be powered using the FACP-based smoke detection circuits. FACPs shall provide for resetting smoke detectors, fault-isolation and sensor loop operation. It shall be possible to mix different fire devices within the same FACP to optimize field wiring.
- 2.6 FACPs shall provide indication for communication with the central console and alarm/trouble conditions in each sensor loops.
- 2.7 FACPs shall provide monitoring and control of one floor or area or for multiple floors or areas. FACPs shall meet the following requirements to assure the integrity and reliability of the system:
 - a. The FACP shall be UL or FM listed independently as a fire alarm control panel.
 - b. FACP electronics shall be contained in an enclosure made of minimum 16 gauge steel. Access to FACP switches and electronics shall be by key-lock. Usage of no other tools should be required. Visual indicators of FSP status for each zone shall be visible without opening the key-locked cover.
- 2.8 All hardware and software to allow the FACP configuration and operation to be changed shall be provided. Memory data shall be contained in non-volatile memory (EPROM).
- 2.9 Alarm verification with field-adjustable time from 0 to 60 seconds for individual smoke detector shall be provided. During the alarm verification, the panel shall retard the alarm until the end of the period. If the alarm is only a transient smoke alarm, the panel shall automatically reset the

alarm. Only a verified alarm shall initiate the alarm sequence for the software zone (Logical Point Group) or point. Final time setting shall be as per approval of the fire authorities. When alarm verification is being performed on a smoke detector, the action shall be printed on the listed printer(s).

- 2.10 Digital numeric display at the FACP shall be provided to indicate point in alarm or trouble. In such systems, means for manually scanning the points in trouble shall be provided and a trouble and alarm LED shall be used to indicate that there are points in alarm/trouble. The alarm/trouble LED shall only extinguish when all alarm/troubles are cleared from the loop.
- 2.11 It shall be possible to command test, reset and alarm silence from both the FACP and the central console.
- 2.12 FACP switches shall allow authorized personnel to accomplish the following, independent of the central console :
- a. Initiate a general alarm condition.
 - b. Silence the local audible alarm.
 - c. It shall be possible to acknowledge (Silence the local FACP audible without silencing the alarm indicating devices (hooters).
 - d. Reset all zones (Logical Point Group) / points, after all initiating devices have returned to normal.
 - e. Perform a complete operational test of the microprocessor and memory with a visual indication with each board.
 - f. Test all panel LEDs for proper operation without causing a change in the condition of any zone (Logical Point Group)
 - g. Walk Test
- 2.13 Software zones/loops shall be circuited and protected by Fault Isolation Modules such that in the event of a zone/loop short-circuit, not more than twenty (20) devices shall be left non-functional.
- 2.14 Intelligent Smoke and thermal sensors shall be located as shown and shall report sensed levels in analog form.
- 2.15 Monitor modules shall be provided to monitor and address contact-type input devices. The monitor module shall be supervised by FACP.
- 2.16 The FACP shall process the true continuous analog signal from the sensors. System using step setting to represent analog signal will not be accepted. The FACP shall be able to set dual alarms threshold for occupied and unoccupied periods. During unoccupied period, the alarm threshold shall automatically be lowered to facilitate quicker response. In addition, the FACP shall further process all analog values for pre-alarm limits to prompt the operator for early maintenance. If a sensor value increases to an above normal level or a pre-alarm limit for an extended duration, the FACP shall communicate maintenance pre-alarm.
- a. Any time sensor value transitions beyond the secondary and higher limit value, an alarm initiation and report shall be issued.
 - b. Limits and sensor values shall be displayed, modifiable, and reported in decimal values.
 - c. The FACP shall have Drift Compensation facility to compensate for environment. The FACP shall have the ability to recalibrate Pre-alarm and Alarm limits if required, after comparing each sensor's operating characteristics with the set sensitivity. This should be carried out at least

- once in every 24 hours. FACP should annunciate trouble conditions when sensor(s) is beyond compensation range (excessively dirty sensor).
- d. The FACP should be UL listed or FM approved to provide the sensitivity measurement and documentation required by NFPA72E.
- 2.17 FACP shall be backed up with its built in UPS power and shall also be connected to central DG Power available in the building.
- 2.18 FACP shall be provided with following features:
- | | | |
|----------------------------|---|--|
| Charger Rate Control | | |
| Control-by-Time | : | Non-Alarm Module Reporting |
| Day/Night Sensitivity | : | Periodic Detector Test |
| Device Blink Control | : | Remote Page |
| Drift Compensation | : | Trouble Reminder |
| NFPA 72 Sensitivity Test | : | Verification Counters |
| System Status Reports | : | Walk Test |
| Security Monitor Points | : | Maintenance Alert |
| Alarm Verification | : | System Configuration Report |
| Printer Interface | : | System Point Report |
| Event Historical log | : | Programmable Automatic Timed and Manual Signal Silence |
| Programmable Manual Signal | : | Control-By-Event with Boolean Logic |
| Silence Inhibit Timer | : | and Timer Control |
- 2.19 FACP shall have real-time clock to prevent loss of time and date in case of failure of power supplies.
- 2.20 The display on FACP shall provide indication for AC Power, System Alarm, System Trouble/Security Alarm, Display Trouble and Signal Silence.
- 2.21 Minimum two different password levels will be provided to prevent unauthorized System control or programming.
- 2.22 Operator control switches for Signal Silence, lamp Test, Reset, System Test and Acknowledge shall be provided.
- 2.23 The FACP should truly field programmable. This would mean that in the event of change of any logic, detector / zone sequence alteration, the operator can initiate these by use of the alpha-numeric keys on the FACP panel to reconfigure the above parameters. Panels, which require external programming devices to perform the above function will not be acceptable.
- 2.24 The FACP should have a degraded mode of operation. In the event of the CPU failure the field devices (detectors & modules) should report the condition on a simple digital communication mode to ensure reliability even during failure.
- 2.25 Power supply unit of FACP shall have following characters :
- a. The main power supply shall be 230 VAC±10%, 50 Hz±1% and shall in turn provide all necessary power of the FACP.
- b. It shall provide a battery charger for 24 hours for standby power using dual-rate charging technique for fast battery recharge.
- c. It shall provide a very low frequency sweep earth fault detect circuit, capable of detecting earth faults on sensitive addressable modules.

- d. It shall be power-limiting using Positive Temperature Coefficient (PTC) resistor.
 - e. It shall provide indication for battery voltage and charging current.
- 2.26 For ease of service, all wiring terminal blocks shall be plug-in type and shall have sufficient capacity for 18 to 12 AWG wire termination. Fixed terminal blocks shall not be acceptable.

3. DETECTORS & ADDRESSABLE DEVICES

3.1 GENERAL FEATURES COMMON TO ALL DETECTORS

- a. Compatibility: All automatic fire detectors shall be inter changeable without requiring different mounting bases or alterations in the signal panel.
- b. Response Spectrum: Combustion gas detectors shall respond to both visible and invisible aerosols; size and colour of the aerosols shall not have a decisive influence on the response of the detector.
- c. Sensitivity: On average 30 mgs of burned material per cu.m. (as measured in a 1 cu.m. chamber) shall release an alarm sensitivity which shall be adjustable according to the use of the space.
- d. Power Consumption: Each detector shall use the minimum of power, for economic circuits, so that it shall have capacity to connect atleast 99 detectors, 50 modules and 20 fault isolator modules in one loop.
- e. Built-in-response indicator: Each detector shall incorporate indicator "LED" at the detector which shall blink during normal condition and light up on actuation of the detector to locate the detector which is operated. The detector shall not be affected by the failure of the response indicator lamp.
- f. Maintenance: All detectors shall be fitted either with plug-in system or bayonet type connections only, from the maintenance and compatibility point of view.
- g. Construction: The detector shall be vibration and shock proof. When disassembling for cleaning purposes, its components must not be damaged by static over voltage.
- h. Atmospheric and Thermal Disturbance : The detector shall so designed as to be practically immune to environmental criteria such as air currents, humidity, temperature fluctuations, pressure and shall not trigger false alarm, due to the above conditions.
- j. Continuous Operation: An alarm release shall not effect a detector's functioning. After resetting the alarm, the detector shall resume operation without any readjustment.
- k. Adaptability to ambient conditions: Detectors shall be designed for adaptability to humid locations. No performance deterioration shall be acceptable.

3.3 MULTI-SENSOR PHOTO THERMAL DETECTOR:

The mutisensor or multitech smoke detector which will have both photoelectric as well as thermal detection elements shall have inbuilt microprocessor, and shall be capable of taking an independent alarm decision. The scattering of smoke particles shall activate the photo sensor. Each intelligent addressable smoke detector's sensitivity shall be capable of being programmed electronically from Control Panel without any extra tools as: most sensitive, more sensitive, normal, less sensitive or least sensitive.

In addition to the five sensitivity levels the detector shall provide a prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The detector should continue to give TRUE alarms even if the loop controller on the main panel fails. Alarm condition shall be based upon the combined input from the photoelectric and thermal detection elements.

Each detector shall be capable of transmitting prealarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

3.4 ADDRESSABLE THERMAL DETECTORS

Thermal detectors shall be intelligent and addressable devices, and shall connect with two wires to one of the Fire Alarm Control Panel loops. Minimum 99 intelligent thermal detectors may connect to one loop.

The detectors shall use an electronic detector to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements. The detectors shall be ceiling-mounted type and shall include a twist-lock base.

The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated remotely on command from the control panel.

The detectors shall provide address-setting means on the detector head using rotary decimal switches. Systems which use binary jumpers or DIP switches to set the address shall not be acceptable. Detectors providing address setting through hand held programmers shall also be accepted.

The detectors shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions. In certain applications, LEDs may be selected to be polled without flashing through system programming. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.

An output connection shall be provided in the base to connect an external remote alarm LED.

3.5 ADDRESSABLE MANUAL STATIONS

Addressable manual stations shall be provided to connect to the Fire Alarm Control Panel loops. Minimum 99 addressable manual stations may be connected to one loop.

The manual stations shall on command from the Control Panel send data to the panel representing the state of the manual station. Press/break stations with resettable capability are also acceptable. Manual stations shall be constructed of high impact LEXAN sheet with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters.

Stations shall be suitable for surface mounting as shown on the plans, or semi-flush mounting, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor unless otherwise specified by applicable building codes.

3.6 ADDRESSABLE MONITOR MODULE

The monitor module shall provide address-setting and shall also store an internal identifying code which the Fire Alarm Control Panel shall use to identify the type of device. Modules using binary jumpers are not acceptable. An LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

3.7 CONTROL MODULE

The control module shall provide address-setting and shall also store an internal identifying code which the control panel shall use to identify the type of device. Modules which use binary jumpers are not acceptable. An LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.

3.8 ADDRESSABLE HOOTERS

All field hooters should preferably be addressable and software configurable. All hooters should be able to provide at least a minimum of 3 different tones, which should be user configurable. The minimum decibel level of each hooter should be 74 to 84 db. All hooters should be UL/FM listed.

4. CABLES

All PVC insulated FR twin twisted copper conductor stranded cables shall be 650 volts grade and shall generally conform to IS and meet the signal cabling requirement of the system manufacturer.

Strands of cables shall not be cut to accommodate & connect to the terminals. Terminals shall have sufficient cross-sectional area to take all the strands.

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturers. All cables shall be laid with minimum one diameter gap and shall be clamped at every metre and shall be tagged for identification with aluminium tag and clamped properly. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

6. FUNCTIONAL REQUIREMENTS**6.1 INTELLIGENT SYSTEM DEVICES**

- a. Each device shall be assigned a unique address via easily understood decade (01 to 99) switch. Address selection via binary switches is not acceptable. Devices which take their address from their position on the circuit are unacceptable.
- b. Devices shall receive power and communication from the same pair of conductors.

6.2 SENSORS

- a. All fire sensors shall mount on a common base to facilitate the changing of sensor type if building conditions change. The base shall be incompatible with conventional detectors to preclude the mounting of a non-intelligent device.
- b. Each sensor shall contain an LED which shall blink each time the sensor is scanned by the FACP. If the FACP determines that the sensor is in alarm, the FACP shall command the sensor LED to get latched on.
- c. Each sensor shall be capable of being tested for alarm via command from the FACP.
- d. Each sensor shall respond to FACP scan for information with its type identification to preclude inadvertent substitution of another sensor type. The FACP shall continue operation with the detector installed but shall initiate a mismatch (trouble) condition until the proper detector is installed.
- e. Each sensor shall respond to FACP scan for information with an analog representation of measured fire-related phenomenon (smoke density, particles of combustion, temperature). Systems which only monitor the presence of conventional detector in an addressable base shall not be acceptable.
- f. Photoelectric smoke sensors shall contain an optical sensing chamber with nominal sensitivity of 2.3% foot obstruction.
- g. Ionization smoke sensors shall contain a unipolar dual chamber with nominal sensitivity of 2.3% foot obscuration.

6.3 INPUT DEVICES

- a. The input device shall provide an addressable input for N.O. or N.C. contact devices such as manual stations etc.
- b. The input device shall provide a supervised initiating circuit. An open-circuit fault shall annunciate at the FACP (subsequent alarms shall be reported).
- c. The device shall contain an LED which will blink upon being scanned by the FACP. Upon determination of an alarm condition, the LED shall be latched on.

6.4 AUTOMATIC FUNCTIONS AT FACP

The alarms shall be displayed at the FACP on an LCD display. The display shall indicate the device in alarm by ID number, the appropriate alarm state, and the current time and date. It shall also display a point description of minimum 32 characters and, the respective analog value. The display shall also contain a minimum 40 characters alarm message. It shall be possible to see the number of acknowledged alarms, number of current fire alarms, number of trouble conditions and number of other miscellaneous alarms in the system. The FACP printer shall print out same information displayed on the LCD display. The LCD display and printer shall be powered directly from the panel.

6.5 MANUAL FUNCTIONS AT FACP

- i. At any given time, operator shall have the following manual capabilities at FACP by means of switches located behind a key-locked cover:
 - a. Initiate an alarm summary display on the FACP LCD display. This display shall step through all currently active alarms in the system.
 - b. Initiate a summary printout of all currently active alarms on the FACP printer.
 - c. Initiate an "all-point summary" printout on the FACP printer recording the status of each system point (initiating circuits, indicating circuits etc.)
- ii. At any time, the operator shall have following manual capabilities at the FACP under password control; Operator privileges and ID numbers of upto four digits shall assignable by the main operator or designated alternate. Actions taken by operators shall automatically be printed on the FACP printer with operator initials, time and date.
 - a. Commands output points to different mode. Such commands shall be printed with selected descriptors ON/OFF/AUTO, OPEN/CLOSE, DAY/NIGHT etc. In addition, command shall be used to ISOLATE or DISCONNECT points. When isolated, alarms and troubles shall be received but not acted upon.
 - b. Modify system parameters. Alphanumeric key pad shall be provided for operators to modify the following parameters:
 - Change sensor alarm and pre-alarm threshold
 - Update date and time
 - Change point descriptors
 - Change action message
 - Disable a point
 - Change sensor verification time
 - Change password
 - Activate/deactivate indicating output control point
 - Control-by-event programs on line
 - c. Select a system status report for printing on the printer from the control station. The following real time reports shall be provided:

- All point log.
- Alarm summary
- Trouble summary
- Status summary
- Sensitivity log
- Disabled points log.
- Isolated points log
- Disconnected points log
- Logical group points log

The sensitivity log shall print the analog value of each addressable analog sensor.

- d. Select printing of a trend sensitivity log which when enabled, shall print minimum last 24 analog values for every addressable analog sensor taken at predetermined intervals. Systems which limit the number of addressable analog sensors which can be trended are not acceptable.
- e. Select a sequence of programmed commands which can be automatically executed, in sequence, via a single command.
- f. Perform a walk-test function such that a operation can be periodically checked out for all initiating devices on a zone. In walk test mode, all initiators on the selected zone shall automatically be isolated. As each device is placed into an alarm or trouble condition, the FACP shall print the condition and automatically reset the device. No audible signals shall be initiated from the zone to prevent disruption of building occupants. If a zone is inadvertently left in the walk-test mode, it shall automatically reset to normal after a five-minute idle time is exceeded.

6.6 SYSTEM SUPERVISION

- a. In the normal supervisory condition, only the “POWER” ON, and “RUN” conditions, shall be illuminated. The LCD display shall display “System Normal” and the current time and date.
- b. The LCD display shall indicate the loss of power condition and the printer shall record the same. Following restoration of normal AC power, the trouble indicators shall be automatically reset and the printer shall record the „return to normal condition.
- c. The LCD display shall indicate the loop in trouble and the printer shall record same.
- d. The LCD display shall indicate trouble and the printer shall record same. Operation of a momentary “Silence” switch shall silence the audible trouble signal but the visual “Trouble” LEDs shall remain ON until the malfunction has been corrected and the system has reset. The FACP printer shall record this action.

6.7 PROGRAMMING OF FACP

The LCD display and printer programming shall be accomplished on site by means of lap-top personal computer which shall plug into the FACP. Modules requiring off-site programming are not acceptable. LCD shall initiate test of all addressable sensors in the system. Programming functions shall include alarm/trouble type assignment, point descriptor assignment, alarm message assignment etc. Data file for the LCD display and a printer shall be stored in EEPROM.

6.8 OTHER DEVICES

Fault-isolation of fire zones (Logical Point Group) / circuit modules shall be provided to enable part of a fault-tolerant loop to continue operating when a short occurs in the loop.

6.9 FIRE ALARM GRAPHICS SOFTWARE (FAS)

The status of each detector shall be monitored by the FAS.
Using the FAS, the operator shall be able to adjust the sensitivity of any detector.
Using the FAS, the operator shall be able to define the entire database for the file system. Fire system which are not field programmable shall not be accepted.

The FAS operator shall be able to acknowledge alarms or trouble messages at the FAS. It shall be necessary for all alarm or trouble conditions to be acknowledge at the fire system central panel.

FAS software shall be upload/download type as well as with graphic facilities.

The bidder shall list out the graphic facilities being provided by him.

All devices & detectors shall be visible on building plans superimposed in FAS software.

7. THE RATE OF EACH ITEM OF WORK FOR FIRE DETECTION AND ALARM SYSTEM SHALL ALSO INCLUDE THE FOLLOWING

- a. All materials, fixing materials, accessories, appliances, tools and equipment.
- b. Approved cover plates for inspection, junction and outlet boxes.
- c. 1.6 mm thick outlet boxes and junction boxes.
- d. All fixing accessories such as clips, nails, screws etc.
- e. Providing and fixing approved saddles, hooks and grouting the same as required, in the case of all exposed conduit work.
- f. Embedding conduits and accessories in wall, floors etc. during construction and / or cutting chases and making good as necessary in the case of all concealed conduit work.
- g. Testing and commissioning of each device, circuit as per the requirements of NFPA 72, TAC, local authorities and to be witnessed by the Engineer-In-Charge/ Department and or fire protection consultant.

8. TESTING

8.1 GENERAL

At the completion of the work, the entire installation shall be subject to the following tests in the presence of the NCCF

- Wiring continuity test.
- Insulation resistance test
- Earth continuity test.

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the Bidder at his own cost.

8.2 TESTING OF WIRING

All wiring systems shall be tested for continuity of circuits, and earthing after wiring is completed and before installation is energized.

8.3 INSULATION RESISTANCE TEST

The insulation resistance shall be measured between earth and the whole system of conductors, or any section thereof, with all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 divided by the number of points provided on the circuit, the whole installation shall have an insulation resistance greater than one megaohms. The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant standard specification or where there is no such specification, shall not be less than one megaohms. All equipments, cables shall be inspected at works by the Engineer-In-Charge as per relevant IS and testing commissioning of installation as per Appendix 'E' of IS:732-1989 shall be done and all record to be maintained.

8.4 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor metallic envelopes of cables shall be tested for electric continuity and the electrical resistance of the same, along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation, shall not exceed one ohm.

8.5 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCH

In a two wire installation a test shall be made to verify that all non-lined single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Engineer-In-Charge as well as the local authorities.

8.6 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

- a. Fire Alarm Control Panel (FACP): The FACP shall be fixed as indicated on the drawings the enclosure with the top of the cabinet 1830 mm 6 feet above the finished floor or center the cabinet at 1525mm or 5 feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FACP.
- b. Manual Stations: The Manual stations shall be fixed as required by NFPA 101 and NFPA 72 or as shown on the drawings or in accordance with NCCF Mount stations so that their operating handles are 1220 mm 4 feet above the finished floor. Mount stations so they are located no farther than 1525 mm 5 feet from the exit door they serve, measured horizontally.
- c. Notification Appliance Devices: Notification appliance devices shall be fixed as required by NFPA 72 or as shown on the drawings. Mount assemblies on walls 2030 mm 80 inches above the finished floor or 150 mm 6 inches below the ceiling whichever is lower. Ceiling mounted speakers shall conform to NFPA 72.
- d. Smoke and Heat Sensors: Sensors shall be fixed as required by NFPA 72 and their listings or as shown on the drawings on a 100x100mm inch mounting box. Sensors located on the ceiling shall be installed not less than 100 mm 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor at least 100 mm 4 inches below the ceiling, but not more than 300 mm 12 inches below the ceiling. In raised floor spaces, the smoke sensors shall be installed to protect 20.9 square meters 225 square feet per sensor. Install smoke sensors no closer than 1525 mm 5 feet from air handling supply outlets.
- e. Graphic Annunciator: Locate the graphic annunciator as shown on the drawings. Surface mount the panel, with the top of the panel 1830 mm 6 feet above the finished floor or center the panel at 1525 mm or 5 feet, whichever is lower.
- f. Water Flow Detectors and Tamper Switches: Locate water flow detectors and tamper switches where shown on the drawings at each supervised sprinkler valve station.
- g. Firefighter Telephones: Locate wall mounted in each stair at each floor landing, in each elevator lobby, and in each elevator cab 1220 mm 4 feet above the finished floor.

8.7 FIELD QUALITY CONTROL

Tests

- a. Megger Tests: After wiring has been installed, and prior to making any connections to panels or devices, wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.
- b. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.

- c. Preliminary Testing: Conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests." After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Bidder and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- d. Request for Formal Inspection and Tests: When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests to the Contracting Officer.
- e. Final Testing: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the operation and maintenance (O&M) manuals are furnished to the Contracting Officer and the following are provided at the job site:
 - i. The systems manufacturer's technical representative
 - ii. Marked-up red line drawings of the system as actually installed
 - iii. Megger test results
 - iv. Loop resistance test results
 - v. Complete program printout including input/output addresses

The final tests shall be witnessed by the Fire Protection Engineer deputed by the Department or as instructed by project in charge. At this time, any and all required tests shall be repeated at their discretion. Following acceptance of the system, as-built drawings and O&M manuals shall be delivered to the Contracting Officer for review and acceptance.

8.8 MINIMUM SYSTEM TESTS

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

- a. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.
- b. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.
- c. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- d. Verify activation of all waterflow switches.
- e. Open initiating device circuits and verify that the trouble signal actuates.
- f. Open and short signaling line circuits and verify that the trouble signal actuates.
- g. Open and short notification appliance circuits and verify that trouble signal actuates.
- h. Ground all circuits and verify response of trouble signals.
- i. Check presence and audibility of tone at all alarm notification devices.
- j. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- k. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- l. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Testing of duct smoke detectors shall comply with the requirements of NFPA 72.
- m. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.
- n. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.
- o. Determine that the system is operable under trouble conditions as specified.

- p. Visually inspect wiring.
- q. Test the battery charger and batteries.
- r. Verify that software control and data files have been entered or programmed into the FACP. Hard copy records of the software shall be provided to the Contracting Officer.
- s. Verify that red-line drawings are accurate.
- t. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.
- u. Measure voltage readings for circuits to ensure that voltage drop is not excessive.
- v. Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke sensors shall be conducted using real smoke. The use of canned smoke is prohibited.
- w. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

PUBLIC ADDRESS SYSTEM

STANDARDS

International:

The technical design must comply with EN 54-16 for the VA/PA system.

Compliance can be verified by means of a manufacturer declaration, CPD certificate or by obtaining approval from VdS or similar certification body.

Certification according to EN 54-16 is a mandatory requirement.

With the VA/PA system provided and its additional components, it must be possible to set up a project which also conforms fully to EN 60849 requirements and which can be approved by a relevant expert or authority.

GENERAL DESCRIPTION

For the transmission of alarm signals in the event of a fire or other disaster, as well as for public announcements and playing music, an emergency audio warning system or a voice alarm system with self-monitoring functionality and alarm criteria should be installed in compliance with TRVB S 158, VDE 0833-4 and DIN 33403 standards.

The purpose of the system is to quickly evacuate people in an orderly manner via escape routes through the use of prepared clear text instructions. In addition, it must also be possible to for all instructions that are announced live to be sent to circuits and groups.

There must be an intercom function between the digital call stations.

The failure of an amplifier or a loudspeaker circuit should not lead to the failure of a public address area. For this reason, in addition to the backup amplifier, the loudspeaker circuit also has A/B wiring in all public areas.

In total, up to 6,000 programmable, monitored loudspeaker circuits must be available as well as up to 2,000 NF inputs (250 x 4 x 2) or 1,000 digital call stations.

Due to simultaneous program transmissions, there must be up to 120 simultaneous audio transmissions within the VA/PA system.

It must be possible to assign inputs (including digital call stations) and outputs throughout the system without any restrictions.

A graphical user interface is used for simple and convenient configuration of the combination of groups, changes in loudspeaker circuits or key assignments without the need for any mechanical modifications.

When selecting the loudspeaker systems and rating the electrical and acoustic audio frequencies, the following sound pressure levels are used:

- 90 dB in larger public areas and
- for fire alarm/evacuation announcements, at least 12 dB higher than the maximum anticipated ambient noise with speech intelligibility STI > 0.5.

Loudness level and speech intelligibility must correspond to all the points of the above areas where required (e.g. in the event of an alarm or rescue operation) for evacuation purposes and transmission of information.

The public address system must be designed in accordance with the following basic requirements:

- provision of direct sound to widest possible area +/- 3 dB of the relevant ranges
- high level of system reliability (at least 99% availability)
- optimal transmission quality

A fully digital, programmable, network-ready VA/PA system must be provided to ensure that the system is future-proof, flexible, and can be easily extended.

A 100 Mbit Ethernet LAN, also for proprietary use, serves as a means of transmitting signals. It must be possible to design a redundant network by means of external modules.

It is particularly important that 100 V lines, power cords, control and modulation lines are properly isolated.

Amplifiers must have symmetrically audio inputs.

The VA/PA system must fulfill the following requirements:

- Fully digital network-capable system with graphical user interface. Operating software for remote control and diagnosis of all systems states. Software for optional setup (configuration) of functions, modes and properties of system components, devices and controls including the connection of loudspeaker lines to public address areas, and the corresponding allocation of a selection key at the system digital call station;
The user can modify the configuration using any client with an easy-to-understand, menu-driven user interface. Up to 120 simultaneous audio channels must be available over the network with an available bandwidth of 100Mbit/s effective.
- Continuous, inaudible monitoring of all signal paths
- All errors must be detected, displayed, and recorded (log view) within a matter of seconds.
- Ability to easily program digital call stations for selective, group and collective calls (e.g. 1 fire control PA panel, 3 information call stations, more possible at any time).
- Continuous monitoring of power amplifiers with integrated noise detection and inaudible tone. If a power amplifier should fail, a backup amplifier will automatically and immediately replace the power amplifier in question.
- Double pole connection of 100 V loudspeaker modulation;
- Continuous processor - controlled line monitoring of all loudspeaker lines for short circuits, idling, ground faults and impedance value errors, independent of activated announcements. Monitoring must not be audible. Save error messages with the option for subsequent display; save set points of line parameters; Set up and interrogate system with easy-to-understand, menu-driven software. Non-reactive disconnection of loudspeaker circuits detected to be faulty without any consequence to any other speaker lines.

- To ensure continuous operation, the gooseneck microphone for the digital call station must be acoustically monitored. Similarly, the malfunction of any button, component, cable, or any logical connection must be monitored and sent to the operating unit immediately via the LAN. The signal is transmitted between the digital call station and the central control unit in AHO/EBU digital audio format.
- Intercom function between digital call stations.
- To adjust the volume in public address areas with constantly changing noise levels, an automatic volume control must always be available in real time, independent of the ambient noise level. This function is activated using software tools from the appropriate central output modules for this area.
- Digital storage and playback of at least 16 different alarm signals and texts for 260 seconds in non-volatile memory.
- Input of external signal sources (independent programs/background music) in the VA/PA system via separate input modules and via NF inputs in the system digital call stations.
- Connection to a fire alarm system

The planning and invitation to tender are based on Honeywell's VARIODYN D1 model. Equivalence must be ensured in the case of alternate offers as these are based on customer-specific assessments of requirements.

Special performance features

List features which can only be answered with YHO or NO, or with a value:

Performance features with YHO/NO

Audio monitoring

- All audio information can be selected locally on the VA/PA system using the monitor button and can be monitored via the integrated loudspeaker.
- The monitor function can be deactivated automatically by pressing a button or via a user-defined timeout.

Alarm mode

- The system switches to an alarm mode for alarm announcements.
- Announcements with low priority, such as background music, are stopped.
- Standard-compliant alarm signaling.

Digital signal processing (DSP)

- Per DAL bus audio stream
 - * Adjustable volume
 - * Configurable limiter for the digital call station microphone (DCS, DCSF).
- Per Amplifier channel
 - * Adjustable volume
 - * Automatic volume control (AVC)
 - * High-pass filter 2, 4, 6 sequence (cutoff frequency: 20 Hz - 20 kHz)
 - * Low-pass filter 2, 4, 6 sequence (cutoff frequency: 20Hz - 20kHz)
 - * Delay (0-2.000 msec)
 - * Parametric equalizer, 8 bands
- Level indicator for audio inputs and outputs.

Audio memory/signals

- Audio memory for critical alarms such as evacuation announcements in accordance with IEC EN 60849 on non-volatile flash memory. 16 memory places for 260 sec in total are available.

E.g. for pre recorded audio signals (gongs, signals, texts, etc.) for example in accordance with DIN 33404 and KTA 3901, in each digital audio distribution and connection system (maximum 24 Loudspeaker lines each)

-System wide audio memory for critical alarms such as evacuation announcements in accordance with IEC EN 60849 on non-volatile flash memory. The memory capacity is approximately 120 minutes.

- Audio memory for non security relevant announcements such as advertising texts or music on a hard drive. The memory capacity is approximately 1000 hours.

Connection of a source to a target taking the following into account

- Connection time limit
- Activation type - press/toggle
- Individual volume
- With/without automatic volume control
- Multisource; an audio source can be used by several connections simultaneously.
- Priority (1-250)
- Recording the activation or deactivation of the connection.
- Saving the announcement
- Partial connection
- Timeout
- Warning signal, e.g. an attention signal such a gong
- Reconnection
- Repetition

Error display

- The error message can be displayed based on the location.
- Error display either by LED or control contact and by means of an entry in the message list.
- Error messages are always reported as "OK" after the underlying cause has been rectified.
- Error messages can also be automatically reset - if necessary.
- Error messages can also be manually acknowledged by means of key(s) or contact(s).
- Potential error-specific signaling to LEDs and control outputs.
- Monitoring can be completely switched on or off at the device level for each DOM.

Remote control, remote maintenance

- The system can be remotely maintained via an open data protocol. Building management systems, path control machines, or airline passenger information systems, for example, can set any individual announcements and obtain status information from the system.

- The system can be maintained remotely via ISDN, for example.

Configuration changes and read outs of all events can be performed over long distances.

Graphical user interface.

- A user interface customized to specific customer requirements can be implemented easily and flexibly.

Backup amplifier

- In the event of failure of an amplifier channel, the system automatically switches to a backup amplifier.

- The system switches to the backup amplifier dynamically. In the case of two faulty amplifiers within a group of amp's which are connected to one backup amp, the priority of the announcement decides which amplifier is switched to the backup.

This is must be dynamically. That means no fixed backup / amp combination. If another time the priority of a nother not available amp is higer, this will be replaced.

- The volume from the faulty amplifier channel is transferred over.

- The ratio and the number of main to backup amplifiers can be defined by the user between 4 and 12 amplifiere channels to one backup amp

Intercom call stations

- Digital call station to digital call station.
- Digital call station to digital call station and other loudspeaker circuits.
- Digital call station to several digital call stations.
- Digital call station to several digital call stations and other loudspeaker circuits.

Configuration

- Configuration via graphical user interface.
- Parameters can be read and modified in real time.
- Certain user privileges can be allocated via user management.

Volume control

- Automatic volume control
- Each amplifier channel is regulated dynamically depending on the ambient noise and taking into account predefined parameters and background music.
- Announcements (mostly alarms/evacuations) with a certain priority can be played out on a fixed configured volume, without automatic volume control.
- The ratio of ambient noise to changes in volume can be set individually.
- The automatic volume control inputs for the sensor microphones can also be used as audio signal inputs, if necessary.
- Background music must not have an influence on the automatic volume control
- Manual volume control for all audio inputs/outputs via buttons and contacts.
- Alarms/evacuations can be output with maximum volume per configuration (Manual volume control is ignored).
- Time-based volume control for all audio inputs/outputs, e.g. reduced volume at tram stops at night time.

Message list

- All system-related events are recorded in the message list.
- download of error message with a PC/Notebook.
- "External systems", e.g. emergency power supplies can create entries in the message list.

Power management

- Primary power supply: 230 V AC
- Secondary power supply (emergency power): 24 V DC
- Less important announcements (e.g. background music) can be switched off when there is an outage in the primary power supply (230V AC).

Control inputs & control outputs

- Keys with associated LEDs or contacts
- Any allocation of control inputs and control outputs for functions, e.g. for triggering priority relays for 100V volume controllers.

Monitoring

- Monitoring of connection from digital call station to VA/PA system.
- Acoustic monitoring of digital call station microphone or hand microphone (fire control PA panel).
- Acoustic monitoring of amplifier channel.
- Monitoring of loudspeaker line for short circuits, interruptions and impedance changes via impedance measurement – independent of connections.
The thresholds for short circuits, open lines, and ground faults can be customized.
- Monitoring of loudspeaker line for short circuits or interruptions by means of EOL (end of line module) – independent of connections.
- Monitoring of loudspeaker line for ground faults.
Independent of circuit-entering loudspeaker lines:
- Monitoring of the communication of several VA/PA systems on the network.
- Lamp tests/contact tests via button or contact.
- Error in data interface to fire panels (e.g. Honeywell, Notifier)
- Failure in primary and secondary power supply (emergency power)

Wiring

- Each required system can be wired quickly and clearly using only a few system cables.

Networking

- Up to 250 digital audio distribution and connection systems on a network.
- Networking via 10, 100 Mbit(recommended) or Gbit Ethernet.
- Transmission of various audio data is only restricted by the transmission bandwidth.
- Up to 120 audio data channels on a 100 Mbit network.
- Up to 16 different audio channels items per digital audio distribution and connection systems can be processed simultaneously over the network.
- SNMP (Simple Network Management Protocol) to monitor network elements from a central station.
- Specified delay of local destination for a connection to offset the latency period of the network destinations.
- VLAN ID can be adjusted for integration in existing network structures, e.g. taking into account other network systems such as CCTV, etc.

Timer programs

- Time-controlled connection for bell systems, e.g. in schools.
- Time-based volume control for all audio inputs/outputs, e.g. reduced volume at tram stops at night-time.
- Time-controlled activation/deactivation of monitoring of loudspeaker lines.
- Time-controlled actuation/deactivation of amplifier channels monitoring.
- Time synchronization
 - The individual devices are synchronized. Master/Slave configuration possible.
 - External time synchronization via NTP (Network Time Protocol) possible.
 - External time synchronization via GPS possible.
 - Automatic adjustment for daylight saving changes.

Destination – Group formation

- Any circuits (destinations) can be grouped together in pre-selection points.
- Circuits can be grouped in any nested format.

Temporary storage of an announcement (automatic)

- Announcements can automatically saved and played back within a user-defined timeout period when the required points are released.
- Status display and control options via buttons and control contacts.

Temporary storage of an announcement (manual)

- Record, listen and playback possible.

Audio matrix

- Any input can be route to any output without any restrictions
- Input can be a call station, analog audio input, and audio memory
- Out put can be a loudspeaker line, call station and analog audio output

Performance features with value indication

Max. number of addressable audio inputs: 2.000

Max. number of audio data items that can be transmitted simultaneously via 100 Mbit Ethernet: 120

Max. number of addressable amplifier channels: 1.000

Max. number of addressable loudspeaker circuits: 6.000

Interfaces**Connection to fire alarm system**

This system also allows for alarm management with prepared texts in the case of an emergency by means of an interface to the fire detection system. For this, the system must be connected to the emergency power supply, and the loudspeakers should be installed in such a way that they are fire resistant in the event of a fire escaping beyond the fire compartment (see instructions). All VA/PA systems must be approved as alarm detector systems by an authorized testing body.

Interface: RS232
Data rate: 19,200 bps

The interface is monitored continuously; in the event of a failure/interruption, an error message occurs on the VA/PA system and the fire alarm control panel. The triggering of the alarm can be defined via control zones. Any other errors that may arise, such as the failure of a power amplifier, digital call station or routing to the loudspeakers, will be forwarded to the fire alarm control panel as a trouble alarm. Trouble alarms can be reset via the fire alarm control panel. A date/time synchronization can be configured between the VA/PA system and the fire alarm control panel.

Connection to a building management system (or safety management system)

A building management system (or safety management system) and the VA/PA system must be linked by means of the relevant interfaces; mere contact connections/controls are eliminated. The system is connected to the fire detection system via the fire control settings.

With regard to the VA/PA system that is to be linked to the safety management system, the following functions at the very least must be in operation or available:

- Circuit selection (must also be possible for each available call circuit to be selected from the master computer)
- Group call (groups can be defined freely in terms of software)
- Collective call from digital voice memory
- Alarm sounds
- System synchronization (messages, time)
- Message fault VA/PA System on building management system (or safety management system)master computer
- Message fault amplifier on building management system (or safety management system)master computer
- Message fault digital call station on building management system (or safety management system)master computer
- Message fault loudspeaker on building management system (or safety management system)master computer
- Message fault call circuit (by monitoring circuits) on building management system (or safety management system)master computer

It must be possible to configure and program the VA/PA system via a PC. The software enables the loudspeaker matrix and digital call stations to be monitored and controlled remotely. A color graphic depicting all of the components to help users identify errors more effectively. The PC and the system are at least connected via a serial interface.

Products

System components

Digital audio distribution and connection system for up to 8 loudspeaker zones

Module with audio signal processing for connecting and controlling power amplifiers and connecting loudspeaker circuits.

Four independent audio outputs for connecting power amplifiers (up to 500 Watt per channel) and for simultaneous processing of up to four different audio information items per module.

Connection of a audio signal to one or two user-defined loudspeaker zones. In total up to eight loudspeaker circuits per module. Either up to 8 loudspeaker circuits can be operated as transmission line technology or as up to 4 loops with VARIODYN D1 *loop technology*. Where required, the two technologies can be used in combined mode via the configuration *as two loops and 4 transmission lines*.

Upgrade to a complex alarm/public address system through integrated LAN interfaces.

Continuous monitoring of power amplifiers by means of a 22 kHz test tone. In the event of a failure of a power amplifier, a backup amplifier will automatically and dynamically replace the faulty power amplifier. The defined loudness level is also taken into account for the backup amplifier.

Continuous inaudible monitoring of loudspeaker lines (ground faults, short circuits, interruptions, and impedance deviations with specified tolerances for each loudspeaker circuit), even in power-saving mode, independent of activated announcements. An end of line module can also optionally be used as a line termination and the line to the EOL can be monitored.

This ensures that short-circuited loudspeaker circuits are disconnected without affecting the rest of the system.

Continuous monitoring of line and microphone of up to four connectable digital call stations or universal input modules.

All errors are detected, displayed and recorded (message list) within seconds.

Audio filters such as parametric equalizers, high and low-pass filters and delays per audio channel can be set.

For each of the four amplifier channels, there are four sensor inputs for optional, continuous and automatic volume control in real time, independent of the ambient noise level.

It is possible to monitor locally all of the input and output channels via the integrated loudspeaker and monitor button.

Eight programmable, potential-free contact outputs for controlling external components (e.g. priority relays) or for signaling various indicator states (collective fault messages).

Four Ethernet 100 Mbit/s interface connections with switch function.

Integrated TWI bus for optional connection of an additional module (e.g. time synchronization using TCM-GPS). Display for indicating operation status, errors, circuit connection, and active power-saving mode via multi-colored LEDs.

Emergency control operation during a power failure to preserve battery capacity – this means not activating background music or low-priority announcements when there is a failure in the primary power supply. The connected amplifiers are switched to stand-by mode.

Non-volatile audio memory for up to 260 seconds, freely scalable, for user-specific canned audio. Various gong and alarm signals in accordance with DIN VDE 33404, ZBV.

Emergency 24 V power supply as secondary power supply.

Display

4 LEDs for device operating state:

in operation, warning/error, emergency control option, power-saving mode

8 LEDs for indicating the control contacts state

4 LEDs for indicating the state of each of connected power amplifier

8 error and 8 loudspeaker circuit relay LEDs

Operating elements

A button for sequential monitoring local audio channels and acknowledging an acoustic error message

1 monitoring loudspeaker

Audio output

Output type	electronically symmetrical
Nominal level	0 dBu
Max. output level	+6 dBu
Frequency range	20 Hz to 20 kHz
Max. deviation from linear frequency	± 1 dB in frequency range
Distortion factor at nominal level	< 0.03% at 1 kHz
Max. distortion factor	0.1% in frequency range
Signal-to-noise ratio at nominal level	>75 dB (A)
	> 70 dB
Load impedance	min. 5 kΩ, max. 500 pF

Sensor input (AVC*)

Input type	symmetrical, non-earthed
------------	--------------------------

Nominal level	-51 dBu
Nominal level for emergency call station	0 dBu
Frequency range	100 Hz to 8 kHz
Max. deviation from linear frequency	± 6 dB in frequency range
Distortion factor at nominal level	< 0.2% at 1 kHz
Max. distortion factor	1% in frequency range
Signal-to-noise ratio at nominal level	> 65 dB (A) > 60 dB
Input impedance	typ. 200 Ohm
Control contacts	
Max. voltage	100 V DC/1 A
Impulse withstand voltage	> 2.5 kV
Pass-through contacts	
Max. voltage	250 V AC, 30 V DC/5 A
Impulse withstand voltage	> 1.5 kV
Power supply	
Rated voltage	90 V AC to 264 V AC
Nominal frequency	47 Hz to 440 Hz
Power rating with/without 4x DAL	4 W/70 W at 230 V AC
Emergency power supply	
Voltage range	21.6 V DC to 30 V DC
Ambient temperature range	-5°C to +55°C
Relative humidity	15% to 90%

*AVC = Automatic Volume Control

Digital audio distribution and connection system for up to 24 loudspeaker zones

Module with audio signal processing for connecting and controlling power amplifiers and for connecting loudspeaker circuits.

Four independent audio outputs for connecting power amplifiers (up to 500W per channel) and for simultaneous processing of up to four different audio information items per module.

Connection of audio signal to one or up to six user-defined loudspeaker zones for each audio output to obtain upto twenty-four loudspeaker circuits per module.

Upgrade to a complex alarm/public address system through integrated LAN interfaces.

Continuous monitoring of power amplifiers by means of a 22 kHz test tone. In the event of a failure of a power amplifier, a backup amplifier will automatically and dynamically replace the faulty power amplifier. The defined loudness level is also taken into account for the backup amplifier.

Continuous inaudible monitoring of loudspeaker lines (ground faults, short circuits, interruptions, and impedance deviations with specified tolerances for each loudspeaker circuit), even in power-saving mode, independent of activated announcements. An end of line module can also optionally be used as a line termination and the line to the EOL can be monitored.

This ensures that short-circuited loudspeaker circuits are disconnected without affecting the rest of the system.

Continuous monitoring of line and microphone of up to four connectable digital call stations or universal input modules.

All errors are detected, displayed and recorded (message list) within seconds.

Audio filters such as parametric equalizers, high and low-pass filters and delays per audio channel can be set.

For each of the four amplifier channels, there are four sensor inputs for optional, continuous and automatic volume control in real time, independent of the ambient noise level.

It is possible to monitor locally all of the input and output channels via the integrated loudspeaker and monitor button.

Eight programmable, potential-free contact outputs for controlling external components (e.g. priority relays) or for signaling various indicator states (collective fault messages).
 Four Ethernet 100 Mbit/s interface connections with switch function.

Integrated TWI bus for optional connection of an additional module (e.g. time synchronization using TCM-GPS). Display for indicating operation status, errors, circuit connection, and active power-saving mode via multi-colored LEDs.

Emergency control operation during a power failure to preserve battery capacity – this means not activating background music or low-priority announcements when there is a failure in the primary power supply. The connected amplifiers are switched to stand-by mode.

Non-volatile audio memory for up to 260 seconds, freely scalable, for user-specific canned audio.

Various gong and alarm signals in accordance with DIN VDE 33404, ZBV.

Emergency 24 V power supply as secondary power supply.

Display

4 LEDs for device operating state:

in operation, warning/error, emergency control option, power-saving mode

8 LEDs for indicating the control contacts state

4 LEDs for indicating the state of each connected power amplifier

24 error and 24 loudspeaker circuit relay LEDs

Audio capacity flash memory	approx. 2 hours.
Audio capacity hard drive	approx. 1,000 hours.
Power supply	
Nominal voltage	90 V AC to 264 V AC
Nominal frequency	47 Hz to 63 Hz
Nominal current	typ. 0.5 A @ 230 V AC
Emergency power supply	
Voltage range	21.6 V DC to 30 V DC
Ambient temperature range	-5°C to +55°C
Relative humidity	15% to 90%

Digital call stations

Digital call station with 12 keys

Fully digital call station with electret microphone (cardioid characteristic) on a flexible 300 mm long gooseneck.

Integrated broadband loudspeaker for monitoring and previewing purposes as well as intercom functions.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

12 freely programmable buttons, which can be labeled.

13 integrated and 12 freely programmable LED display elements including a combined operation and error display.

Digital transmission of control signals and all four audio signals to and from the digital call station and the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5E cable (shielded) and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

RJ12 socket for connection with up to 6 expansion modules via daisy chain.

An audio input with 2 cinch sockets at the back of the digital call station for connecting an auxiliary device allows audio playback outside of the central control unit.

An audio output can be used for monitoring purposes or for audio distribution or recording.

In- and output are independent from the microphone and can be used simultaneously

A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

Microphone	electret, cardioid characteristic
Gooseneck	300 mm
Frequency range	100-15,000 Hz
Loudspeaker - power	1 W
Audio input	
Nominal level	0 dBu
Max. level	+6 dBu
Frequency range	20 Hz to 22 kHz
Signal-to-noise ratio	> 95 dB
Distortion factor (at nominal level)	< 0.1 %
Audio output	
Nominal level	0 dBu
Frequency range	20 Hz to 22 kHz
Signal-to-noise ratio	> 85 dB
Distortion factor (at nominal level)	< 0.1 %
Output impedance	180 Ohm
Sample rate	48 kHz
AD/DA converter	24 Bit
Max. power consumption	150 mA
Ambient temperature range	-5 °C to +55 °C
Relative humidity	15% to 90%

Digital call station with one key

Fully digital call station with electret microphone (cardioid characteristic) on a flexible 300 mm long gooseneck.

Integrated broadband loudspeaker for monitoring and previewing purposes as well as intercom functions.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

A freely programmable button, which can be labeled.

Two integrated and one freely programmable LED display elements including a combined operation and error display.

Digital transmission of control signals and all four audio signals to and from the digital call station and the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

RJ12 socket for connection with up to 6 expansion modules via daisy chain.

A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

Microphone	electret, cardioid characteristic
Gooseneck	300 mm
Frequency range	100-15,000 Hz
Loudspeaker - power	1 W
Sample rate	48 kHz
AD/DA converter	24 Bit

Max. power consumption	150 mA
Ambient temperature range	-5 °C to +55 °C
Relative humidity	15% to 90%

Fire Control PA Panel with 12 keys

Fully digital call station with handheld microphone and built-in loudspeaker for monitoring and previewing purposes and intercom functions in integrated housing. Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

12 freely programmable buttons, which can be labeled.
 12 integrated and freely programmable LED display elements including a combined operation and error display.

Digital transmission of control signals and all audio signals to and from the digital call station and to the supply voltage via DAL link.

Fire Control PA Panel with one key

Fully digital call station with handheld microphone and built-in loudspeaker for monitoring and previewing purposes and intercom functions in integrated housing. Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

A freely programmable button, which can be labeled.
 Two integrated and one freely programmable LED display elements including a combined operation and error display.

Digital transmission of control signals and all audio signals to and from the digital call station and to the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).
 Optional fiber optic connection for distances up to 2,000 meters.
 RJ12 socket for connection with up to 6 expansion modules via daisy chain.
 A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

Microphone	Handheld microphone, cardioid characteristic
Frequency range	200-12,500 Hz
Loudspeaker - power	1 W
Sample rate	48 kHz
AD/DA converter	24 Bit
Max. power consumption	150 mA
Ambient temperature range	-5 °C to +55 °C
Relative humidity	15% to 90%

Digital fire control PA panel

Fully digital call station with handheld microphone and built-in loudspeaker for monitoring and previewing purposes and intercom functions in surface-mounted or flush-mounted housing. Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

Five freely programmable buttons for the alarm
 One button for the all-clear signal
 One button for reset/acoustic
 Three integrated LED display elements (in operation, fault, busy)

Digital transmission of control signals and all audio signals to and from the digital call station and the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

Display window and locking mechanism in accordance with EN 54-11.

Conforms to the Austrian F 3033 standards and must be verified by a positive test protocol carried out by an accredited body.

Microphone	Handheld microphone, cardioid characteristic
Frequency range	200-12,500 Hz
Loudspeaker - power	1 W
Sample rate	48 kHz
AD/DA converter	24 Bit
Max. power consumption	150 mA
Ambient temperature range	-5 °C to +55 °C
Relative humidity	15% to 90%
Color	Red RAL 3000
Weight	approx. 2.0 kg
Dimensions (H x W x D)	300 x 200 x 30 mm

Digital Keyboard Module

Digital keyboard module for digital call stations

Allows an extension of 18 extra freely programmable keys that can be labeled as well as 18 LED display elements.

Digital transmission of control signals to the digital call station.

The keyboard module is supplied with 24 V DC by the digital call station.

Ambient temperature range -5 °C to +55 °C

Relative humidity 15% to 90%

Interfaces

Universal Interface Module

Interface module for connecting two analog audio inputs, two analog audio outputs, and 48 control contacts.

The two audio inputs are both asymmetrical (RCA) and symmetrical (XLR-f).

The two audio outputs are both asymmetrical (RCA) and symmetrical (XLR-m).

The 48 control contacts can be set via software configurations in any combination as potential input contacts and/or output contacts; eight can be monitored.

Digital transmission of control signals and all audio signals to and from the VA/PA system and the supply voltage via DAL link.

Display

A green POWER LED

A yellow ERROR LED

4 green SIGNAL LEDs for signaling potential audio modulation.

Audio inputs

Nominal level 0 dBu

Max. level +6 dBu

Frequency range 20 Hz to 22 kHz

Signal-to-noise ratio > 95 dB

Distortion factor (at nominal level) < 0.05 %

Input impedance XLR socket 100 kΩ, symmetrical, potential-free

Output impedance CINCH socket 1 kΩ, asymmetrical, potential-free

Audio outputs

Nominal level 0 dBu

Frequency range	20 Hz to 22 kHz
Signal-to-noise ratio	> 85 dB
Distortion factor (at nominal level)	< 0.05 %
Output impedance XLR socket	200 Ω, symmetrical, potential-free
Output impedance CINCH socket	200 Ω, asymmetrical, potential-free
Control contacts	
Input contact	
Max. input voltage	+36 V DC
Output contact	
Contact rating	36 V DC/50 mA
Short-circuit proof for +24V	1 s
Ambient temperature range	-5 °C to +55 °C
Relative humidity	15% to 90%

Contact Interface Module

Interface module for connecting eight control contacts.

The eight control contacts can be set via software configurations in any combination as potential input contacts and/or output contacts; four can be monitored.

Digital transmission of control signals and the supply voltage via TWI (two-wire interface).

Control contacts

Input contact

Max. input voltage +36 V DC

Output contact

Contact rating 36 V DC/50 mA

Short-circuit proof for +24V 1 s

Ambient temperature range -5 °C to +55 °C

Relative humidity 15% to 90%

Amplifier

Power amplifier 2 x 250 W/100 V; class D, 24 V DC

Highly efficient class D power amplifier.

The power amplifier includes the following characteristics:

- Complies with IEC BS EN 60268-3, 55013, and 55020 standards
- Self-monitoring and self-testing via microcontrollers
- Protected against overload, short circuits and over-heating
- Built-in fan with temperature-controlled rotation speed control, with airflow from front to back of device
- Monitoring of the fan's t self, if one is failed - the left fan must set on 100% speed automatically.
- LED status display per channel for POWER, SIGNAL, CLIP, and ERROR
- LED status display for MAINS POWER; BATT POWER, CPU STATUS, SYS FAULT
- Emergency power supply via 24 V DC
- Symmetrical audio inputs and control via CAT 5 cable with RJ45 connector
- 100 V outputs via pre-assembled system cable, lockable

Technology	Class D, 100 V outputs with transformers
Output power (at 230 V mains supply)	250 W with 40 Ω load
Output power (at 24 V DC emergency power supply)	250 W with 40 Ω load
Mains supply	230 V AC 50/60Hz +10% to -15%
Emergency power supply	21.5 V DC to 28.5 V DC
Frequency response	50 Hz to 22 kHz ± 3dB
Distortion factor	< 0.3% at 1 kHz sine
Signal-to-noise ratio	90 dB (A-weighted)
Channel separation	> 75 dB

Efficiency at maximum power
Color
Ambient temperature range
Relative humidity

> 80%
RAL 7016
-5 °C to +55 °C
up to 90 % (non-condensing)

6.8 TECHNICAL SPECIFICATION OF SOLAR PANEL

SOLAR POWER SYSTEM WITH GRID TIE INVERTER:

INTENT OF SPECIFICATION:

This specification covers the Design, manufacture, assembly, shop testing, packing, dispatch, transportation supply, erection, testing, commissioning, performance and guarantee testing of Solar Power System, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

GRID TIE INVERTER:

Grid Tie based inverter shall be provided to control & convert the D.C. Power generated by solar panel to AC power and directly connected to Main L.T. Panel. Inverter output shall be 3 phase, 4 wire system

SOLAR PANEL:

Solar Cell shall be Monocrystalline type. Monocrystalline silicon cell shall be connected in series. Front cover shall be of high transmission ARC glass material. Back cover shall be white polyester and frame shall be silver anodized aluminium. The solar cell / panel shall be certified according to the extended version of the IEC 61215:2005 (Crystalline silicon terrestrial photovoltaic modules - Design qualification and type approval) Certified according to IEC 61730-1 and IEC 61730-2. Photovoltaic module safety qualification, requirements for construction and testing) Module electrical measurements are calibrated to World Radiometric Reference via third party international laboratories Manufactured in ISO 9001 and ISO 14001 certified factories which are audited annually by VDE. The data sheet should be complies with the requirements of EN 50380.

Solar Panel Nominal Wattage	-180Wp
Type	-Monocrystalline
Area / Panel	-1.25 SQ.M TO 1.30 SQ.M
Module Weight	-15 Kg - 17 Kg
Max-power Voltage	-35.8V
Max-power Current	- 5.03A
Max power	-180W
Module Efficiency	-15% minimum
No of Panel Approx	-30
Total Panel Wattage	-101520 Wp

MOUNTING STRUCTURE:

Type	Module mounting structure
Make	Reputed

Country of origin	India
Location	Roof mounting
Material	Angle Sections, Mild steel
Surface finish	Hot dip galvanized
Range of tilt	20 to 45 degree
Hardware	MS

JUNCTION BOX:

Make	Reputed
Country of origin	India
Type & Quantity	a) Array junction box b) Main junction box
Construction	Weather proof
Material	FRP/ Thermo Plastic
Colour	Suitable
Earthing Provision	Provided
Hardware's	As required
Marking	Suitable ferules are provided to identify all the cables
Mounting type	Structure
Cable entry	Suitable
Cable glands	Suitable
Accessories	As required

6.9 TECHNICAL SPECIFICATION OF HVAC, MECHANICAL VENTILATION & BMS WORK.

1 TECHNICAL SPECIFICATION OF EQUIPMENTS

1.1 VRV / VRF Outdoor Unit

The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V

(Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.

1.1.1 **Scope of Work**

The specification for VRV / VRF Units covers the general design, materials, constructional features, supply, installation, testing, commissioning & carrying out performance test at site.

1.1.2 **Codes & Standard**

The design, materials, manufacture, inspection, testing & performance of VRV/ VRF shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed.

1.1.3 **General**

Each VRV / VRF Unit shall be air cooled, split type multi-system air conditioner consisting of outdoor units and number of indoor units, each having capability to cool for the requirements of the individual area to be air-conditioned. The VRV / VRF unit should be capable of connecting minimum ten different type of indoor units to one refrigerant circuit and controlled individually.

Each VRV / VRF unit shall have minimum two number scroll compressor and out of two number Compressors minimum one shall be inverter Compressor (With inverter controller) and capable of changing the rotating speed to follow variations in cooling loads. Each indoor unit shall have capability to cool for the requirement of the rooms.

Compressor shall be inverter controlled. Compressor installed in each outdoor module unit shall be equipped with all inverter compressor in bigger (if modular) machines for higher reliability, improved life, better backup and duty cycling purpose. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.

The Outdoor units shall be suitable for mix-match connection of following type.

- Ceiling mounted cassette type (Double flow)
- Ceiling mounted cassette type (Multi flow)
- Ceiling mounted duct type.
- Ceiling suspended type.
- Wall mounted type
- Floor standing type
- Concealed floor standing type.
- Or
- VRV DX AHU

Please note that the refrigerant piping shall be capable of extending up to 150m with 50m level difference without any oil traps.

Both indoor and outdoor units shall be factory assembled, tested and filled with first charge of refrigerant. These being very hi-tech in construction with lots of factory checks being conducted, hence no sub assembly should be done at site preferably.

1.1.4 Outdoor Unit

1.1.5

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired, tested with all necessary controls tested prior to dispatch conforming to the following specifications.

- a) All outdoor units shall consist of all inverter scroll/rotary.
- b) In such case, the units shall be provided with duty cycling arrangement for multiple inverter compressors.
- c) The outdoor unit shall be modular in design to facilitate installation one after another close to each other. Preference would be given to compact units having smaller footprint.
- d) Outdoor units should be rugged of anti-corrosion design and should have strong base plate for easy mounting of unit. All interconnecting piping, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air pollution.
- e) The outdoor unit shall comprise of sub-cooling feature to effectively use the entire coil surface through proper circuit/bridge in order to prevent flushing of refrigerant owing to large length of piping.
- f) The condensing unit shall be provided with state-of-the-art microprocessor based control panel.
- g) The outdoor unit shall be provided with provided with Aero spiral design fan exhibiting low noise level characteristics complete with aero fitting grille to facilitate spiral discharge of airflow to effect reduction in pressure losses. The fan should be capable to respond to external static pressure of 5mm.
- h) Motor shall be speed controlled to ensure a stable operation for varying ambient, by a factory fitted direct acting head pressure activated variable speed drive for at least 15 steps to give precise discharge pressure and minimum power consumption of condenser fan motor.
- i) The condenser shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessories necessary with the equipment supplied.

The condensing unit shall be designed to facilitate fail safe operation when connected to multiple indoor units. If possible, the system should work on standard operating parameters like discharge pressures of not more than 300 PSI as the ref. Piping will be moving around within a residential house, otherwise on any misfortune of any leakage it will act like a bullet on higher pressures. If working on higher operating pressures, vendor to comply with all safety codes of high pressure safety & testing as recommended by Japanese (being Japanese design product) and give 2 sets of special tools to handle such equipment at site. All brazing should be done by only qualified trained person who had training on HIGH PRESSURE brazing, special tools & procedures.

1.1.6 Scroll Compressor**1.1.7**

The scroll compressor shall be an industrial quality rugged, cast iron, direct hermetic compressor with scroll plates, suction & discharge service valves. The compressor shall be completely enclosed in a chamber with no leakage path and providing the capability for scroll plates to separate. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance.

The compressor shall be highly efficient inverter control. The inverter compressor shall change the speed in accordance to the variation in cooling or heating load requirement:

- a) All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.
- b) Oil heater shall be provided in the compressor casing.

1.1.8 Heat Exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil.

- a) The aluminum fins shall be covered by anti-corrosion resin film.
- b) The unit should be with heat exchanger to optimize the path of heat exchanger and for better efficiency of condenser.
- c) The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

1.1.9 Refrigerant Circuit

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution.

All necessary safety devices shall be provided to ensure the safely operation of the system.

1.1.10 Refrigerant

The VRV / VRF units shall be selected on R410 refrigerant only. The units should be fully factory charged with refrigerant & oil & spare refrigerant & oil must be sent along with the machine for topping up of gas & oil as may be required.

1.1.11 Safety Devices

All necessary safety devices shall be provided to ensure safe operation of the system.

Following safety devices shall be integral part of the out door unit :

- High pressure switch
- Fan drive overload protection switch
- Fusible plug
- Overload relay including overload protection for inverter driven compressor.

1.1.12 Oil Recovery System

Entire system shall be designed and capable of oil recovery to ensure stable operation with long refrigeration piping lengths.

The system should have inbuilt (avoid external) oil balancing circuit to avoid poor lubrication.

1.1.13 Transit Damage

The unit shall be restored to original conditions in case of any transit damages by the bidder at his own cost.

1.1.14 Technical Requirement of VRV / VRF Unit

S/N	Description	Unit	Condition of Service
a)	Type	--	Cool Type
b)	Capacity (cooling)	HP (Nominal)	As per BOQ
c)	Quantity	Nos.	As per BOQ
d)	Connectable No. of possible indoor unit	Nos.	Refer Drawings
e)	Air entering condenser	Deg. C DB	48.0
f)	Electric Supply	--	415 V/3 Ph/50 Hz
g)	Maximum Refrigerant Piping Length For One Unit	--	150 RMT

1.2 VRV / VRF Indoor Unit

The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF. The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.

1.2.1 Scope of Work

This section deals with supply, erection, testing and commissioning of Various Type Of Indoor Units conforming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as specified in Schedule of Quantities.

1.2.2 General

Indoor units shall be VRV/VRF DX AHU, ceiling mounted cassette type, ceiling mounted ductable type, floor standing type, wall mounted type or other as specified in BOQ. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variations of the room.

- a) The address of the indoor unit shall be set automatically in case of individual and group control
- b) In case of centralized control, it shall be set by liquid crystal remote controller

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.

Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating.

Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

1.2.3 Ceiling Mounted Cassette Type Unit (Multi Flow Type)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo fan type. Also Units shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center.

Each unit shall have high lift drain pump, fresh air intake provision (if specified) and very low operating sound.

All the indoor units regardless of their difference in capacity should have **same decorative panel size** for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

1.2.4 Ceiling Mounted Ductable Type Unit

Unit shall be suitable for ceiling mounted type. The unit shall include pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for Ductable arrangement.

1.2.5 Ceiling Suspended Type

Unit shall be suitable for ceiling suspended arrangement below false ceiling. The unit include pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

1.2.6 Hi Wall Mounted Unit

The units shall be wall-mounted type. The unit includes pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel. Unit shall have an attractive external casing for supply and return air.

1.2.7 Floor Standing Type

Unit shall be suitable for floor standing arrangement. The unit include pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

1.2.8 Centralized Type Remote Controller

A multifunctional compact centralized controller shall be provided with the system.

The controller should be LCD remote controller to act as an advanced air-conditioning management system to give complete control of VRV / VRF air-conditioning Equipment, It should have ease of use for the user and must have a user friendly panely and LCD display.

It shall be able to control up to minimum 64 indoor units with the following functions:-

- a) Starting/stopping of Air-conditioners as a zone or group or individual unit.
- b) Temperature settling for each indoor unit or zone.
- c) Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.
- d) Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, trouble shooting information.
- e) OPTIONAL-Display of air conditioner operation history.
- f) OPERATIONAL-Daily management automation through yearly schedule function with possibility of various schedules.

The controller shall have wide screen user friendly LCD display and can be wired by a non polar 2 wire transmission cable to a distance of 1 km. away from indoor unit.

1.2.9 Colour

The colour of indoor units should be white or to suit interiors as designed by the architects / clients.

1.3 Double Skinned DX VRV / VRF AHU**1.3.1 Scope of Work**

The specification for Double Skinned DX AHU with Air Cooled VRV / VRF Outdoor Unit covers the general design, materials, constructional features, supply, installation, testing, commissioning & carrying out performance test at site.

1.3.2 Codes & Standard

The design, materials, manufacture, inspection, testing & performance of unit shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed.

1.3.3 Air Cooled VRV / VRF Outdoor Unit**Compressor**

The compressor shall be hermetically sealed scroll compressor. The compressor should be suitable to withstand voltages varying from 340 to 460 volts.

Air Cooled Condenser

The Air cooled condenser should have high efficiency condenser coils having copper tubes & collared aluminium fins with serrated edges & wavy airways to ensure sub cooling. The air cooled condenser should be housed in factory finished cabinet duly enamel painted. The air cooled condenser should have aluminium fins mechanically bonded with copper tubes.

The fan of the air-cooled condenser shall be statically / dynamically balanced and driven by 3 phase motor of suitable horse power.

Note:- For more details about VRV / VRF outdoor unit, please refer the separate specification given with this tender.

1.3.4 Double Skinned Air Handling Units

Scope

The specification for Double Skin Air Handling Units covers the design requirement, constructional feature, supply, installation, testing & commissioning. The handlers shall be of double skin construction, draw through type comprising of various sections such as pre filter section, DX cooling coil section, fan section etc as per details given in BOQ.

Double Skinned Casing

The casing shall be self supporting type, factory fabricated & assembled made of extruded anodised aluminum hollow sections to make a rigid frame structure. The frame shall be assembled using pressure die cast aluminum joints. The self supporting unit shall consist of sandwiched panel made out of 0.6mm thick pre-plasticide / pre-coated GI sheet outside & 0.6mm GI sheet inside (0.6 mm polished stainless steel in case of AHU for Operation Theatre) duly factory fabricated insulated with 23 / 48 mm thick PU foam insulation in between as specified in Bill of Quantities. The insulated panels shall be bolted to mainframe with neoprene rubber gaskets held captive in the framed extrusion to make it leak proof. Suitable airtight access doors / panels with pressure die cast aluminum hinges & nylon handles and locks shall be provided for access to various sections for maintenance. The Entire housing shall be mounted on Extruded Aluminum channel framework having pressure die cast aluminum jointers or the framework shall be joined together with corner plates Condensate. Drain Pan shall be constructed of 22 gauge Stainless steel sheet with all corners welded with uniform slope from all sides leading to drain pan ensuring no stagnation of condensate water.

Motor & Drive

The fan motors shall be suitable for $415 \pm 10\%$ volts, $50 \pm 5\%$ HZ, 3 phases TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation & motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of oil resistant type only.

Fan

The casing shall have heavy gauge GI construction forward curved DIDW imported fan statically & dynamically balanced mounted on EN8 solid shaft or C 40 carbon steel. The supply air DIDW fan shall be forward / backward curved as per BOQ. The fan impeller shall be supported to housing with angle iron frame & pillow block heavy duty ball bearing. The fan shall be selected for a fan outlet velocity below 10 meter / sec. The fan housing with TEFC Sq. Cage motor shall be mounted on a common adjustable base frame on vibration isolators in case the impeller diameter is exceeding 450 mm & rubber turret mounts vibration isolators for fan diameter up to 450mm diameter. The fan motor shall be installed inside the housing of air handling unit to keep low noise level. The fan & motor assembly shall be of aluminum extruded section only.

DX Cooling / Heating Coils

The Cooling coil should be at least 4 row deep or as per BOQ and shall have at least 4.7 fins/cm. The Cooling coil should have aluminium fins and copper tubes mechanically

bonded. The unit shall be factory aligned, tested and complete with refrigerant piping connection port, charging valves, thermostatic expansion valve, distributor, liquid strainer, dehydrator, liquid line shut off valve etc.

The cooling coil should be tested for leaks at a hydraulic pressure of at least 10 Kg / sq.cm. for a minimum period of 3 hours at works. The velocity across face should be limited to 152 metre / minute.

Filters

Each unit shall be provided with a factory assembled pre-filter section containing washable synthetic tube air filters having extruded aluminum frame. The filtration efficiency shall be 90 % down to 10 micron particle size. Filters shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filters cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Face velocity across filters shall not exceed 152 MPM.

1.3.5 Accessories

The following accessories shall be provided with each air handlers without any additional cost.

- a) Vibration isolators shall be provided with all air handling units. Vibration isolators shall be cushy foot mountings, springs or approved equal type.

1.4 Ventilation Fans

1.4.1 Scope of Work

The specification for supplies & exhaust air blowers for mechanical ventilation covers the design requirement, constructional feature, supply, installation, testing & commissioning.

1.4.2 Type

The blower shall be of Tube Axial Flow fans / Centrifugal Fans / Inline fans / Propeller Fans with or without ducting system & shall be of floor mounted / ceiling hung type.

1.4.3 Capacity

The capacity of Tube Axial Flow fans / Centrifugal Fans / Inline fans / Propeller Fans, diameter, maximum motor H.P & static pressure etc. shall be according to schedule of quantities.

1.4.4 Axial Flow Fans

The exhaust air blower shall be Tube Axial Flow fans connected to the duct & shall be of floor / ceiling / wall mounted type as specified in the Bill of Quantities / GFC Drawings / Shop Drawings. The capacity of tube axial flow fans, diameter, maximum motor H.P & static pressure etc. shall be according to schedule of equipment & Bill of Quantities. The noise level of axial fan shall be less than 80 dba at a distance of 2.5 mt from the fan.

Axial Flow Fan shall be **AMCA certified** for Air and Sound performance in accordance to **AMCA 210 and AMCA 300**.

The cylindrical casing should be made from welded carbon steel sheet. The inlet & outlet of the casing shall be fitted with flanges for ductwork connection & other accessories as required. The casing shall be coated with minimum 2 coats of rust proof primer and enamel paint thereafter or to be Powder Coated after phosphating process. The blade of axial flow fan shall be made of die cast aluminium alloy. The blade angle shall be set at manufacturing place & shall also have facility to modify latter. The hub shall consist of two half-hubs pressed in carbon steel & the centre boss shall be made of die-cast aluminium alloy. The blade feet shall be locked in two half - hubs. The impeller assembly shall be fixed on the shaft by means of a double cone type expansion bush. The design shall facilitate the alteration of blade angle without disconnecting the hub from the motor shaft. The fan shall be directly driven by TEFC sq. cage induction motor. The fan motors shall be 415±10% volts 50HZ ± 5%, 3 phase TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation & motor RPM shall be as given in Bill of Quantities. After

assembling the impeller shall be statically & dynamically balanced. Fan RPM shall be 960 for normal working & 1450 RPM for working in case of fire.

The mounting ring shall be of CRCA / sheet steel with brackets to connect the frame, with the Fan / Motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.

All the fans selected for smoke extraction shall withstand 250 °C temperature for 2 hours & shall work satisfactorily at this temperature. Motors selected for this application shall be certified according to standard BS EN 12101-3:2002 / UL 705 for 250 °C for 2 hours.

Complete Fan assembly for smoke extraction application (Fan Impeller, Fan Casing, Motor base frame alongwith Motor) shall be tested and approved by Exova Warringtonfire in accordance with BS EN 12101-3:2002 / UL 705 standard for "Powered Smoke and Heat Exhaust Ventilators for Smoke Control Systems" for (250 degree C) temperature for a 2 hours of operation.

1.4.5 Centrifugal Fans

The Centrifugal blowers shall be double / single inlet, double / single width, forward / backward curved as given in the BOQ & of non-overloading type of suitable construction. The blower performance must be rated in accordance with approved test codes and procedures. The centrifugal fans should confirm to IS – 4894 – 1987 (Revised as on date) The blower housing comprising of scroll & side plates shall be accurately cut of heavy gauge construction and reinforced with angle bracings. Outlets shall be flanged to assure proper duct connection. Inlet cones shall be spun venturi type, to ensure smooth air entry. The base frame shall be GI / MS channel in bolted / welded construction. Impeller shall be fabricated from sheet steel with backward / forward curved, properly designed blades, with heavy C.I. Hub and shall be both dynamically and statically balanced, to a close tolerance for quiet and vibration free performance. Shaft shall be EN-8., more than 40 mm diameter and shall be accurately ground and polished to a close tolerance. Bearings shall be self aligned, heavy duty ball or tapered roller type with integral dust and grease seals. Fan having wheel diameter of 1220 mm or more, shall be supplied with split, bolted housing for convenience of handling and installation.

Drive assembly for each blower shall consist of blower pulley, motor pulley, and a set of 'V' belts, belt guards, and belt tension adjusting devices. Pulleys shall be selected to provide the required speed. They shall be multi-groove type, with section and grooves selected to transmit 33% more load than the required power and shall be statically balanced. The belt guards shall be of M.S. sheet with angle iron reinforcements and expanded metal screen. The fan motors shall be 415±10% volts 50HZ ± 5%, 3 phase TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation & motor RPM shall be as given in Bill of Quantities.

All the fans selected for smoke extraction shall withstand 250 °C temperature for 2 hours & shall work satisfactorily at this temperature. Motors selected for this application shall be certified according to standard BS EN 12101-3:2002 / UL 705 for 250 °C for 2 hours.

1.4.6 Propeller Fans

The Propeller Fan blades shall be pressed steel of aerofoil design for high fan efficiency and static pressure. The blades shall be riveted to a central steel hub. The motor and blades assembly shall be mounted in a cast iron / sheet steel frame with steel brackets. Rubber mounts shall be provided between the mounting frames and brackets. The fan motor shall be totally enclosed type.

1.4.7 In-Line Fans

Inline fans shall be complete with centrifugal impeller, casing, direct driven motor, vibration isolators, direction of discharge and rotation position shall be as per the job requirement and shall be marked on the fan assembly. Housing shall be constructed of hot rolled GSS sheet metal construction. Housing metal parts shall be either spot-welded or screwed or mounted together with rivets. Indication showing rotation arrow and make, model number

and duty conditions of the fan shall be available on the housing. Fan wheel shall be forward curved type, statically and dynamically balanced. The fan shall be provided with ball bearings can be used in any mounting position at maximum indicated temperature.

1.4.8 Accessories

All necessary accessories shall be provided for proper operation and shall also include as part of Unit Price.

- Vibration spring isolators for the blowers
- Double canvas connections at the outlets of each fan
- Nuts, Bolts, Shims etc. as required for the grouting of the equipment
- Slide rails for mounting the motor and belt adjustments
- Bird Screens in the Inlet
- Detachable and washable fresh air filters at the inlets

1.4.9 Performance Data

All fans shall be selected for the lower operating noise level. Capacity ratings, power consumption, with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. All the technical data of fans should be as per AMCA accredited.

1.4.10 Testing

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current. Bidder has to carry out the field balancing, if required.

1.5 Demand Controlled Basement Car Park Ventilation

1.5.1 Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of CO Sensor for basement Car Park Ventilation in auto mode conforming to these specifications and in accordance with Bill of Quantities.

Fans shall be working on CO based sensing system for automatic running & modulating the VFD motor for parking ventilation supply and exhaust fans for normal / fire mode operation.

The fan control mechanism shall be based on variable frequency drive. Each zone shall have controlled ventilation rate of 25% of the specified fan capacity at a given frequency when CO measurement is below 25 ppm & Ventilation rate shall increase proportionally when CO level increase beyond 25 ppm and reach the maximum fan capacity when CO level is above 150 ppm. User should be able to vary these set points through web based software interface / supervisory controller. Logic Controller shall also have the logic to switch ON the fan when CO is above 15 ppm & switched OFF again when CO drops below 9 ppm. Logic Controller shall also have the facility of Timer & Manual Override for fan operation.

1.5.2 Type

Sensor should have CO monitoring with dedicated measuring sensor cell. It should be BMS compatible with analogue output of 4-20mA / 2-10 Volts. Sensor should not be cross-sensitive or respond to other ambient gases, including gases like SO₂, acetone, ammonia, Nitrogen dioxide, Nitric oxide & should be wall mountable without need of further mounting brackets etc. It should have auto recovery to zero point with replaceable sensor cell. Sensor must have reverse polarity and short circuit protection along with over-flooding protection. Sensor should have IMMUNITY TO RF/FM INTERFERENCE as per the guidelines of EMC-Directive 2004/ 108/ EEC & should have enclosure flammability in accordance to UL 94: VO. The sensor should be UL, CE certified & should have minimum IP44 protected housing, with provision of dust and moisture protection with hydrophobic filter arrangement.

1.5.3 Specifications for carbon monoxide detection sensor

It should be capable of continuous, online detection and measurement of carbon monoxide and carbon monoxide radicals & should have Electro-chemical type sensor cell. The same should have Gel based (not watery – for longer shelf life, no mounting orientation problem). Electrolyte sensor cell should have 0-300ppm measuring range, taking care of over range

detection. Response time should be < 15 sec & accuracy should be ≤ 1% of measuring range. It should have low warm up time ≤ 3 minutes. It should have plug-in, easy replaceable sensor cell (simple push – pull arrangement) and PCB for easy service and replacement (no need to change the whole unit).It should have manual trim-pot calibration facility, with annual calibration frequency.

1.5.4 I-O Summary For One Zone

S. No	Description	AI	DI	AO	DO
1	Start/Stop Command for fans in Normal Operation Mode				2
2	Zonal CO Feedback	2			
3	Fans Auto/ Manual Status		2		
4	Fans Run Status		2		
5	VFD Modulation			2	
6	Provision For Hard Wired Alarm Feedback to Fire Alarm Panel		1		
	Total Points per Zone	2	5	2	2

2 TECHNICAL SPECIFICATION FOR ELECTRICAL ITEMS

2.1 Electrical Motors

2.1.1 Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of all types of motors used for HVAC Units conforming to these specifications and in accordance with Schedule of Quantities. The motor installation, wiring & its control shall be carried out in accordance with the specifications as detailed below.

2.1.2 Motors

The motor shall be of the following design and should run at all loads without any appreciable noise or hum.

Totally enclosed fan cooled Sq. Cage.

Enclosure and type of motor shall depend upon duty and usage unless otherwise specified.

- a) The winding of motors shall be class ‘B’ insulation and suitable for local conditions. The insulation of motors shall confirm to IS:325/1978.
- b) All motors shall comply with IS:325, IEC-34.1 or BS – 2313, IEC-72.1 for foot mounted motors.
- c) The rating of the motor shall be as indicated in the Schedule of Quantities. The motors shall be selected on the basis of ambient temperatures and allowable maximum temperature rise.
- d) Motor above 1HP shall be three phase unless otherwise specified.
- e) All motors shall be rated for continuous duty as per IS:325. Motor shall be suitable for operation on 415 volts ± 10% volts, 50 ± 5% Hz three phase AC supply (or 230 ± 10% volts, 50 ± 5% Hz for single phase AC supply).
- f) Motors shall be provided with cable box to receive Aluminum conductors, PVC insulated, PVC sheathed and armored cables.
- g) All motors shall be provided with combination of ‘Ball and Roller Bearing’. Suitable grease nipples for regreasing the bearing shall be provided.
- h) Motors above 0.25 HP shall be provided with overload protection. Motors above 100 HP shall be provided with thermal protection and thermistor detector in the stater winding.
- i) The starter current and the type of starter to be used shall be as follows (unless otherwise specified)

	Type of motor	Starting Current	Starting method
a)	Sq. Cage motor up to 7.5 HP	600% of full load current	D.O.L
b)	Above 7.5 HP up to 60 hp	250% of full load current	Star / Delta
c)	75 HP & above	200% of full load current	Closed transition Star / Delta or Double Star

2.1.3 Motor Starters

- a) All starter shall confirm to IS: 13947. The starter shall be enclosed in sheet metal enclosure, which would be dust vermin proof.
- b) All starter should have suitable range of voltage and frequency.
- c) All starter shall have integral stop/start push button of international colour code.
- d) Contactor shall have number of poles as required for appropriate duty. Contacts should be made of solid silver faced & shall be suitable for at least 40 contacts per hours.
- e) In event of power failure, the starter should automatically disconnect.
- f) All starters shall be provided with thermal over load relay.
- g) All star delta starters shall have adjustable timers.
- h) Terminal blocks with integral insulating barrier shall be provided for each starter.
- i) All starters shall be provided as specified in Schedule of Quantities. All starter shall be compatible to the drive and driven equipment.
- j) Extra contact for interlocking purpose shall be provided in the starter.
- k) All starter shall be compatible for Auto / Manual operation (BMS Compatible)
- l) All starter shall have separate single phasing preventer.

2.1.4 Installation of Motors

- a) The motor and drive machine shall be fixed on slide rails to facilitate belt and other adjustments.
- b) Vibration isolation arrangement shall be provided.
- c) The installation of motor shall be carried out as per IS:900.
- d) The motor with driving equipment shall be mounted on foundation and connected to each other with flexible coupling with guard in condenser & chilled water pumps.
- e) All motor shall be wired as per specifications. Earthing of motor frame shall be done with GI strips as specified in 'Schedule of Quantities'.
- f) All motors shall be tested at manufacturer's works as per I.S. standard and test certificates shall be furnished.
- g) All motors after AC bidder shall test installation at site for vibrations, heating and electrical insulation resistance.

Motor Control Centre, Ventilation Sub Panel, Power & Control Cabling, Earthing etc.

2.1.5 Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of Motor Control Centre, Ventilation Panels, AHU Sub Panel, power / control cabling & earthing work shall be carried out as per the specification given below and in accordance with Schedule of Quantities. All work shall confirm to Indian Electricity Act (amended up to date), I.S. code of practices, local rules and regulations etc. The codes & standard to be followed shall be as given below:-

- BIS 13947 (Part 4) - AC contactors up to 1000V
- BIS 13947 - AC Circuit Breakers
- BIS 2705 - Current Transformers
- BIS 3156 & 4146 - Potential Transformers
- BIS 4064 - Air break switches for voltage not exceeding 1000V
- BIS 13947 - Control switches
- BIS 1822 - Motor duty Switches
- BIS 12021 - Specification for control transformer
- BIS 8623 - Factory built assembly of switchgear & control gear
- BIS 13947 (Part I) - Degree of protection for enclosure
- BIS 3842 - Specification for electrical relays for AC system

- BIS 13707 - Specification for HRC fuses
- BIS 5082 - Wrought Al. and Aluminium alloys, bars, rods, tube and sections for electrical purposes
- BIS 13947 (Part 1) - General requirement for switchgear & control gear for voltage not exceeding 1000V
- BIS 3231 - Electrical relays for power system protection

2.1.6 Motor Control Centre / Ventilation Sub-Panel

Motor control centre shall be floor mounted extendable type & Ventilation sub-panel shall be wall mounted type. The sheet steel (CRCA) used for fabrication shall be of 2.0mm for load bearing members and 1.6mm for non-load bearing members. The panels shall be supplied with required base channels. These panels shall be cubical sectionalized type, totally enclosed dust & vermin proof. Gaskets shall be provided in all joints to prevent dust to reach the internals of the panels to make it completely dust proof. The degree of protections for panels shall be IP 52 for indoor applications and IP 65 for outdoor applications as per IS:2147.

These panel (MV) shall be suitable for voltages up to 500 volts, three phase 50 Hz, 4 wire supply capable of functioning satisfactorily in temperature ranging up to 45 to 50 degree centigrade and rupturing capacity suitable for connected load & design should be type tested for 42 KA fault level. All joints of panels shall be welded and braced as necessary to provide a rigid support for all components. The base channel provided in the floor mounted MV panel shall be 100mm x 50mm x 6mm & a clear space of 200mm between the floor and the bottom most part of the unit shall be provided. The panel shall be correctly positioned. Self- threading screws shall not be used in the construction of control panels. Appropriate knock-out holes of proper sizes shall be provided for incoming and outgoing cables. The facility for bottom or top entry of cables in the panels shall be provided. Necessary cables clamps shall provided for holding the cables in position.

All power/control wiring inside the panel shall be colour coded and control wiring ferruled for identification purpose. All labeling shall be provided in engraved anodized aluminum strips on the front face of the panel.

Each circuit breaker shall be housed in separate compartments. It shall have steel sheets on top and bottom of compartment. The steel sheet hinged door shall be interlocked with the circuit breaker on the "ON" position. When the breaker is on the "ON" position, suitable preventive measures shall be provided, such as interlocks, to prevent the breaker from being drawn out. When the breaker is in "ON" position steel sheet shall be provided between the tiers in the vertical section. The door of this compartment shall not form part of the draw out arrangements.

2.1.7 Bus-Bars

The bus-bar and its connections shall be aluminum Electrolytic grade E-91 as per IS: 5082 and shall be of rectangular section. These should be suitable for full load current for phase bus-bar and neutral bus-bar shall be of half rated current capacity. The bus-bar should have provision on either side for extension. The bus-bar should be sleeved with colour coded heat shrinkable PVC sleeve. Bus-bar supports shall be of fibre glass reinforced thermosetting polyester having in built and tracking barriers to break the path of conducting dust through moulded ribs.

In panels bus-bar connections shall be done by drilling holes with cadmium coated bolts and nuts. Extra cross section shall be provided to compensate drilling of the holes. Insulated aluminum strips of suitable size of full rated current capacity shall be used for interconnecting bus-bar and breaker.

A horizontal / vertical wire way shall be provided for interconnecting control wiring between different vertical sections.

The terminal blocks shall be used for outgoing terminals and neutral link at a suitable located place in the control panel. Separate compartments for outgoing and incoming cable shall be provided. The current transformers of all instruments shall be mounted with terminal blocks.

All live parts including incoming and outgoing link / terminals should be totally shrouded by means of non hygroscopic and fire retardant material.

2.1.8 Air Circuit Breakers

The circuit breaker shall be capable of making and breaking the specified fault currents without straining or damaging any part of the switchgear. The breakers shall be air break, motorized / manually operated as specified in BOQ and draw out type. All feeders of rating 800A and above shall be ACB and of fully draw out type. The circuit breaker shall be stored energy closing type, manual/electrically operated with tripping mechanism. The circuit breaker shall be provided with 4 NO + 4 NC of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block. Circuit breakers with stored energy closing mechanism shall be capable of making the rated short-circuit current, when the stored energy is suitably charged by a spring. It shall also be capable of closing on no-load without suffering undue mechanical deterioration. The maximum make- time shall also not be exceeded.

The direction of motion of the handle, for manual spring charging shall be marked. A device indicating when the spring is charged fully shall also be provided. Motors and their electrically operated auxiliary equipment for charging a spring shall operate satisfactorily between 85% and 110% of the rated supply voltage. The breaker operating mechanism should store energy for O-C-O operation and shall not, in any case, get stuck in closed position during this cycle. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible. The breaker operating mechanism shall be electrically and mechanically trip-free in all positions.

All ACBs shall be provided with microprocessor based trip unit for protection against overload, short circuit and earth faults. The releases shall be communicable to other systems on an open communication protocol. The Communication Port shall be provided in front/back. The circuit breakers shall be suitable for locking in fully isolated condition.

Following interlocks and features shall be provided so that

- a) Truck can be moved within panel only when CB is off.
 - b) CB can be closed only when the test (or) service limit switches permits.
 - c) Breaker compartment door cannot be opened when the CB is in Service/test position.
 - d) Breaker cannot be put in to service position with compartment door open.
 - e) Earth slide beyond the test position till trolley is drawn out.
- Closing and tripping coil shall operate satisfactorily under the following conditions of supply voltage variation:
- a) Closing coils - 85% to 110% of rated voltage..
 - b) Trip coils - 70% to 110% of rated voltage.

2.1.9 Moulded Case Circuit Breakers

The MCCBs shall conform to the latest applicable standards. MCCBs in AC circuits shall be of four pole construction arranged for simultaneous four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator. Operating handle for operating MCCBs from door of board shall be provided. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings. MCCBs shall incorporate time delay devices to ensure that it will tolerate harmless transient overload unless this is well in excess of 25% of its rated value for a sustained period. The circuit breaker shall be provided with 2 NO + 2 NC of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block. The breaking capacity of MCCB's shall be as per the design requirements.

2.1.10 Miniature Circuit Breakers

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 230/415 VAC 50 Hz applications with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting be type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall

publish the values. The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar.

- 2.1.11 Rotary Switch / Selector Switch / Switches / HRC Fuses / Starters / Single Phase Preventers / Toggle Switch**
These shall be of approved make and conforming to relevant ISI standard. The rupturing capacity of HRC fuses should not less than 80 KA and in case of switches it should be 60 Amps maximum.
- 2.1.12 Current Transformer**
The current transformers shall have accuracy of class I and 5P10 / 10P10 and suitable VA burden for operation of the connected meters and relays.
- 2.1.13 Overload Relays**
All the motors shall have overload relay protections conforming to relevant IS.
- 2.1.14 Time Delay Relays**
These shall be adjustable type with time delay adjustments of 0-180 or as per manufacturers standards.
- 2.1.15 Indicating Lamps And Metering**
These shall conform to BS37 & BS39. All meters shall be flush mounted and draw-out type. The indicating lamp shall be filament type and with very low burden & economy resistor.
- 2.1.16 Voltmeter And Ammeters**
Motor Control Centre (MV Panel) shall have flush type voltmeter & ammeter of size 96 x 96 mm.
- 2.1.17 Push Button Stations**
These shall be suitable for panel mounting and accessible from front without opening. These shall be provided for manual starting and stopping of motors/equipments as per normal practices. The contacts shall be suitable for 6AMP current capacity.
- 2.1.18 Name Plate**
Suitable anodized Aluminium name plate of 1.2 mm thick shall be provided on all the Switchboards and individual compartments.
- 2.1.19 Conduits**
These shall be preferable made of mild steel, stove enameled from inside and outside with minimum wall thickness of 1.6 mm for conduits up to dia of 25mm and 2 mm for conduits above 25 mm diameter.
- 2.1.20 Cables**
Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.
The cables shall comply with the latest edition of the following standards
- BIS: 7098 (PART-I) - XLPE Cables - LT
 - BIS: 8130 - Conductors for insulated electric cables & flexible cords.
 - BIS: 3975 - Mild steel wires, strips & tapes for armouring of cables.
 - BIS: 10418 - Wooden drums for electric cables.
 - BIS: 10810 (PART 58) - Oxygen Index test
- The material of cable shall be as follows:-
- a) The MV power cable of 660/1100 V. grade shall be XLPE insulated Aluminium conductor armoured cable.
 - b) The MV control cables shall be PVC insulated copper conductor armoured stranded cable.

- c) The HT power cable of 11 KV grade shall be XLPE insulated Aluminium conductor armoured cable.

2.1.21 Laying Of Cables

These shall be laid as Indian Standard code of practice. All cables shall be laid on 16G GI Perforated U shaped Channel 40mm x 20mm cable trays. In case more than one cable is running, then proper space in between the two cables shall be provided to avoid loss of current carrying capacity. While cables are running on walls, proper saddles must be provided.

2.1.22 Wire Sizes

Single stand PVC-copper conductor wires shall be used inside the control panel for interconnecting different components. All wires shall be neatly dressed and coloured beads shall be provided for easy identification in control wiring. The minimum size of control wiring shall be 1.5sq.mm. Testing of panels as per code of practice shall be done at works by NCCF / Architect before inspection & dispatch to site.

2.1.23 Drawings

Necessary drawings of all control panels and wiring of equipment etc., shall be submitted by the bidder for approval of the Engineer in Charge. On final completion of job and before handing over of AC System As Built Drawings shall be submitted to the Department.

2.1.24 Testing

All equipment and components supplied may be subjected to inspection and tests by the client / consultant or his authorized representatives during manufacture, erection / installation and after completion. No tolerances shall be allowed other than the tolerances specified or permitted in the relevant approved Standards, unless otherwise stated. If the guaranteed performance of any item of equipment is not met and / or if any item fails to comply with the specification requirement in any respect whatsoever at any stage of manufacture, test or erection, the client / consultant may reject the item, or defective component thereof, whichever he considers necessary.

The complete electrical installation shall be tested in accordance with relevant IS codes in presence of Electrical Supervisor of the client before commissioning of plant.

2.1.25 Painting Of Panels

All sheet metal enclosures shall be powder coated only after de-rusting & hot-dip phosphating degreasing etc. at works only.

NOTE: Rubber mats of 1100 volts shall be laid in front of all switch boards.

2.1.26 Sizes Of Power Cabling

The following size of power cabling shall be used only :

	HP of Motors	Cable size
a)	Up to 5 HP	3c x 4sq.mm aluminium conductor armoured cable.
b)	5 to 7.5 HP	3c x 6sq.mm aluminium conductor armoured cable.
c)	10 to 15 HP	2no. 3c x 6sq.mm aluminum conductor armoured cable.
d)	20 to 25 HP	2 nos. 3 x 16sq.mm aluminum conductor armoured cable.
e)	30 to 35 HP	2 nos. 3c x 25sq.mm aluminum conductor armoured cable.
f)	40 to 50 HP	2 nos. 3c x 35sq.mm aluminum conductor armoured cable.
g)	60 HP	2 nos. 3c x 50sq.mm aluminum conductor armoured cable.
h)	75 HP	2 nos. 3cx 70sq.mm aluminum conductor armoured cable.
i)	100 HP	2 nos. 3cx 95sq.mm aluminum conductor armoured cable.
j)	125 HP	2 nos. 3cx 120sq.mm aluminum conductor armoured cable.

2.1.27 Capacity Of Relays And Contacts

The following capacity relays and contacts shall be used for various rating of motors:

Type of Starter Contactor Overload Relay

Contactor Phase Relay Range

a)	50/60 HP Motor	Star Delta Starter	70 Amp.	30 - 50 Amp.
b)	40 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
c)	30 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
d)	25 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
e)	20 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
f)	15 HP Motor	Star Delta Starter	25 Amp.	9-15 Amp.
g)	10 HP Motor	Star Delta Starter	16 Amp.	6-10 Amp.
h)	7.5 HP Motor	D.O.L. Starter	16 Amp.	9-15 Amp.
i)	5 HP Motor	D.O.L. Starter	16 Amp.	6-10 Amp.

2.1.28 Earthing

The earthing of all equipments shall be carried out by Copper strips / wires as mentioned in Bill of Quantities. All panels / three phase motors shall be earthed with two number distinct and independent Copper strips / wires of the following sizes:

1. Motor up to 5.5 KW	3 sq. mm Copper Wire	4 mm dia GI Wire
2. Motor 7.5 to 18.75 KW	4 sq. mm Copper Wire	6 mm dia GI Wire
3. Motor 18.75 to 50 KW	25x3 mm Copper Strip	25x6 mm GI Strip
4. Motor 51 to 89 KW	25x6 mm Copper Strip	32x6 mm GI Strip

The earthing connections shall be connected to main earth station or main earth grid. The earth connections shall be connected to equipments after removal of paint, grease etc.

3 SERVICES SPECIFICATION

3.1 Air Distribution

3.1.1 Scope of Works

The scope of this section comprises supply, fabrication, installation & testing of all sheet metal GI ducts as well as supply, installation, testing & balancing of all grills, diffusers & other accessories in accordance with these specification & Schedule of Quantities.

3.1.2 GI Duct (Site Fabricated)

- a) All ducts shall be fabricated either from Galvanized Sheet Steel (GSS) conforming to IS: 277 or aluminum sheets conforming to IS:737. The steel sheets shall be hot dip galvanized with coating of minimum 120 grams per square meter (GSM) of Zinc.
- b) The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

Longest side (mm)	Minimum sheet thickness	
	For GSS	For Aluminum
750 mm and below	0.63	0.80
751 mm to 1500 mm	0.80	1.00
1501 mm to 2250 mm	1.00	1.50
2251 mm & above	1.25	1.80

- c) All sheet metal connections, partitions and plenums required for flow of air through the filters, fans etc. shall be at least 1.25 mm thick galvanized steel sheets, in case of G.I. sheet ducting or 1.8 mm thick aluminium sheet, in case of aluminium sheet ducting and shall be stiffened with 25 mm x 25 mm x 3 mm angle iron braces.
- d) Circular ducts, where provided shall be of thickness as specified in IS: 655 as amended up to date.
- e) Aluminium ducting shall normally be used for clean room applications, hospitals works and wherever high cleanliness standards are functional requirements.

3.1.3 Associated Items For Duct

- a) Jet nozzles/Eye ball suitable for long throw distance with optimum acoustic properties, preferably used for heating and cooling in critical areas. The adjustment facilities – manual or automatic. The adjustment can be rotated through 360°. The material of eye ball is aluminium and mounting for the eyeball is with two plastic rings colour white. The connection element and saddle connection are in galvanized sheet steel. The surface can be pre-treated and powder coated.

- b) Supply/return air outlets F.A. grilles and accessories shall be constructed from extruded aluminium sections.
- c) Flanges for matching duct sections, stiffening angels (braces) and supporting angles shall be of rolled steel sections, and shall be of the following sizes.

Application	Duct Width	Angle Size
Flanges	Up to 1000 mm	35mm × 35mm × 3mm
-do-	1001 mm to 2250 mm	40mm × 40mm × 3mm
-do-	More than 2250 mm	50mm × 50mm × 3mm
Bracings	Up to 1000 mm	25mm × 25mm × 3mm
-do-	More than 1000 mm	40mm × 40mm × 3mm
Support angels	Up to 1000 mm	40mm × 40mm × 3mm
-do-	1001 mm to 2250 mm	40mm × 40mm × 3mm
-do-	More than 2250 mm	Size and type of RS section shall be decided in individual cases

- d) Hanger rods shall be of mild steel and of at least 10 mm dia for ducts up to 2250 mm size, and 12 mm dia for larger sizes. All ducts shall be supported from the ceiling / slab by means of MS rods of dia (10-12) mm fully threaded with MS angle at the bottom with neoprene pad in between the duct & MS angle. The ducts shall be suspended from the ceiling with the help of dash fasteners. The bidder shall arrange provision for necessary ancillary materials required for hanging the ducts.
- e) All nuts, bolts and washers shall be zinc plated steel. All rivets shall be galvanized or shall be made of magnesium - aluminium alloy. Self tapping screws shall not be used.
- f) The vanes shall be provided wherever required and shall be securely fastened to prevent noise & vibration.
- g) The rubber gasket shall be installed between duct flanges in all connections and joints.
- h) All flanges and supports should be primer coated.
- i) The flexible joints shall be fitted to the delivery side of AHU fans with Fire Retardant Double canvass. The length of flexible joints should not be less than 150 mm and not more than 300 mm between faces.
- j) The ducting work can be modified if deemed necessary in consultation with the Engineer in Charge to suit actual site conditions in the building.

3.1.4 Construction Of Duct

- a) Ducts shall be fabricated at site or factory fabricated and shall be generally as per IS: 655 “Specifications for metal air ducts”. Unless otherwise deviated in these General Specifications.
- b) The interior surfaces of the ducting shall be smooth.
- c) All the ducts up to 600 mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600 mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300 mm centres for ducts upto 600 longest side, and 100 mm centres for ducts above 600 mm size shall be provided for stiffening.
- d) As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.
- e) Flanged joints shall be used at intervals not exceeding 2500mm. Flanged shall be welded at corners first and then riveted to the duct.
- f) Stiffening angels shall be fixed to the sides of the ducts by riveting at 1.25 meters from joints for ducts of size 600 mm to 1500 mm, and 0.6 mm form joints for ducts of size larger than 1500mm. Bracings for ducts larger than 1500mm can alternatively be by diagonal angels.
- g) Plenums for filters shall be complete with suitable access door of size 450mm × 450mm.

3.1.5 Box Type Dampers & Splitters

These dampers shall be provided in the ducting work for proper control and balancing of air distribution. All dampers shall be louver type robust construction. These dampers shall be fitted with easily accessible operating mechanism, complete with links, levers, quadrant for proper control and setting in a desired position. The position of the handle of the damper operating mechanism shall be clearly visible and shall indicate the position of the damper in the duct. All dampers, splitters shall be fabricated out of G.S. sheet of two gauges higher than the duct piece having these fittings. Dampers shall be installed in duct at all required locations. No extra payment shall be made separately since these form part of Air Circulation System.

NOTE: In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the bidder shall support the ducts with M.S flats of at least double the thickness of the angle iron supports.

3.1.6 Supply / Return Air Grills & Ceiling Diffusers

Grilles and diffuser constructed of extruded aluminium sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grills and diffusers shall have a rear set of adjustable blades, perpendicular to the face blades for deflection purpose.

All grills / diffusers shall have soft continuous rubber / foam gasket between the periphery of the grills / diffusers and surface on which it has to be mounted. The colour of grills / diffuser shall be as per the approval of the Engineer in Charge.

a) Rectangular / Square / Linear Supply And Return Grills

Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shooter side to achieve horizontal spread air pattern to at least 45 degrees. Fixed bar linear air grills shall have only front louvers. The outer framework to the grills shall be made of not less than 1.6 mm thick aluminium sheet. The louvers shall be of aerofoil design of extruded aluminium section with minimum thickness of 0.8 mm at front and shall be made of 0.8 mm thick aluminium sheet. Louvers may be spaced 18 mm apart.

b) Square / Rectangular Ceiling Diffusers

Square and rectangular ceiling air diffusers shall have a flanged flush with the ceiling into which it is fitted or shall be of anti smudge type the outlets shall comprise and outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6mm thick extruded section aluminium sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminium section.

c) Circular Ceiling Diffusers

Circular ceiling diffusers shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

d) Linear Slot Diffusers

Linear diffuser shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

e) Laminar Supply Air Diffusers

Laminar supply air diffusers shall be made of 2 mm thick powder coated aluminum sheet duly insulated with 5 mm thick closed cell polyethylene foam insulation having factory laminated aluminium foil and joints covered with self adhesive aluminium taps and having holes 2/3 mm dia including frame work.

f) Volume Control Device

All supply air outlets shall be fitted with a volume control device, made of extruded aluminium gate section. The blades of the device shall be mill finish/block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied spaces without removing any access panel. The volume control device for circular outlets shall be opposed blade radial/shutter type dampers, or two or more butterfly dampers in conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/wall outlets and intakes.

3.1.7 Fresh Air Intake Louvers With Bird Screen

The fresh air intake louvers at least 50mm deep will be made of powder coated extruded aluminum construction. A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens. The blades shall be inclined at 45 degree on a 40mm blade pitch to minimize water ingress. The lowest blade of the assembly shall be extended out slightly to facilitate disposal of rain water without falling on door / wall on which it is mounted. Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/vibrating of the louvers, at not more than 750mm centres where the louver’s length in longer than 750mm. The intake louvers shall be provided with factory fitted volume control dampers in black finish.

3.1.8 Painting

All ducts collar / shoot behind the grills / diffuser shall be given at least two coats oil black enamel paints.

3.1.9 Testing

The complete duct system shall be tested for air leakage & complete air distribution system shall be balanced in accordance with air quantities indicated on the approved drawing.

3.1.10 Factory Fabricated Ducting

3.1.10.1 General

Ducting work shall mean all ducts, casing, dampers, access doors, joints, stiffeners and hangers.

3.1.10.2 Governing Standards

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA - 1995 standards (“HVAC Duct Construction Standards - Metal and Flexible - Second Edition - 1995” - SMACNA).

3.1.10.3 Duct Materials

The duct shall be fabricated from Lock Forming Quality (LFO) grade galvanized steel sheets with 120 gms / sq.m galvanizing (total coating on both sides) on the sheets. All ducts wherever specified, shall be factory fabricated in box sections from G.I. continuous coils with all suitable joints, supports, sealing arrangements etc. The thickness of galva

nized sheet and type of flange class at 1200 mm spacing shall be as follows:-

Size of Duct	Sheet Thickness	Type of Flange
Up to 450 mm	0.50 mm	C&S cleats
450 mm to 750 mm	0.50 mm	Type E
Size of Duct	Sheet Thickness	Type of Flange
751 mm to 1000 mm	0.63 mm	Type E
1001 mm to 1500 mm	0.63 mm	Type H
1501 mm to 1800 mm	0.80 mm	Type H
1801 mm to 2100 mm	1.00 mm	Type J
2101 mm and above	1.00 mm	Type J

The gauges, joints and bracings for sheet metal ducting work shall further conform to the provision as shown on the drawings.

Ducts larger than 600 mm shall be cross broken or straight beaded. Duct sections upto 1200 mm length may be used with bracing angles omitted.

Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the engineer - In - Charge.

All ducts shall be supported from the ceiling / slab by means of fully threaded GI rods of 8 mm – 12 mm dia, with M.S. slotted double – C channel of 3.0 mm thickness at the bottom. The rods shall be anchored to R.C. slab using metallic expansion fasteners.

3.1.10.4 Installation

During the construction, the bidder shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of engineer - In - Charge.

Great care should be taken to ensure that the ducting work does not extend outside and beyond height limits as noted on the drawings.

All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

The ducts shall be reinforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence.

Turning vanes shall be securely fastened to prevent noise of vibration.

The ducting work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the engineer - In - Charge. The bidder shall verify all measurements at site and shall notify the engineer - In - Charge. The bidder shall verify all measurements at site and shall notify the engineer - In - Charge of any difficulty in carrying out his work before fabrication.

Self adhesive sponge rubber / PVC gaskets of 6 mm maximum thickness shall be installed between duct flanges as well as between all connection of sheet metal ducts to walls, floor column, heater casing and filter casings. Sheet metal connections shall be made to walls and floor by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.

Flanges, bracing and supports shall be galvanized steel. The connection shall be 4 bolts slip on type flange system with sealant injected within the flanges. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

Joints, seams, sleeves, splitter, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineers -in -Charge.

Hexagon nuts and bolts, stove bolts or buck bolts, rivets, or closed center top rivets, or spot welding may fix joints requiring bolting or riveting. Self tapping screws must not be used .All jointing materials must have a finish such as cadmium plating or galvanized as appropriate.

Fire retarding non- porous, vermin proof flexible joints are to be fitted to the suction and delivery of fans. The material is to be normally double heavy canvas or as directed by Engineer-in-Charge .On all circular spigots the flexible materials are to be screws or clip band with adjacent screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.

The flexible joints are to not less than 75 MM and not more than 250 MM between faces.

The duct work should be carried out in a manner and at such times as not to hinder or delay the work of the other agencies especially the boxing or false ceiling bidders.

Duct passing through brick or masonry, wooden frames work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

3.1.10.5 Dampers**Splitter Dampers**

At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than the gauge of the large duct and shall be rigid in construction.

The dampers shall be of an approved type, lever operated and complete with locking devices, which will permit the dampers to be adjusted and locked in any positions, and clearly indicating the damper position.

The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 mm (18) Gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm. Angle shall not interfere with the operation of dampers, nor cause any turbulence.

3.1.10.6 Opposed Blade Dampers

Automatic and manual volume opposed blade dampers shall be complete with frames and nylon bush as per drawings. Dampers and frames shall be constructed of 1.6 mm steel sheets and blades shall be of extruded aluminium of aerofoil design. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with the mesh.

Wherever required for system balancing, a balancing opposed blade damper with quadrant and thumb screw lock shall be provided.

After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.

3.1.10.7 Access panel

A hinged and gasketed double skin, factory fabricated access panel measuring at least 450 mm x 450 mm shall be provided on duct work before each fire damper and at each control device that may be located inside the duct work.

3.1.10.8 Miscellaneous

All duct work joints are to be true right angle and with all sharp edges removed.

Sponge rubber gaskets also to be provided behind the flange of all grilles.

Each chute from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by engineer - In - Charge.

The ducts should be routed directly with a minimum of directional change.

All edges shall be machine treated using lock formers, flanges and rollers.

All the flanges shall be connected to the GSS ducts by rivets at 100 mm centres.

The ducts should be supported by approved type supports at a distance not exceeding 2.0 meters

3.2 Refrigerant Piping**3.2.1 Scope of Works**

The scope of this section comprises supply, installation, testing & commissioning of refrigerant piping as detailed below in specifications.

3.2.2 Refrigerant Piping

All refrigerant piping for the air conditioning system shall be constructed from soft seamless up to 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by

passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 20Kg per sq.cm and 10 Kg per sq.cm (low side). Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg and held for 24 hours.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than 20gauge for pipes up to 19.1mm and 18 gauge for bigger sizes

The suction line pipe size and the liquid line pipe size shall be selected according to the manufacturers specified outside diameter. All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

The OD & wall thickness size of copper refrigerant piping shall be as per VRV / VRF manufacturer standard. **The pipe thicknesses given below are minimum.**

Outside Diameter (mm)	Wall Thickness (MM)
a) 50.8	1.64
b) 44.5	1.64
c) 41.3	1.43
d) 34.9	1.21
e) 28.6	1.0
f) 25.3	0.8
g) 22.2	0.8
h) 19.1	0.8
i) 15.9	0.8
j) 12.7	0.8
k) 9.5	0.8
l) 6.4	0.8

3.3 Insulation / Lining Work

3.3.1 Scope of Works

The scope of this section comprises supply & fixing of thermal / acoustic insulation of ducts, pipes etc. as per the specification given below & in accordance with Schedule of Quantities.

3.3.2 Material & Process of Acoustic Insulation of Duct / AHU Room

a) Resin Bonded Fibre Glass Wool

The Thermal conductivity values in W/m.K of fibre glass shall confirm to following:

Mean Temperature P ⁰ PC	Density In Kg / Cmt.	Thermal W/m.k	Conductivity
25P ⁰ PC	32/48	0.030	

Acoustic Lining of Duct

The material to be used for duct lining shall be 12 / 25 mm thick resin bonded fibre glass rigid board having a density of 48 Kg/m³ & covered with 0.5 mm thick perforated aluminum sheet. The lining of initial length of the duct shall be done as shown in the tender layout drawings & shall be carried out as follows.

- a) Clean the duct piece thoroughly,
- b) Fix the board of suitable thickness inside the duct & cover with fibre glass tissue paper.

- c) Cover the insulation board with 0.5mm thick perforated aluminum sheet with atleast 20% perforation.
- d) Secure the insulation board & aluminum sheet with cadmium coated bolts nuts & cup washers / steel screws.
- f) Finally seal the ends completely, so that no lining material is exposed.

Acoustic Lining of AHU Room

The four walls and ceiling of AHU Rooms shall be provided with acoustic lining of thermal insulation as per following specifications & as specified in the Schedule of Quantities.

- a) Clean the surface.
- b) A 610 x 610 mm frame work of 25 x 50 x 50 x 50 x 50 x 25 mm 'U' shape channel made of 0.6 mm. thick G.S.S. shall be fixed on to walls by means of rawl plug in walls & dash fasteners in ceiling. Before fixing channel shall be filled with fibre glass.
- c) Fix the resin bonded glass wool having density of 32 Kg/cmt.in the frame.
- d) Finally, finish it by covering the surface with 0.5 mm thick perforated aluminium sheet with brass screws. Before fixing aluminium sheet, fibre glass tissue paper must be sandwiched.
- e) All horizontal and vertical joints shall be covered with at least 25 mm. wide, 1mm aluminium strips held in position by steel or brass screws.

3.3.3 Material & Process of Thermal Insulation of Duct Material

- Insulation material shall be Closed Cell Elastomeric Nitrile Rubber.
- Density of Material shall be between 50+/-10% Kg/mP^{3P}.
- Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 W/mP^{0PK} at an average temperature of 0P^{0PC}.
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990.
- Water vapour permeability shall not exceed 0.017 Perm inch (2.48 x 10⁻¹⁴ Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 7000.

Thickness of the insulation shall be as specified for the individual application.

Unexposed Duct Insulation

External thermal insulation shall be provided as per following:

The thickness of the nitrile rubber shall be as given in the table below. Following installation procedure should be adopted:

- Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
- Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
- Material shall be fitted under compression and no stretching of material should be allowed.
- A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The adhesive shall be strictly as recommended by the manufacturer.
- The detailed Application specifications are as per the manufacturer's recommendation.

Exposed Duct Insulation

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer’s recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection. FRP coating should be provided for protection from sun light.

Recommended Adhesive

In all cases, the manufacturer’s recommended Adhesive (SR-998) should be used for the specified purpose.

Installation Exposed Directly to Sunlight

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer’s recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection. FRP coating should be provided for protection from sun light.

Parameters for Selection of Thickness

- a) Design Basis: Condensation Control
- b) Region: Non Costal Area
- c) Application: Outdoor & Indoor
- d) Design Conditions: 30 Deg. C & 82 % RH

Thickness of Insulation

- a) Refrigerant Pipe Line Temperature 3.0 Deg. C
 - Up To 9.5 mm Pipe Size - 19 mm Thick Insulation
 - Above 9.5 mm & Up To 22.2 mm Pipe Size - 25 mm Thick Insulation
 - Above 22.2 mm & Up To 41.3 mm Pipe Size - 32 mm Thick Insulation
- d) Duct Insulation
 - Supply Air Duct (Line Temperature 14 Deg. C) - 19 mm Thick Insulation
 - Return Air Duct (Line Temperature 22 Deg. C) - 19 mm Thick Insulation
 - Supply Air Duct (Exposed to Atmosphere) - 25 mm Thick Insulation

3.4 Condensate Drain Piping Work

3.4.1 Scope of Works

The scope of this section comprises supply, installation, testing & commissioning of drain water pipes, pipe fittings and valves etc. as detailed below in specifications. All pipes, fittings and valves etc. shall conform to relevant Indian standards.

3.4.2 Drain Water Piping

The pipes, fittings and valves shall be of approved make given in the tender.
 Drain water / make up water pipes shall be "B" Class GI Pipe & shall Conform to IS: 4736.
 The pipes shall be sized for individual liquid flow & shall ensure smooth noiseless balanced circulation of fluid.
 All piping and their steel supports shall be thoroughly cleaned and primer coated before installation.

3.4.3 Pipe Fittings

The pipe fittings for screwed piping shall be malleable iron and for piping with welded joints shall of weldable quality. Also the fittings shall be suitable for same pressure ratings as for the piping system.
 All bends up to sizes 150 mm dia shall be ready made of heavy duty wrought steel of appropriate class.
 All bends in sizes 200 mm and above shall be fabricated from the same dia and thickness of pipe in at least four sections and having a center in radius of at least 1.5 times diameter of pipes. Fittings such as tees, reducers etc. shall be fabricated from the same pipe and its length shall be at least twice the diameter of the pipe.

The dead ends shall be formed with flanged joints & shall have 6mm thick blank between flange pair for 150 mm and over.

3.4.4 Flanges

All flanges shall be of mild steel as per IS : 6392 / 71 (with latest amendments) & shall be slip on type welded to the pipes. Flanged thickness shall be to suit Class II pressure. 3 mm thick gasket shall be used in between the flanges.

Flanged pair shall be used on all such equipments which are required to be isolated or removed for service for example condenser / chilled water pumps, chilling m/c, AHU etc.

3.4.5 Installation of Water Piping

a) All pipes shall be securely supported or suspended on stands, hangers, clamps etc. as required. The Air-conditioning bidder shall design all brackets, saddles, anchors, clamps etc. & shall be responsible for structural adequacy.

b) All pipe supports shall be of steel, coated with two coats of anti-corrosive paint and finally finished with paint.

c) The pipe spacing shall be as follows :

Dia of Pipe	Spacing between supports
Up to 25mm	1.5 mt
30 mm to 50 mm	2.0 mt
65 mm to 75 mm	2.5 mt
100 mm to 125 mm	3.0 mt
150 mm	3.5 mt
200 mm & above	4.0 mt

d) The vertical rises shall run parallel to walls and should be straight to wall duly checked with plumb line.

e) In case pipes with/ without insulation while passing through the wall / slab, shall be provided with sleeve 50mm higher in size than the pipe with / without insulation.

f) Wherever insulated pipes are running, it should be supported in such a way that no undue pressure is exerted on the insulated pipe.

g) The expansion-joints or expansion-loops shall be provided to take care of the expansion and contraction in pipes due to temperature rises.

3.4.6 Testing of Pipe System

a) All tools, tackles, labours etc. shall be arranged by A/C Bidder.

b) All pipes shall be tested hydraulically at 1.5 times the maximum operating pressure for a period of 24 hours. All leaks occurring during testing shall be rectified to the satisfaction of the Engineer in Charge. After repairs of leak it shall be tested again at the same pressure.

c) In case piping is tested in parts, these sections shall be securely sealed and capped during testing.

d) The A/C Bidder should ensure that there should be minimum vibration / noise in the chilled water / condenser water circuit due to water turbulence.

3.4.7 Air-Vents

Air vents for purging of air trapped in piping system shall be provided at the highest point. Globe valves of the size as indicated below shall be provided & **no additional price shall be paid.**

Pipe Size	Valve Size
Upto 100mm	25mm dia
Above 100mm to 300mm	40mm dia

4 MODE OF MEASUREMENT

The following measurement code shall apply to the Contract:

4.1 Sheet Metal Work**4.1.1 Ducting**

- a) The final finished sheet area in sq. mt shall be measured only.
- b) Vanes, splitters, flanges, access doors etc. shall not be separately measured. These shall be treated as part of duct work.
- c) Bends, Elbows, Transformation, pieces etc. shall be measured along the centre line and measured as per duct work.
- d) Canvas connections, Duct Supports, Stiffening members, frames etc. shall not be measured separately and shall form part of duct work / equipment.

4.1.2 Grills / Diffusers / Fire Dampers

All Grills / Diffusers / Fire Damper areas will be measured in terms of effective area (Neck Area). Any Extruded aluminum grill / diffusers having an area less than 0.1 sq.mt shall be accounted as 0.1 sq.mt.

4.1.3 Box Dampers

- a) Duct dampers shall be measured in Sq. Mt. in terms of effective area.
- b) Fresh air dampers shall be measured as effective areas only. No separate measurements for bird screen inlet / outlet louvers shall be done.

4.2 Piping Work

- a) The length of piping accessories & fittings shall be measured along its centre line in meters and no measurements for bends, elbows, tees etc. shall be made. All such fittings / accessories shall be treated as part of the piping work.
- b) Flanges shall not be measured, as they form part of piping work.
- c) For thermometer wells & pressure gauge sockets no measurement shall be done separately.
- d) All kinds of supports, hangers etc shall be part of piping work & no extra measurements shall be done.
- e) No additional price for installation of purge & de-scaling valves as required at site shall be paid.

4.3 Insulation**4.3.1 Insulation of Duct**

This shall be measured on the basis of bare duct surface area i.e. the area of duct insulation & area of duct shall be same.

4.3.2 Insulation of Chilled Water / Drain Water Pipes.

- i) Insulation of pipes shall be measured in terms of linear length of pipe for each size.
- ii) For insulation of bends, elbows, tees etc. it shall be measured along with the center line of insulation and shall be measured in meters.
- iii) Insulation of valves shall be separately accounted as per bill of quantities.

4.3.3 Insulation of Chiller / Expansion Tank / Suction Line

The insulation of the above equipments shall be deemed to form part of equipment and no separate measurements for insulation of such items will be accounted for.

4.3.4 Acoustic Lining of Duct & Plenum

This shall be measured on the basis of bare duct surface area i.e. the area of duct lining & area of duct shall be same.

4.4 Electrical Cabling Work

- a) All power cables / controls cables shall be measured on linear basis in meters.
- b) No extra price shall be paid on account of end termination of cables which includes thimble, gland etc.

4.5 Structural Supports

No extra price shall be paid on account of structural supports required for piping, ducting & cabling work.

Note:- The items not specified above or not specified in BOQ & Specification but technically required shall be part of that particular equipment / material.

4.6 Flexible Pipe Connector

Flexible pipe connector wherever required are part of the equipment & are specified in BOQ with the equipment. No extra price shall be paid on account of this.

6.10 TECHNICAL SPECIFICATION OF FIRE FIGHTING SYSTEM, STP & WTP

1 **TECHNICAL SPECIFICATION**

The work shall be executed as per CPWD's general specification for Electrical Works Part-I (Internal) 2013, Part-II (External) 2007, Part-IV (Sub-station) 2013, Part-V (Wet Riser and Sprinkler System for Fire Fighting Installation) 2006, Part-VI (Fire Alarm System), Part-VII (DG Set) 2013, Part-VIII (Gas Based Fire Extinguishing System) 2013 and CPWD General Specification for Electrical Works (Part III Lifts & Escalators-2003) IE Rules, Indian Standards amended upto date and as per direction of NCCF. The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply. Work under this sub-head consists of furnishing all Labor, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the followings:

- Providing M.S. black steel (Class C) pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Painting of pipe and Making Connection to supply system.
- Black Steel Pipe, Mains Laterals, Branches, Valves, Hangers and Appurtenances.
- Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets, Sprinkler heads and Landing Valves.
- Portable Fire Extinguishers
- Fire Fighting Pumps, diesel operated pumps, panels and all connected accessories including suction & delivery pipes.
- Testing Commissioning and giving live demonstrations to the various Inspection Authorities and Obtain their "No Objection Certificate" (NOC) for occupation of the building.

2 **GENERAL REQUIREMENTS**

All materials shall be of the best quality conforming to the Specifications and subject to the approval of the NCCF

Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in shaft, passage etc.

Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.

Valves and other appurtenance shall be so located that they are easily accessible for operation, repairs and maintenance.

3 **PIPES**

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:

- Pipes 150 mm dia and below IS: 1239 (Class C) Heavy Class
- Pipe 200 mm dia and above IS 3589 of thickness specified.

4 **PIPE FITTINGS**

Fittings should be follows codes below:

- ASME/ANSI B-31.1 - Power Piping
- ASME/ANSI B-31.3 - Process Piping
- ASME/ANSI B-31.9 - Building Piping Services
- ASTM F-1476 Couplings
- ASTM F-1548 Fittings
- ANSI/NSF Standard 61 for potable water service

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality. The pipe fittings are of GROOVED Design and joined by use of Mechanical Grooved Couplings and nowhere should the onsite welding has to be used in the pipe and fitting jointing.

Fabricated fittings shall not be permitted.

Pressure should be follows as below:

Union at every joint

- Pressure ratings of 500 psig
- Variety of gasket materials available
 - E- EPDM (-34 °C to +120 °C) for Water
 - D- NBR (-29 °C to 82 °C) for Petroleum/ Oils
 - S- Silicon Rubber (-40 °C to 177 °C) for
 - Dry Air/ some chemical products

When used, they shall be fabricated, welded and inspected in workshops undersupervision of Engineer-in-Charge whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

5 **JOINTING**

5.1 **Grooved Coupling**

Joint for black steel pipes and fittings shall be metal-to-metal Grooved Coupling Joints. No LEAD to be used for lubrication purpose. Joints shall not be welded or caulked.

The pipes have to be Grooved onsite with manufacturer recommended Grooving Machine and Roll Sets.

5.2 **Flanges**

Flanged joints shall be provided on:

- Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of with 3 mm insertion neoprene gasket complete.

5.3 **Unions**

No need of separate unions as the Grooved Coupling System is a Union at each joint.

6 **PIPE PROTECTION**

All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.

All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.

7 **PIPE SUPPORTS**

All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.

Where inserts are not provided, the Bidder shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

8 TESTING

All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 kg/cm² without drop in the pressure for at least 2 hours. Rectify all leakages, make adjustment and retest as required.

9 ANCHOR BLOCK

Bidder shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

10 VALVES**10.1 Valves, Gauge and Orifice Plates**

Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves up to 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 kg/cm² class-II as per I.S: 778-1971. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.

Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

11 EXTERNAL YARD HYDRANTS

The Bidder shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S of size 76.8 x 61.44 x 25.80 cm, as approved by the Architect to equip 2 nos. of 63 mm dia controlled percolating hose and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the Engineer-in-Charge/Architect.

12 INTERNAL HYDRANTS

The Internal Hydrant outlet shall comprise "Single Headed Single Outlet SS Landing Valve" conforming to type 'A' of IS: 5290-1977. Separate valve on the head shall form part of the landing valve construction.

A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.

The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

13 FIRST-AID HOSE REEL EQUIPMENT

First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall conform to IS:1532-1969.

The hose tubing shall be 20 mm dia and 36.5m long. The GM nozzle 5mm and globe valve shall be of 20 mm size.

The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the MS pipe riser taken independently from ring.

14 HOSE PIPES, BRANCH PIPES AND NOZZLES**14.1 Hose Pipes**

Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall conform to type A (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

15 BRANCH PIPE

15.1 Branch Pipes

Branch pipe shall be of Gunmetal 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

15.2 Nozzle

The nozzle shall be of Gunmetal 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

16 HOSE CABINET

The internal hose cabinet shall accommodate the Hose pipes, branch pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge MS/aluminum sheet. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

The hose cabinet shall be painted red and stove enameled and words FIRE written in front glazed portion.

17 FIRE BRIGADE INLET CONNECTIONS

Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified, for the following purposes:

- Fire Brigade suction connection for fire static tank with provision of foot valve.
- Fire brigade inlet connection to fire static tank.
- Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of Sluice valve and Non return valve.

The locations of this Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

18 HYDRAULIC SIREN

A siren shall be provided in the system, to indicate the flow of water in the wet riser system. Alternative arrangements may also be adopted. This shall be turbine type.

19 VALVE CHAMBERS

Bidder shall provide suitable Brick Masonry Chamber in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

Valve chambers shall be of following size:

- For depths 100 cm and beyond 90x90x100 cm

20 PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per the drawing and shall confirm to IS:2190-1979.

- Two 9 lit. water CO2 type for every 600 m2 area with minimum of 1 extinguishers per floor as per (IS:15683)
- Dry Chemical powder type of 6 Kg. Capacity as per (IS:15683)
- CO2 type of 4.5 kg capacity as per (IS: 15683).

21 SPRINKLER HEADS

Sprinkler heads shall be provided at approximate spacing to cover 9 to 12 m² per Sprinkler head. The spacing shall however, be in conformity with the drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling.

Sprinkler heads shall be chrome finished Brass/Gunmetal with quartz bulb with a temperature rating of 68°C. Sprinkler heads shall be of type and quality approved by the local fire brigade authority. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special application side wall Sprinkler types as shown in drawings. All Sprinklers should have the Specifications.

Bidder shall supply spare Sprinkler Heads of each type as per requirement and one Spanner for each type of sprinkler neatly installed in a steel box with glass shutters at locations approved by the NCCF

22 ALARM VALVE & AUTOMATIC WATER MOTOR GONG VALVE

The alarm valve & water motor gong valve UL approved shall be provided on the Sprinkler main delivery pipe complete in all respects.

23 SHOP DRAWINGS & SPECIFICATIONS

The Bidder shall submit to the Engineer-in-Charge two copies of Shop Drawings for Fire Fighting works for approval before start of work. Subsequent to the approval of the shop drawings, the Bidder shall submit six copies of Shop Drawings for execution to the NCCF Also the Bidder shall submit four copies of the Technical Specifications and Catalogues.

Shop drawings shall be submitted for the following conditions:

- Structural supports/hanging/laying and jointing details for all types of pipes as required.
- Fire Fighting layout plans as required and for any changes in the layout of Fire Fighting/Architectural drawings.

The Bidder can only commence the work after the approval of above documents by Engineer-in-Charge

SPECIFICATION OF SEWAGE TREATMENT PLANT (STP)**24 SCOPE****24.1 Work under this Contract consists of**

Detailed engineering design of all plan areas, section, Civil, Structural, mechanical, electrical and piping systems according to the current and applicable BIS codes as applicable. The proposed plans of the STP shall be subject to the approval of the Architect / Consultant.

Design, manufacture, assembly, installation, testing and commissioning of the main treatment units in RCC tanks, mechanical equipment for the packaged type Sewage Treatment Plant (STP) of capacity and design parameters given in BOQ & specifications broadly comprising of :

-
- Diffused aeration system comprising of non-metallic piping submerged diffusers to be provided in the RCC equalization tank, **MBBR unit**, and sludge holding tank
- Twin lobe air blowers with belt drive, electrical motors, piping headers, piping connections to all units.
- Pumping sets from equalization tank to STP, effluent, post filtration and final effluent disposal pumps as per design requirements.
- Final effluent pressure filters, softener pumps for final disposal /reuse.
- Motor control centers, cabling from MCC to all units, all instrumentation, and measuring devices and earthing of equipment. All electrical works to be carried out guidelines as per detailed annexure enclosed.
- Instrumentation and chemical test kit as specified.

Drain channel, sump with a drainage submersible pump (1 working + 1 standby) with pipe work, valves and discharge pipe up to nearest external manhole in plant room shall be provided by others.

Provide PH Meter, Electronic magnetic flow meter in inlet & outlet of filtration system

24.2 The Work Includes

- Civil, Mechanical & Electrical works
- Piping as specified.
- Testing, commissioning and operation of plant with water and under load conditions.

Construction of all architectural, civil and structural works related to the construction of the building, its internal lighting, sludge disposal system.

Incoming power connection, electrification of pump house.

Incoming sewer / rising main connection to the plant.

Connection from final effluent tank / pump to point of use for reuse or for disposal in accordance with approval of the State Board for Prevention and Control of Pollution.

24.3 Bidder's Experience

Bidder quoting for the work shall be an experienced specialize bidder engaged in the design, manufacture and execution of STP of similar types and must have completed at least 5 plants of similar or larger size in the last 5 years.

Each offer must accompany a list of plants planned, constructed, executed and are in operation for at least 12 months given: -

- Owner's name, address, telephones and faxes nos.
- Architects/Consultants name, Address, Telephone & fax nos.
- Type of load (Domestic and Industrial)
- Average daily flow, BOD and other information of plant.

24.4 Shop Drawings

The bidder shall submit shop drawings as follows:

- On award of the work, he shall submit GA drawing, PIB diagrams, plant layout with basic dimensions, flow diagram with levels of elements.
- Fabrication and equipment layout piping, valves and all other information required for installation.
- Electrical layouts, detail of all MCC, cable sizing and system diagrams and ear thing system.
- Piping layout with pipe dia. slopes, fixing arrangements.
- Three copies of the shop drawings shall be submitted for initial scrutiny. On approval of the same bidder shall submit six copies of the same incorporating corrections etc. Two sets will be stamped "GOOD FOR CONSTRUCTION" by the Consultant and returned to the bidder.

24.5 Other Submittals

Bidder shall furnish four sets of folders giving:

- Catalogues and technical information sheets of equipment to be installed.
- Performance curves, foundation details and fixing arrangements.

Bidders proposal for testing procedures for individual equipment and for overall testing of the plant.

Submittals shall be separate for:

- Mechanical and Piping works
- Electrical Works

All shop drawings and submittals mentioned above shall be approved by Architect and two sets duly stamped shall be returned to the bidder for execution of the works.

24.6 Execution of Work

All work shall be executed only in accordance with the approved shop drawings and other submittals. Bidder shall ensure that all inserts, support plates, puddle flanges and other items required to be incorporated during execution shall be placed in position as per his own requirements during execution of the works.

All special tools and tackle required for erection and assembly of the equipment covered by the contract shall be obtained by the bidder himself. All other materials such as foundation bolt

nuts, etc. required for the installation of the plant and equipment shall be supplied by the bidder and are part of the contract.

24.7 Testing & Handing Over

The bidder shall carryout tests on different equipment as required in the presence of the Consultant or his representative in order to enable him to determine whether the plant, equipment and installation comply with the specifications, local codes and in accordance with the letter and intents of the specifications.

The installation shall be handed over to the Engineer-in-Charge only on successful completion, operational tests and acceptance of the effluent quality by the municipal/ pollution control and statutory authorities.

24.8 Statutory Permissions

Bidder shall submit a write-up of process of the plant, drawings, design parameters flow and PIB diagrams as necessary and required for submission to the State pollution control authority.

Bidder shall furnish at his own cost, analysis of influent at source (for evaluation) as well as that of influent at the holding tank of the STP and the effluents from the STP for submitting to State Pollution Control Board and any other statutory authority whose approval is required.

Bidder shall perform all testing and operation of the plant in presence of the Pollution Control Board if so stipulated by them.

Bidder to obtain all statutory approval as required for PCB or any other approval. Only official fee will be reimbursed to bidder by the Owner.

24.9 Completion Documents

On successful completion of the entire work, the bidder shall submit 4 sets of following documents to Architect.

A brief write-up of process, day to day operating and maintenance instructions.

List of approved chemicals and procedure for storage and safety norms.

Completion drawing and data, catalogues, performance charts, technical data sheets and equipments installed.

Manufacturer's maintenance and operating instructions for mechanical and electrical equipment.

Laminated and framed "As Built" drawings with plans, section, process flow diagrams, pipe runs, levels and final disposal point schedule of equipment installed with all their model Nos. plate data and date of installation.

Test readings of Influent & Effluent parameters taken at final handing over time

NOC (No Objection Certificate) from State Pollution Control Board and any other statutory authority whose approval is required.

24.10 Performance Guarantee

Equipment supplied and installed shall be guaranteed to yield the specified effluent standards which must meet and accepted with the requirements of Pollution Control Board.

The guarantee implicitly includes replacement of the entire plant on failure to meet desired effluent parameters, replacement of individual equipment or repairs as warranted. Decision on each and every aspect on this matter shall rest with the Consultant and shall be final and binding on the bidder.

24.11 Defects Liability

All equipment and the entire installation shall be guaranteed against defective materials and workmanship for a period of 12 months reckoned after taking over of system by Owner along with the documentation. During the defects liability period, the bidder shall replace defective parts and components free of cost. Rectification or repair may be permitted in case the defect is of minor nature.

24.12 Deviations from Tender Specifications

Tendered may indicate their comments only as deviations from the conditions stipulated herein. Wholesale submission of their own conditions and/or printed conditions in disregard of the conditions stipulated herein shall not be binding on this Tender.

No corrections, erasure etc. of this document shall be accepted.

24.13 Sewage Characteristics

24.13.1 Design Parameters

- Project : Group Housing Building
- Usage : Residential
- Location : Under ground
- Level : Ground

24.14 Design Consideration

- Capacity (Max). : As per BOQ
- Area Available : Marked in the Drawings
- Operation : Domestic Sewage (round the clock)
- Influent
 - pH : 7.5 to 8.5
 - BOD 5 days @ 200C. : upto 250-350 mg/l
 - Suspended solids (SS) : upto 250-400 mg/l
 - Oil & grease : 50 mg/l
 - COD : upto 450-600 mg/l
- Treated Effluent
 - pH : 6 - 7
 - BOD 5 days @ 200C. : less than 20 mg/l
 - Suspended solids (SS) : less than 10 mg/l
 - Oil & grease : NIL
 - COD : less than 100 mg/l

24.15 Salient Features

- The plant should be suitable for low/peak flow in line with medical waste usage.
 The plant should not create any noise, with no nuisance on fly or mosquito and no foul odors.
 The plant should work without the use of in-organic chemical additives
 The plant should be provided with tertiary treatment in form of dual media/activated carbon filter /UV system to provide zero bacteriological standards for reuse on:
- Irrigation system
 - HVAC cooling tower

24.16 Basis of Design

- The capacity/ rating of pumps and equipment etc. shall hold good for the capacity of 110 m3 /day and shall be good for meeting the treated parameters requirement as follows:
- Permissible limit as prescribed in IS: 2490 (Part-I)-1974 and environment (Protection) Rules 1986.
 - Water (Prevention and Control of Pollution) Act, 1977 & 1978.
 - Environment (Protection) Act, 1986.
 - Environment (Protection) Rules, 1986.
 - Hazardous Wastes (Management & Handling) Rules, 1989.
 - Manufacturer, Storage and Import of Hazardous Chemicals Rules, 1989.
 - Manufacturer, use import and storage and hazardous Micro-Organizers, Genetically Engineered organizations or Cell Rules, 1989.
 - Manual on sewage & sewage treatment - CPHEEO
 - The Public Liability Insurance Act, 1991.
 - All standards as laid down by Central Pollution Control Board and any other relevant statutory authority.
 - 100% recycle of waste water and removal of sludge in cake form, no water to be discharged outside the premises.

a.	Type of equipment, material specification, methods of installation and testing and type of control shall be in accordance with the specifications, approved shop drawings and the relevant Indian Standards, however capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.
b.	The unit rate for all equipment or materials shall include cost in INDIAN RUPEES (INR) for equipment and materials including all taxes and duties and also including forwarding, freight, insurance and transport into Bidder's store at site, storage, installation, testing, balancing, commissioning and other works required.
c.	The rate for each item of work included in the Schedule of Quantities shall, unless expressly stated otherwise, include cost of:
i.	All materials, fixing materials, accessories, appliances tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of work called for in the item and as per Specifications and Drawings.
ii.	Wastage on materials and labour.
iii.	Loading, transporting, unloading, handling/double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and for the job in accordance with the contract documents, good practice and recognized principles.
iv.	Liabilities, obligations and risks arising out of Conditions of Contract.
v.	All requirements of Specifications, whether such requirements are mentioned in the item or not. The Specifications and Drawings where available, are to be read as complimentary to and part of the Bill of Quantities and any work called for in one, shall be taken as required for all.
d.	All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar / concrete / water proofing of appropriate mix and strength as directed by the Project Manager. Bidder shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds.
e.	Any pipe crossing fire rated wall as per fire compartmentation will be provide with higher size of GI sleeve. All floor crossing pipes will be provided with higher size GI sleeve.
f.	Any pipe crossing fire rated wall as per fire compartmentation will be provide with higher size of GI sleeve. All floor crossing pipes will be provided with higher size GI sleeve.
g.	The bidder shall , from time to time, clear away all debris and excess materials accumulated at the site failing which the same shall be done by Project Manager at bidder's risk and cost and cost of clean up shall be deducted from the bidders prorata bill.
h.	After the equipment and appliances have been installed and commissioned, bidder shall clean up the same and remove all plaster, paints, stains, stickers and other foreign matter or discoloration leaving the same in a ready to use condition.
i.	On completion of all works, bidder shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done by the Project Manager at the Bidder's risk and cost. Cost of the clean up shall be deducted from the bidder's bills on pro-rata basis in proportion to his contact value.
j.	Bidder shall provide operation and maintenance training for 15 days to a person authrised bythe Client

24.17 Sewage Treatment Plant
24.17.1 General

The sewage treatment plant (STP) system outlined in this section specifies the system design, manufacture, supply and installation of a standard **MBBR (Moving Bed Biofilm Reactor)**. The Bidder shall submit analytical test reports of effluent water samples after the commissioning or after the system is put into operation or as required by the Consultant. The report shall contain analysis of all data related to those requirements laid down by the local Authorities. The effluent from the Sewage Treatment Plant shall be suitably treated and the effluent water recovered shall be used for irrigation purposes/ flushing system/ irrigation/ D.G etc.

24.17.2 Description of Process

The treatment process shall comprise the following stages:

- Physical treatment: Fine bar-screening / Oil & Grease Chamber
- Equalization / Collection tank: Flow equalization with air mixing
- Biological treatment: MBBR based
- Final sedimentation: Settler tank
- Intermediate treatment: UV System in Intermediate tank
- Water reclamation: tertiary filtration and sterilization (For irrigation purpose, flushing or cooling tower make up)
- Sludge disposal: In cake form through Filter Press or (Transfer through a screwed type pump to municipal tanker)

24.17.3 Performance Criteria of the Plant

Raw sewage will be brought into the Sewage Treatment Plant. The Bidder shall receive sewage from this point to the treatment plant for treatment process.

The treatment plant shall be designed to treat the above basic characteristics expected in the raw sewage.

Treated effluent shall be connected to a tertiary filtration / Softening plant to treat and shall be use for irrigation purpose and Flushing/CT make up purposes.

24.17.4 Process Description

- Inlet Screen Chamber / Oil & Grease Chamber
Raw sewage shall flow into the inlet screen chamber by gravity. Large solids particles shall be intercepted by a fine screen. Then there shall be Oil & Grease Tank. Sewerage will then flow into Equalization / Collection Tank The incoming sewage shall be mixed in the EQT and fine bubble aeration shall be maintained.
- Equalization / Collection Tank
The equalization tank shall be designed to provide a minimum storage of 2 hours at peak flow while pumping. Submersible pumps as per specifications shall be provided with level switch control and automatic cut-in of the standby unit.
An aeration system similar to the SAFF tank shall be provided for mixing and aerating the sewage.
- MBBR Tank
Sewage shall be retained in the **MBBR** tank for a minimum of **4-5** hours and subjected to biochemical oxidation by fine bubbles aeration. The deck media shall be installed in the form of rectangular blocks & shall be fixed in the form of layers not more than 600 mm vertical height. The media shall be corrugated type & shall facilitate cross flow for better air distribution. The media shall be duly glued as per manufacturers recommendations.
- Tube Settler Tank
The sewage after bio-oxidation shall enter the hopper bottom sedimentation tank where the sludge effectively settles to the tank bottom. The clear effluent shall weir into the Intermediate Tank for UV treatment.
The activated sludge collected in the sludge tank shall be returned to the SAFF tank for further oxidation of the incoming organic matter. Excessive sludge shall be wasted in the sludge holding tank.
PVC tube deck media is to be installed in Tube Settler Tank. The media shall installed at 60° angle with the horizontal and the total vertical height when installed should be 750 mm. The media shall be duly glued using recommended material and shall be installed as per the drawing to be given by the vendor as per manufacturer's recommendation.
- Intermediate Tank
The effluent shall be retained in the baffle walled cleared water tank for a minimum of 30 minutes for effective disinfection prior to discharge through UV system.
- Sludge Holding Tank
Excessive sludge shall be stored in the sludge holding tank for final dewatering and disposal.
- Then will be Treated Water Tank (TWT)

- Also there will be Soft Water Tank (SWT).

24.17.5 Equipment

The following give the minimum requirements of the different components of the system.

All equipment and components of the system shall be of top quality construction and shall be corrosion resistant.

- **Fine Screening Equipment**

Bar screen shall be of 304 stainless steel constructions. Drip trays shall be provided for holding and drainage of the screenings. A manual by-pass screen of 30mm opening with stainless steel drip tray shall be provided. An isolation valve shall be provided to divert the flow to the by pass screen when the screen requires service.

- **Air Blowers**

Air blowers shall be provided with standby arrangement. Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V-belt system or direct drive coupling. The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated. Motor speed shall be 1500 rpm.

The size and performance of the air blower shall be so selected that it can provide a minimum airflow rate 0.5 l /sec / diffuser to 1l/sec/diffuser maximum, and to maintain a minimum of 2.0mg/ dissolved oxygen in the aeration tanks in operation.

- **Air Diffusers**

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomeric rubber membrane or composed of crystalline fused aluminum oxide with a suitable ceramic bonding material.

Membrane endurance shall be more than 180,000 expansion/contraction cycles.

The Bidder shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

- **Sewage Pumps**

Working and standby sewage pumps shall be provided.

Each shall be of submersible type c/w guide base to facilitate ease of removal, lift chain and automatic discharge connection.

- **Settling Tanks**

Settling tanks shall include baffles to prevent short circuiting.

- **Ultra Violet (UV) System**

UV system shall be furnished as a complete package assembly for installation in the plant room. Assembly shall include UV Lamps suitable no. UV dosing system shall perform to achieve a residue not more than 1 mg/l in the treated effluent. feed pump shall have a maximum capacity of 1 l/hr will operate on 50 Hz supply.

- **Tertiary Treatment**

This tertiary treatment shall be provided for the effluent used for irrigation and cooling tower make-up water tank/flushing system.

The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria.

- **Electrical Control**

The operation of the treatment process shall be fully automatic.

A completely assembled and pre-wired control panel consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timers, on-off-auto change-over switches and duty selectors for equipment.

- **Other Equipment**

Any other necessary accessories, such as buffer, riser, scum removal devices, partition, control panel, collection devices, etc. for all the tanks and pumps (where necessary) shall be provided in order to provide a fully working systems.

- **Piping Materials**

- SS304 : Submerged air piping
- MS epoxy : Air piping and pumped effluent riser (Non submerged)
- PVC piping : Pumped effluent (submerged) & tank overflow pipe line.

24.17.6 Valves

The Bidder shall supply and install all isolating valves and control valves as indicated on the drawings and as required for the proper and efficient operation and maintenance of the entire systems.

All valves supplied shall be suitable for the working pressure and test pressure of the system as specified elsewhere in this specification.

All valves shall be full line size.

Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows.

Plastic or metal plates (rustles) shall be provided to indicate the open / close status as well as the use of each valve in the pump and tank rooms.

25 **PIPE SUPPORTS**

25.1 **General Support**

Tender drawings indicate schematically the size and location of pipes. The Bidder, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Bidder shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

26 **INSTALLATION**

The Bidder shall check the associated civil work prior to the installation of any item of machinery and advise the Consultant, in writing, of any deviation of such work from the specified details.

The machinery shall be accurately installed to correct dimensions, alignments, levels, etc., all as indicated on the final drawings. The machinery shall be mounted on flat steel packing pieces of thickness suitable to take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machinery shall be aligned and leveled and the nuts of the holding down bolts tightened with

a spanner of normal length. The base plates shall be packed with grout after the machinery has been run and checked by the Consultant for stability and vibration.

Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc.

27 **TESTING**

The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve hour period. The sample shall be taken at periods approximately the flow rates specified by the plant. The sample shall be combined and a 5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.

ELECTRICAL INSTALLATION**28 MOTOR CONTROL CENTRES**

Switchboard cubicles of approval type shall be fabricated from 2mm thick CRC sheet with dust and vermin proof construction. It shall be painted with powder coating of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following (Switchgear as given in the schedule of quantities):

- Incoming MCCB of required capacity.
- MCCB / MPCB - one for each motor.
- Fully automatic DOL/Star Delta starters suitable for motor DOL upto 7.5 H.P.; Star / Delta for 10 H.P. and above H.P. with push buttons one for each motor and On / Off indicating neon lamps.
- Single phasing preventer of appropriate rating for each motor.
- Rotary duty selector switch
- Panel type ampere meters one for each motor shall be with rotary selector switch to read line currents.
- Panel type voltmeter on Incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
- Neon phase indicating lamps and indicating lamp for each motor and on incoming mains.
- Rotary switch for manual or auto operation for each pump.
- Fully taped separate aluminum bus bar of required capacity for normal and emergency supply where specified.
- Space for liquid level controllers and other equipment specified separately in the contract / given in the schedule of quantities.
- The panel shall be pre-wired with color-coded wiring. All interconnecting wiring from incoming main to switchgear, meters and accessories within the switchboard panel. Wiring shall have suitable copper or aluminum ferrules.
- Switchboard cubicle shall be floor or wall mounted type as directed by the NCCF

29 PUMP SET**29.1 Water Supply Pumps (Raw Water / Garden Hydrant Pump)**

Water supply pumps shall be suitable for clean water. Pumps shall be multistage, monoblock vertical centrifugal pumps with Cast Iron body and Cast Iron impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling. Each pump should operate a curve 10m below specified head.

Pump and motor shall be mounted on a common M.S. structural base plate or as required as per site conditions.

Each pump shall be provided with a totally enclosed fan cooled induction motor.

Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Burden" type pressure gauge with gunmetal isolation cock and connecting piping.

Provide vibration-eliminating pads appropriate for each pump.

Provide rate of flow measuring meter with bypass arrangement with every set of pumps.

All water supply pumps shall be provided with mechanical seals.

Detail of Pumps as per BOQ.

29.2 Hydro Pneumatic System (Domestic & Flushing Water Supply Pumps)

Domestic water supply pumps shall be packaged type skid mounted hydro pneumatic system with variable frequency system. Complete system to be mounted on a common base frame.

Pumps shall be multistage, mono block vertical centrifugal pumps with stainless steel body and stainless steel impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling. Each pump should operate a curve 10m below specified head.
 Pressure vessel of non-corrosive FRP composite construction lined with NSF and/or FDA listed material, like high density polyethylene with fully replaceable polyurethane. Air cell burst pressure of minimum of 5 times the vessel operating pressure and cycle tested for 2,50,000 cycles. No. and capacity of Pressure Vessel As per manufacturer recommendation.
 Pump and motor shall be mounted on a common M.S. structural base plate or as required as per site conditions.
 Each pump shall be provided with a totally enclosed fan cooled induction motor.
 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Burden" type pressure gauge with gunmetal isolation cock and connecting piping.
 Provide vibration-eliminating pads appropriate for each pump.
 Provide rate of flow measuring meter with bypass arrangement with every set of pumps.
 All water supply pumps shall be provided with mechanical seals.
 Pumps shall have Control Panel with programmable logic controller (PLC) for cyclic operation of pumps. Pump working sequence should change after every operation. Bidder overload relays and MCBs should confirm to IEC 898 – 1995/ specifications. Blinking indications for pumps start, trip, low level trip, and health supply should be provided in the panel along with the ammeter & voltmeter. Control panel should also consist of cooling fan.

29.3 Detail of Pumps as per BOQ

30 SUMP PUMP

Sump pumps shall be submersible type for lifting domestic sewage or muddy water/drainage. Pump with impeller of approved material shall be mounted on waterproof motor. The impeller shall be suitable for handling solids upto 46-100mm dia.
 The pump shall automatically operate with high water level and stop at low water level in the sump by means of "Electronic Level Controller", of the approved make.
 The sump pumps shall be complete in all respect and shall be installed as per manufacturer's requirement as shown in the drawing. All accessories shall be In-Built as per manufacturer's specification.
 Sump pumps are compact monoblock dry motor submersible pumps for suitable rating, with non-clog free flow open impeller, minimum solid handling capacity up to 100mm for sewer & 40 for storm water . Suitable for operation on 415 volts + 5%-15%, 50 C/s A.C 3 phase supply, speed 960/1440R&M including oil chamber, guide wire for lifting & lowering of pump, M.S. galvanized lifting chain, duck foot bend.

The above pump sets must be supplied complete with following accessories :

- Complete piping 100mm dia common delivery upto 1.5m as shone in the drawing. (The pipe should be preferably heavy duty GI)
- Necessary valve i.e Butterfly valve on delivery/suction side and Non return valves are on delivery side.
- Necessary cable from pumps set to control panel.
- Electrical switch panel having all necessary accessories & safety devices of standard specifications. (Panels with sump pumps near each sump as per site conditions)
- Automatic built-up water level controller with necessary length of cable upto control panel.

30.1 Sewage Pumps

Motor rating - 5.0KW
 Discharge - Min. 20 Cu.m/hr.
 Total head - 14 m

(Complete set as above including valves and delivery pipes and panels and with 2 nos. pumps)

30.2 Drainage Pumps

Motor rating - 1.1KW
 Discharge - Min. 15 Cu.m/hr.
 Total head - 14 m

(Complete set as above including valves and delivery pipes and panels and with 3 nos. pumps)

31 FIRE FIGHTING PUMPS

31.1 Electrical Operated Main Fire/ Sprinkler/Water Curtain Pump and Jockey Pumps

Pumping sets shall be single stage horizontal centrifugal single outlet with cast iron body and dynamically balanced bronze impellers. Connecting shaft shall be of stainless steel with bronze sleeve and grease-lubricated bearings.
 Pumps shall be connected to the drive by means of spacer type love-joycoupling which shall be individually balanced dynamically and statically.
 The coupling joining the prime mover with the pump shall be provided with a sheet metal guard. Pumps shall be provided with approved type of mechanical seals.
 Pumps shall be capable of delivering not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.
 The System shall meet the requirements of the National building Code2005 (NBC).
 Necessary 'Y' strainer on the suction side and pressure gauge with GM cocks on the delivery side including bypass arrangement (with 50 valve and up to 5M G.I. Medium pipes) for periodical testing of the working of the pumping set shall be provided.
 Pump shall be mounted on common base frame fabricated from MS channel as per manufacturer's specification.
 Suitable RCC Pump-foundations as per manufacturer's design and 4 nos. Dunlop (cushy foot) heavy duty Anti vibration mounting pads shall be provided.
 Detail of Pumps as per BOQ :

31.2 Motors for Electric Driven Pumps

Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
 Motors shall be suitable for 415 volts, 3 Phase, 50cycles A.C supply and shall be designed for 33°C ambient temperature. Motors shall conform to I.S: 325.
 Motors shall be designed for two start system.
 Motors shall be capable of handling the required starting torque of the pumps.
 Bidder shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

31.3 Air Vessel for Fire Pumps

Provide an air vessel fabricated from 10mm M.S. sheet with dished ends and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 25mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. The vessel shall be 450mm in dia and 2000 mm high and tested to 10.0Kg/cm2 pressure.
 The fire pumps shall operate on drop of 1 Kg/cm2 pressure in the mains. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

31.4 Operating Conditions for the Service Pumps

Fire Pump	Service	Nos.	Cut Pressure in	Cut Pressure Out	Remarks
Jockey pump		One	6.5 kg/cm2	4.0 kg/cm2	To auto start and auto stop on pressure switch on air vessel.
Main pump		One	4.0 kg/cm2	Push button manual	To auto start on pressure switch on air vessel and manual off.

Diesel Fire Pump	One	3.5 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
Sprinkler Pump	One	4.0 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.

31.5 Diesel Fire Pump

31.5.1 Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

31.5.2 General

The diesel pump set shall be suitable for automatic operation, complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

31.5.3 Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1800 rpm.

31.5.4 Fire Pump

The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg. per cm² at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 7 Kg. percm² in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the Rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal.

The pump casing shall be designed to withstand 1.5 times the working pressure.

Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

31.6 Diesel Engine

Environmental Conditions - The engine shall be required to operate under the conditions of environment as required as per site conditions.

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to B.S: 649/I.S: 1601/I.S: 10002, all amended up to date.

Engine Accessories - The engine shall be complete with the following accessories:-

- Fly sheet dynamically balanced.
- Direct coupling for pump and Coupling Guard.
- Radiator with hoses, fan, water pump, drive arrangement and guard.

- Corrosion Resister
- Air cleaner, oil bath type/dry type
- Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- Pump for lubricating oil and lub. oil filter
- Elect. starting battery (2x12 v)
- Exhaust silencer with necessary pipe work
- Governor
- Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).
- Necessary safety controls
- Winterization arrangement, where specified.

Cooling System - The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on brackets at a height not less than 60 cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine.

A semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of work.

Lubricating Oil System - Forced feed lub. oil system shall be employed for positive lubrication. Necessary lub. oil filters shall be provided, located suitably for convenient servicing.

Starting System - The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work. The battery capacity shall be suitable for meeting the needs of the starting system. The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression. The scope shall cover all cabling, terminals, initial charging etc.

Exhaust System -The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 5 meter from the engine manifold. (Adjustment rates for extra length shall also be given). The total back pressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

Engine Shut Down Mechanism -This shall be manually operated and shall return automatically to the starting position after use.

Governing System - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

Engine Instrumentation - Engine instrumentation shall include the following:-

- Lubricant oil pressure gauge.
- Lubricant oil temperature gauge.
- Water pressure gauge.
- Water temperature gauge.
- Tachometer.
- Hour meter.

The instrumentation panel shall be suitably resilient mounted on the engine.

Engine Protection Devices - Following engine protection and automatic shut down facilities shall be provided: -

- Low lub. oil pressure
- High cooling water temp.
- High lub. oil temperature
- Over speed shut down.

Pipe Work - All pipe line with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems. Copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

Anti Vibration Mounting - Suitable vibration mounting duly approved by Engineer-in-Charge shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Battery Charger - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

32 **CABLES**

Bidder shall provide all power control cables from the motor control center to various motors, level controllers and other control devices.

Cables shall conform to I.S: 1554 and carry ISI mark.

Wiring cables shall conform to I.S 694.

All power and wiring cables shall be aluminum conductor PVC insulated armored and PVC sheathed of 1100 volts grade.

All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

All cable joints shall be made in approved manner as per standard practice.

33 **CABLE TRAYS**

Bidder shall provide M.S slotted cable trays at locations as shown on the drawings.

Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by anchor fasteners.

34 **EARTHING**

There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armor clamps shall be connected to the main bar by means of branch earth connections of appropriate size.

All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.

Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centers. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.

A brick masonry manhole 30x30x30cmsize shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated in this manhole for testing.

35 CONTROL PANELS / STARTERS

Switch board cubicles of approved type shall be fabricated from 16-gauge M.S. sheet with dust and vermin proof construction. It shall be painted with powder-coated finish of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the followings:-

- Incoming main isolation MCCB of required capacity.
- Fully Aluminum taped Bus Bar of required capacity.
- Isolation MCCB one for each motor.
- Fully automatic as specified D.O.L/Star Delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps. (DOL up to 7.5 HP and Star Delta from more than 7.5 H.P)
- Single phase preventer of appropriate rating for each motor.
- Panel type ampere meters one for each motor with selector switch.
- Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.
- Neon phase indicating lamps for incoming main and on/off indicating lamps for each motor.
- Rotary switch for manual or auto operation for each pump (manual/auto off).
- Fully taped separate aluminum bus bars of required capacity and with required outlets.
- Space for liquid level controllers as specified + 1 extra space.
- The panel shall be pre-wired with color-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
- Provision of main incoming cables from the top of the panel.

All switch gears and accessories shall be of approved make such as "Siemens, Larsen & Toubro" or equivalent.

Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers. All floor-mounted switchboards shall rest on minimum 225mm high platform. The bidder shall provide the shop drawings for base and panels.

36 VIBRATION ELIMINATORS

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer's details.

37 ILLUMINATED FACSIMILE ANNUNCIATOR PANEL

37.1 Scope

Scope of this section comprises the supply, installation, testing and commissioning of illuminated facsimile annunciation panel.

37.2 Illuminated Facsimile Enunciator

Illuminated facsimile enunciator shall be provided with facsimile of the building, constructed of acrylic panels of suitable dimensions, showing the Basement, Ground floor plans and section showing the location of Zonal Panels oneachty pical floor, entry points, various facilities shown with enamels in various colors.

Alarm lights to indicate fire location shall be arranged within the acrylic panel and shall be either automatically lighted by operation of any automatic fire detection devices or manual station, or by control of push button incorporated in the control desk.

Indicator of each building or facility shall include two lamps connected in parallel and so arranged that the failure of either of the lamps is readily apparent when a call or test is made.

Power for the Annunciator shall be supplied from the power supply for the control desk.

Representation of the various plans/Drawings on the acrylic of the Annunciator shall be by negative film processing with colored Discrimination of various zones for which the drawings shall be furnished for approval.

38 WATER FILTER

Water filter shall be of dual filter media pressure filter downward or upward flow type suitable for a rate of filtration.

Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure as given below. The minimum thickness of shell will be 8mm and dished ends shall be 10mm. The filter shall have at least one pressure tight manhole cover.

Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary and required. Filter shall be painted inside with two or more coats of non-toxic corrosion resistant paint, one coat of red oxide primer outside with two or more coats of synthetic enamel paint of approved shade.

Filter Capacity Shall be as per BOQ

38.1 Under Drain System

Filter shall be provided with an efficient under drain system comprising go for collecting pipes, gunmetal/polypropylene nozzles of manufacturer's design. The entire under drain system be provided on M.S.plate or cement concrete supports.

38.2 Face Piping

Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I./M.S. piping, medium duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves on SOUNDERS pattern with C.I. body and Neoprene rubber diaphragm (Suggested make LABLINE, NKI or equivalent).

38.3 Accessories

Each filter shall be provided with following accessories:-

- Air release valve with connecting piping.
- 150mm dia dial burden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
- Sampling cocks on raw water inlet and filtered water outlet.
- Individual drain connection with gunmetal full way valve.
- Connection with valve for air scouring.

39 PIPING

Pipes for suction and delivery shall be galvanized/M.S tube (heavy duty) conforming to I.S:1239 up to 150mm dia and as per I.S:3589 for dia 200mm and above. The M.Sflanges shall confirm to I.S:6392-1971.

Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780manufacturedby the reputed manufacturers or C.I. double flanged butterfly valves.

Full way and check valves 65mm dia and below shall be gunmetaltestedto20Kg/cm2 pressure certified and conforming to I.S:778.

Suction strainer or foot valves shall be C.I., conforming to I.S:4038 - 1979.

39.1 Joints

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 1.5mm thick gasket complete with nuts, bolts and washers etc.

39.2 Testing

All G.I pipes (except fire pipe) shall be tested hydrostatically for a period of 30 minutes to a pressure of 7 Kg/cm² without drop in pressure and all G.I pipes for fire shall be tested hydrostatically for a period of 30 minutes to a pressure of 10 Kg/cm² without drop in pressure.

40 GUARANTEE

The bidder shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

The form of warranty shall be as approved by the NCCF

The warranty shall be valid for a period of one year from the date of commissioning and handing over.

The warranty shall expressly include replacement of all defective or under capacity equipment, Engineer-in-Charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the NCCF

**41 TECHNICAL INFORMATIONS FOR WATER SUPPLY/FIRE FIGHTING PUMPS & EQUIPMENTS AND WATER TREATMENT UNIT ETC.
(TO BE FILLED BY THE TENDERER)**

S.NO	PARTICULARS	Main Fire Pump	Jockey Pump
(I).	ELECTRICAL OPERATED FIRE PUMP		
(A)	PUMP:		
	1. Discharge :		
	2. Total head at full discharge :		
	3. Type :		
	4. Make and Model No. :		
	5. BHP absorbed :		
	(a) at rated head and discharge		
	(b) at 150% of rated discharge and 65% of rated head.		
	6. Casing material. :		
	7. Impeller material. :		
	8. Shaft material. :		
	9. No. of stages. :		
	10. Type of drive. :		
	11. Type of sealing. :		
(B)	MOTOR:		
	1. Make. :		
	2. Type. :		
	3. Protection type. :		
	4. Insulation class. :		
	5. Electrical particulars (Voltage/No. of phase/frequency). :		
	6. I.S. conforming to :		
	7. H.P. (App.) :		
	8. Speed. :		
(II).	DIESEL FIRE PUMP		
	<u>Diesel Engine:</u>		
	1. Make & Model No. :		
	2. Type. :		
	3. H.P. :		
	4. Speed. :		
	5. No. of cylinders. :		
	6. I.S/BS Standard conforming to :		
	7. Type of cooling. :		
	8. Fuel consumption at full load. :		
	9. Overload capacity. :		

S.NO	PARTICULARS		Main Fire Pump	Jockey Pump
	10.Isolation efficiency.	:		
(III).	RAW WATER PUMPS			
	1.Discharge	:		
	2.Head	:		
	3.Type	:		
	4.H.P of Motor	:		
	5.Other Details	:		
(IV).	GARDEN HYDRANT PUMPS			
	1.Discharge	:		
	2.Head	:		
	3.Type	:		
	4.H.P of Motor	:		
	5.Other Details	:		
(V).	HYDRO PUMPS (FOR DOMESTIC WATER)			
(A)	PUMP:			
	1. Discharge.	:		
	2. Total head at full discharge.	:		
	3. Make and Model No.	:		
	4. Type.	:		
	5. Frame size.	:		
	6. BHP absorbed	:		
	(a) at rated head and discharge.	:		
	7. Casing material.	:		
	8. Impeller material.	:		
	9. Shaft material.	:		
	10. No. of stages.	:		
	11. Type of drive.	:		
	12. Type of seal.	:		
(B)	MOTOR:			
	1. Make.	:		
	2. Frame size.	:		
	3. Type.	:		
	4. Protection type.	:		
	5. Insulation class.	:		
	6. Electrical particulars (Voltage/No. of phase/frequency).	:		
	7. I.S. conforming to	:		
	8. H.P.	:		
	9. Speed.	:		
(VI).	FILTER			
	1.Make	:		

S.NO	PARTICULARS		Main Fire Pump	Jockey Pump
	2. Model	:		
	3. Dia Meter	:		
	4. Height	:		
	5. Type of Flow	:		
	6. Material of Construction	:		
	7. Shell/Dished end thickness	:		
	8. Max. working pressure	:		
	9. Hydro test pressure	:		
	10. Max. Flow rate	:		
	11. Min. flow rate	:		
	12. Filtration Rate	:		
	13. Inlet/outlet pipe Size	:		
	14. Type of Media	:		
	15. Media Quantity	:		
	16. Type of Valve	:		
	17. BackWash Frequency	:		
	18. Pressure drop across bed	:		
(IX).	SUMP PUMPS (FOR SEWAGE)			
	1. Discharge	:		
	2. Head	:		
	3. Type	:		
	4. Solid Handling Capacity	:		
	5. H.P of Motor	:		
	6. Other Details	:		
(X).	SUMP PUMPS (FOR DRAINAGE)			
	1. Discharge	:		
	2. Head	:		
	3. Type	:		
	4. Solid Handling Capacity	:		
	5. H.P of Motor	:		
	6. Other Details	:		
(XI).	ELECTRIC CONTROL PANEL			
	1. Make	:		
	2. Make of switch fuse unit/breaker used.	:		
	3. Thickness of sheet metal used.	:		
	4. Make of bidders.	:		
	5. Make of cables and size of cables for different motors.	:		
	6. Any other informations.	:		
Note:-				
The Tenderer must give as maximum as possible information. They may add any other relevant information's also, if required.				

42 IMPORTANT INSTRUCTION FOR QUALITY OF WATER

The successful bidder will have to carry out a test of raw water from all the sources of the memorial at their own cost from a reputed lab as approved by the Engineer-in-Charge/Consultant. On the basis of these results the bidder has to submit his shop drawings, design calculations and specifications accordingly.

Please note that it is ultimately the responsibility of the bidder to provide treated water for different use in the memorial as per International Standard as given in the attached guidelines.

43 REQUIRED QUALITY OF TREATED WATER

Sl. No.	Characteristics	Acceptable as per Indian Standard of P.H.E.
1	Turbidity (Units on J.T.U scale)	2.5
2	Colour (Units on Platinum Cobalt scale)	5.0
3	Taste and Odour	Unobjectionable
4	pH	7.0 to 8.5
5	Total dissolved solids (mg/l)	500
6	Total hardness (mg/l) (as CaCO ₃)	200
7	Chlorides (as Cl) (mg/l)	200
8	Sulphates (as SO ₄)	200
9	Fluorides (as F) (mg/l)	1.0
10	Nitrates (as NO ₃) (mg/l)	45
11	Calcium (as Ca) (mg/l)	75
12	Magnesium (as Mg) (mg/l)	> 30
13	Iron (as Fe) (mg/l)	0.1
14	Manganese (as Mn) (mg/l)	0.05
15	Copper (as Cu) (mg/l)	0.05
16	Zinc (as Zn) (mg/l)	5.0
17	Phenolic compounds (as Phenol) (mg/l)	0.001
18	Anionic detergents (mg/l) (as MBAS)	0.2
19	Mineral Oil (mg/l)	0.01
20	Arsenic (as As) (mg/l)	0.05
21	Cadmium (as Cd) (mg/l)	0.01
22	Chromium (as hexavalent Cr) (mg/l)	0.05
23	Cyanides (as CN) (mg/l)	0.05
24	Lead (as Pb) (mg/l)	0.1
25	Selenium (as Se) (mg/l)	0.01
26	Mercury (total as Hg) (mg/l)	0.001
27	Polynuclear Aromatic Hydrocarbons (PAH)	0.2 ug/l
28	Gross Alpha activity	3p Ci/l
	Gross Beta activity Pci = pico curie	30p Ci/l
29	Bacteriological Quality of piped water supplies	
	Treated water entering the distribution system	
29.1	Faecal coliforms number/100 ml	0
29.2	Coliform organisms number/ 100 ml	0



JAMIA MILLIA ISLAMIA

VOLUME II GENERAL SPECIFICATIONS

**TENDER DOCUMENT FOR CIVIL, PLUMBING &
SANITATION, INTERNAL ELECTRICAL, FIRE
FIGHTING, ELEVATORS AND EXTERNAL
DEVELOPMENT WORKS**

EXPRESSION OF INTEREST

FOR

CONSTRUCTION OF:-

- 1) Multi-Storey Administrative Block**
- 2) Academic Block for Health & Allied Science**
- 3) Teaching & Training Block**
- 4) Class Rooms (24 Nos.)**

AT

JAMIA MILLIA ISLAMIA, NEW DELHI-110025

- Nodal Agency

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA LIMITED,

LUCKNOW

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GENERAL SPECIFICATIONS

1.0.0 GENERAL

1.1.0 SCOPE OF WORK

This contract covers the completion of all works described herein provided in accordance with the drawings, these specifications and C.P.W.D specifications, all forming part of the contract, in a manner satisfactory and acceptable to the NCCF and Architect/PMC and the rates quoted shall include all activities to perform the contract.

The specifications given in this volume are general in nature. For Exact description of scope of work, the items of work detailed in the Volume III, Scope of work (Schedule A to E) should be referred.

The work shall be carried out strictly for in accordance with General and Special Specifications, conditions of contract, Tender Drawings and instructions given from time to time. The drawings and specifications shall be taken complementary and also supplementary to each other and shall form part of this contract. Any work or material shown in drawings and not specifically included in the specifications or vice versa shall be executed and deemed to be included in the scope of work.

The scope of work for the building under this contract includes full, final and entire completion of all works including internal and external services in all respect described in Scope of work, General and particular specifications and shown in drawings and other constituents forming the part of the contract.

Although as many details of construction have been by and large covered in these documents, any item or detail of construction not specifically covered but obviously implied and essential to consider in civil and internal and external services complete function shall be deemed to have been covered in this contract. NCCF shall provide the details and working drawings to cover such items. The contractor may, if required, consider a minimum level of details confirming to IS code or National Building code / CPWD specifications to cover the specifications of these missing details.

1.1.1 SPECIFICATION

- (a) The specifications are intended for general description of quality and workmanship of materials/finished work and not intended to cover minute details and shall be same as being described in Volume II and Volume III with corrections slips up to date of receipt of the tender. Latest CPWD specifications and relevant ISI standards should be followed for works not covered in the above.
- (b) Rates quoted shall include labor, site grading, leveling and earth work material, tools, plants application, transport equipment, taxes, duties, service tax, laborCess, Development Tax

octroi, levies, construction, supervision, overheads, profits and all that is necessary for the satisfactory completion of the job in totality.

1.2.0 SAMPLES OF MATERIALS

The contractor shall submit samples of all materials to be procured in accordance with the “Schedule of Approved Brand Names” given herein and obtain approval for these before procuring the same for use in the work. Where brand names are specified they must be conformed to Elsewhere, material shall be ISI marked, or conform to IS if ISI marked material is not manufactured.

1.3.0 STANDARD OF WORKS

The contractor shall construct a sample of each type of dwelling unit complete in all respects including flooring internal and external plaster, door and windows, fittings and hardware, painting all sanitary and electrical works including their fittings and fixtures, external development around this unit etc and as otherwise directed within six months of the commencement of work failing which a penalty of Rs. 1000 per day of default will be levied. **The penalty may be reduced/waived off on the discretion of the Employer.**

The contractor shall also undertake any change required by the Architect/NCCF therein, irrespective of what is shown on the drawings and specifications, and the Architect/NCCF approval of the same shall only then determine the acceptable standard of workmanship required for the work. Changes arising out of the above shall be incorporated by the Contractor in all the units.

1.4.0 USE OF WATER

Water used in the work shall be obtained by the contractor at his own cost from **Local STP** or if permitted by the Central Ground Water Authority from tube wells to be bored by him within the site, or procured from outside and shall be permitted for use only if certified “Fit for Construction” on testing from laboratory nominated by the Architect/NCCF and if not found suitable for construction, alternative arrangement shall be made by the contractor, for supply and use of water suitable for construction without cost to the NCCF or claiming for the same.

1.5.0 SPECIFICATIONS

- 1.5.1** The entire work under this contract shall be carried out in the manner described by the Architect/PMC and in accordance with the specifications of the CPWD specifications (latest, inclusive of all corrections slips and amendments issued to or revision made thereof if any up to the date or receipt of tenders) and if not found applicable then the relevant latest Indian standard codes of practice and drawings forming part of this contract. If none of the above are applicable, then the specifications given by the Architect shall prevail.
- 1.5.2** Wherever the specifications given herein require a higher standard of material and workmanship then these specifications shall take precedence over the above.

- 1.5.3 The drawings, scope of work, specification herein if any and the latest specifications of the CPWD with correction slips and amendments up to date are to be considered explanatory to one another, unless directed other-wise by the Architect.
- 1.5.4 Should any discrepancy of variation or any misunderstanding arise, as to the meaning interpretation of anything contained in the specification herein, the conditions of the contract shall rule for any decision required unless specifically stated otherwise herein, in which case only the provisions in these tender documents shall take precedence.
- 1.5.5 **Should any discrepancy arise between the Tender drawings and specifications for any items or work, or in case of any work or no such specifications as stated above occurs, such work shall be carried out in accordance with the instructions and requirements of the NCCF and The Architect/PMC.**

The directions and explanations required to complete the provisions of such specifications and give them due effect shall be given by the Architect/PMC.

- 1.5.6 Should the drawings not illustrate any items but the same be however, specified herein or can be reasonable be inferred to be provided in the work, the contractor is to necessarily provide the same at no extra cost whether shown on the drawings or not, and no advantage of any variance between the drawings and specifications shall be taken.
- 1.5.7 The drawings and specifications are intended to require and include all labor and material and equipment necessary for the complete, functional and proper execution of the work contemplated and the Contractor is nevertheless to provide the same in spite of any inconsistencies and omissions occurring in the drawings and/or specifications without any extra cost.
- 1.5.8 **Final Construction drawings shall be issued alongside construction. The tender drawings exhibited/ enclosed are preliminary drawings intended for the guidance of the contractor only. They may be subject to revision and alteration without vitiating any of the terms of the contract and the contractor shall be bound to execute the works as shown on the final drawings and the Contractor shall have no claim, whatsoever on this account.**

SECTION – A CIVIL WORK

The contractor shall execute the whole and every part of the work in the most substantial and workmanship like manner and both as regard materials and otherwise in every respect in strict accordance with these specifications, which are given as a guidelines. In the case of any ambiguity in the same or not stated other, the work shall be in accordance with the Central Public works Department compilation entitled “Specification for the Works at Delhi 1977” Volume I and II 1991 – 1992 CPWD where ever applicable. General Specifications for electrical works Part I and II (latest addition) with correction slips and addendum up to date or any other printed publication on general specifications referred to elsewhere in the contract.

EARTH WORK

GENERAL

DEFINITIONS

DEADMEN OR TELL - TALE	:	Mounds of earth left undisturbed in pits dug out for borrowing Earth
FORMATION	:	Final shape or profile of the ground after excavation or filling up
LIFT	:	The lift shall be measured from the ground level.
PROFILE	:	The pattern to which the earth is to be cut or made up and dressed
FILL	:	Shall mean earth, Sand, Stabilizer aggregate or other material specified to bring the existing grade to a proposed grade.
BACKFILL	:	Shall be earth, sand, stabilized aggregate or other material specified to replace earth or rock removed during construction.

CLASSIFICATION

The earth shall be classified measured and paid separately for categories as mentioned below.

ORDINARY SOIL

Any soil which can be removed with the ordinary or close application of picks or jumpers or scarifiers and rippers

ORDINARY ROCK

This may be quarried by crowbars or picks such as lime stone, sandstone, hard laterite, hard conglomerate and un-reinforced concrete below ground level.

HARD ROCK

Any rock which requires blasting or cutting by chiseling wedging such as quartzite stone, granite, basalt, reinforced cement concrete below ground level.

1.0.0 SPECIFICATIONS FOR EXCAVATION AND EARTHWORK

1.1.0 SCOPE OF WORK

The Scope of work broadly includes but is not limited to the following i.e. clearing of the site, excavation of foundation Trenches, backfilling, disposal of surplus earth as required including Dewatering, shoring and strutting.

Contractor shall provide all tools & plants, labour, equipment, operations and incidentals necessary and required for completion of all aspects of Work covered in these specifications.

1.2.0 TYPES OF SOIL

Contractor shall thoroughly acquaint himself with the types of soil in excavation by an inspection pit and the nature of the ground at site and carefully scrutinize the soil investigation details available with the Architect/NCCF. Any such detail shall be provided to the Contractor on his specific written request for the same.

The ground cover and the soil in the top surface is loose and therefore the Contractor shall consider providing filling / overlaying materials, facilities for providing comfortable access to all the work areas getting affected due to rain/ flow of water being pumped out during excavation etc, and also equip them to plan their Work schedule accordingly.

It should be noted that as such in the existing Site, there is water accumulated and it is difficult to walk and move around in vehicles during rainy seasons because of the nature of the top soil in the Site.

1.3.0 CLEARING THE SITE

The site on which the structure is to be built shown on the drawing and the area required for setting out and other operations like roads, drains, sheds, etc, should be cleared of all obstructions, loose stones, materials and rubbish of all kinds, stumps, brushwood and trees removed as directed, roots being entirely grubbed up. All useful materials obtained will be the property of the NCCF and will be removed by the Contractor to designated dump or the dumping ground as ascertained by the NCCF. Rejected materials will be removed by the Contractor to his own dump at his own cost.

1.4.0 GROUND LEVELS AND SITE LEVEL PLAN

Before starting the excavations, the requisite block levels of the entire plot shall be taken by the

Contractor in consultation with the Architect/Project Manager and a Proper record of these levels kept, which shall be jointly signed by the Contractor and the Architects/NCCF representatives.

A block level plan showing all the ground levels of the plot shall be prepared and shall be jointly signed by the Contractor and the Architect/NCCF's.

1.5.0 SETTING OUT

After clearing the site, and preparing the site level plan, the Contractor will set out the centerline of the building or other involved works and get the same approved from the Architects/NCCF's representative.

Before ordering any materials or doing any work the Contractor shall verify the pertinent field dimensions for the project and shall be responsible for the correctness of same.

The Contractor shall engage the services of Professional Surveyors (Total Station surveyors) for plotting out the areas allotted and set out the boundaries for each Tower/blocks, apart from clearly demarking the outline of the Type Blocks, alignment of internal Roads, and check for its conformity to the actual sanction Drawings before the commencement of work at Site.

It shall be the responsibility of the Contractor to install substantial reference marks, bench marks etc. and maintain them as long as required by the Architect. The Contractor will assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

1.6.0 EXCAVATION & PREPARATION OF FOUNDATIONS FOR CONCRETING

1.6.1 GENERAL

Foundation trenches mass excavations shall be dug wet or dry to the dimensions as shown on the drawing or as directed by the NCCF/Architect. The excavated material shall be stacked at a sufficient distance away from the edge of the excavated pit so as not to endanger the stability of the sides. The soil heap shall not exceed more than 1.5m from the ground.

The contractor shall, at his own expense and without any extra charges, make provision for all shoring and strutting, extra excavation in slope, extra excavation for working space, dredging or bailing out water, disposing the subsoil water as per specifications and as required by the NCCF/Architect and the excavation shall be kept free from water when the foundation work is in progress.

If excavation is carried out to greater width, length or depth than specified, extra depth shall be made up by filling in lean concrete and extra length or width by filling in with earth rammed hard or by masonry as directed by the NCCF/Architect. Cost of such extra excavation and of the filling required therein as specified above shall be borne in full by the contractor and nothing extra shall be paid on this account.

If required to protect the sides of pits and trenches, timber shoring and Strutting shall be erected. The timbering shall be closed or open depending on the nature of the soil and work, and arrangement of timbering including sizes and spacing of members used shall be as approved by the NCCF/Architect. No extra charges shall be admissible on this account. If desired by the NCCF/Architect, the contractors shall prepare relevant shop drawings and obtain approval of the NCCF/Architect before commencing the work.

The bottom of all excavations shall be trimmed and leveled in accordance with the drawings/directions of the NCCF/Architect. The bottom of all excavations shall be rammed and wetted before deposition of concrete. The contractors shall report to the Architect when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the Contractor has obtained the approval of the NCCF/Architect or his representative.

1.6.2 PROTECTION

All foundation trenches and similar excavations shall be strong, fenced and marked with red lights at night for watchmen and to avoid accidents.

Adequate protection measures shall be taken to see that the excavation does not affect or damage adjoining structures. All measures required for the safety of the excavations, the people working in and near the foundation trenches, property and the people in the vicinity shall be taken by the Contractor at his own cost, he being entirely responsible for any injury and damage to property caused by his negligence or accident due to his constructional operations. The contractor if required shall do the excavations in portions. It is the entire responsibility of the contractor against any injury and damage to property caused by his negligence or accident due to his excavation procedure.

1.6.3 SIDE PROTECTION FOR DEEP EXCAVATION

In case of excavation for foundation exceeding 2.0 meters in depth from existing ground level proper precautions shall be taken to prevent sides from collapse. This can be assured by adopting any one of the following methods and as directed by NCCF/Architect.

1. Stepping
2. Side Slopes
3. Planking and Strutting

The first two methods can be adopted where the soil is not loose and sloping/stepping is possible. The side slopes shall be done to such a degree that the sides are stable.

In case of very loose and treacherous soil, planking and strutting shall be done to avoid collapse. Planking and strutting shall be done in accordance with IS 3764 (safety code for excavation works)

Sheeting, shoring and bracings shall be maintained in place until immediately before filling or backfilling progress. The responsibility of designing, supplying and erecting a sound and stable shoring system rests with the contractor and shall be approved by NCCF/Architect before execution.

1.6.4 STACKING OF EXCAVATED MATERIALS

Work for excavation shall include sorting out of useful materials and stacking them on site as directed by the NCCF/Architect.

Materials suitable and useful for backfilling, plinth filling, leveling of the plot or other use shall be stacked in convenient places but not in such a way as to obstruct free movement of men, animals and vehicles or encroach on the area required for constructional purposes. All surplus material shall be disposed off as per the requirements of the GNIDA.

1.6.5 BACK FILLING

Earth / Sand obtained from excavation or approved earth / sand brought from outside shall be filled in layers around the foundations, under floors, plinth protection, sit outs and courtyards to the levels and plinth height as shown in drawings. The contractor shall obtain prior approval from the NCCF/Architect for any earth / sand brought from outside if required for quality and lead.

When the excavated earth is not suitable for backfilling then approved backfill material shall be brought from outside at his own cost. Back filling is to be done in such a manner as not to cause undue thrust on any part of the structure. Black cotton soil shall not be used for backfilling or plinth filling.

1.6.6 TRENCH BACK FILL

Back filling of trenches for pipelines shall be done first over the middle portion of each length or pipe bringing the cover to a depth of at least 300 mm over the top of the pipe while leaving all field joints exposed. After all required tests of the piping have been carried out and approved by the Architect the remaining trench backfill shall be accomplished. Extreme care shall be exercised during backfilling operations to prevent damages to coated or wrapped pipes.

1.6.7 QUALITY OF FILL

Back Fill shall be of well compacted, well graded earth or sand and shall be free from tree stumps, organic matter, seed and peat etc. Where earth or sand from source other than excavation at site is used, the quality of such earth or sand shall be the same as that obtained from excavation at site, or superior to it.

1.6.8 COMPACTION

The fill shall be spread in layers not exceeding 20 cm thick and each layer shall be watered and thoroughly consolidated by suitable mechanical rollers, rammers, vibrators or other approved plant or system of compaction. The fill material shall be pulverized before depositing in place. Optimum moisture content shall be maintained for the fill materials. Compaction shall be done so as to achieve a dry density of not less than 90% of the maximum density obtained at optimum moisture content, except for the upper 20 cm layer which shall be compacted to a density of not less than 95% of the maximum density.

In order that the fill shall be reasonably uniform through-out, the material shall be dumped in place in approximately horizontal layers. "End dumping", a process by which the material is pushed off edge of the fill and allowed to roll down the slope shall not be carried out. If there is traffic over the fill during construction, either by construction equipment or otherwise, it should be routed to make the compaction as uniform as possible. Where necessary symmetrical filling load shall be maintained and also care shall be taken to prevent any wedging action.

- Filling in site to achieve indicated levels
- Filling Materials in and around building will be of good earth / sand

1.7.0 DEWATERING

Work for excavation shall include bailing or pumping out water which may accumulate in the excavation during the progress of work either from subsoil, seepage, springs, flooding, rain or any other cause and diverting surface flow if any by bunds or other means, pumping out water shall be done in such approved manner as to preclude the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structure. When water is met with in foundation excavations, pumping out water shall be done in an approved manner. Dewatering or pumping out the water shall be done within the contractors quoted price.

Disposal of the water shall be done as approved by the GNIDA Office. The contractor shall make necessary arrangements to obtain the approvals within their quoted price. Unless prior approval is obtained, no water shall be drained out in the GNIDA sewer system.

The excavation shall be kept free from water:-

1. When concreting /reinforcement work/water proofing work are in progress.
2. Till the Architect/NCCF consider that concrete/mortar is sufficiently set.

LIFT AND LEAD

For this purpose generally excavation shall be measured and paid separately for the following lifts:-

- a) Up to 1.5 meter depth from ground level.
- b) 1.5 meter and part thereof.

NOTE: Lead shall not be paid separately. All excavated material shall be disposed either in the premises of the package or carted away as specified.

1.8.0 SURPLUS EXCAVATED MATERIAL

All excavated material certified as surplus shall be removed by the Contractor from the site in an approved manner or to the designated and approved dumping ground as ascertained by the NCCF/Architect. Nothing extra shall be paid to the Contractor on this account.

1.9.0 CONTRACT SUM TO INCLUDE

Apart from other factors mentioned elsewhere in this contract, the Lum-sum quote of the Contractor shall include for the following:

- (a) Clearing site and taking existing ground levels at 3 meters intervals (both sides)
- (b) Setting out works profiles etc as required and setting up bench marks and other reference marks.
- (c) Providing shoring and strutting and subsequently removing the same.
- (d) Bailing and pumping out water as required and directed.
- (e) Excavation at all depth (Unless otherwise specified in the drawings) and removal of all materials of whatever nature wet or dry and necessary for the construction of foundation etc and preparing bed for laying concrete.
- (f) Sorting out useful excavated materials transporting them beyond the structure and stacking them neatly on the site for back filling or reuse or disposing out from the site to approved locations as per GNIDA or as directed.
- (g) Back filling the trenches alongside masonry or concrete with approved excavated material up to the natural ground level including watering and ramming.
- (h) Necessary protection (including labour, material and equipment) to ensure safety against risk of accident.
- (i) Drilling of small holes as directed to explore the nature of sub-stratum if necessary.
- (j) Excavation in soft rock/hard rock if necessary.

1.10 The length breadth and depth shall be measured to nearest centimeter and the quantity shall be worked out in cubic meters to two decimal places. The depth shall be taken as per drawing or as excavated under special conditions under instructions from NCCF/ Architect. The width and length shall be taken as per length and width of PCC as per Drawings.

2.0.0 SPECIFICATIONS FOR WATER PROOFING:

2.0.1 Integral Crystalline Water Proofing

The work in general shall be executed as per CPWD specifications 2009 Vol.-I & II with upto date correction slip. The water proofing compound used in integral crystalline water proofing treatment shall satisfy all the requirements indicated in relevant BIS standards and shall be got tested before its use. Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the NCCF/Architect in writing. Materials shall be kept under double lock and key and proper account of water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements. Contractor shall associate himself with anyone of the specialist firms mentioned in approved list of specialized agencies for the work relating to the Water Proofing Treatment. In case the contractor intends to get the water proofing work executed from an agency other than as specified, he shall apply to the NCCF/Architect in writing along with the credentials and relevant details including name of NCCF/company, its location, capacity technical establishment, past experience etc. NCCF/Architect shall give approval in writing and the work shall not be started without said written approval of the NCCF/Architect. The entire responsibility for the quality of this treatment and its efficiency shall however, rest with the main contractor only.

2.0.2 Horizontal Water Proofing of Raft Slab

2.0.2.1 The work shall be executed as per manufacturer's specifications and executed through authorized applicator by manufactures specialized agency approved by NCCF/Architect.

2.0.2.2 Clean and dry condition is to be ensured before applying the HDPE water proofing sheet.

- (i) Membrane water proofing treatment for "raft slab" by using "Preprufe 300 R", 1.2 mm thick fully bonded HDPE sheet or equivalent shall be applied by manufacture's certified applicator before casting of basement raft slab.
- (ii) The pre applied fully bonded HDPE sheet membrane shall get bonded to the underneath of the poured concrete used as basement raft slab.
- (iii) The water proofing membrane shall consist of HDPE sheet comprises of an aggressive pressure sensitive water proof adhesive and weather resisting coating which bonds integrally with poured concrete of base slab.
- (iii) The waterproofing membrane system shall conform to basement waterproofing protection to grades 2, 3 as defined in BS 1802: 2009.
- (iv) The water proofing membrane shall have following minimum properties. :
- (v) Resist hydrostatic pressure up to 70 m head of water as per ASTM D 5385
- (vi) Puncture resistance of 990 N (as per ASTM E154)
- (vii) Adhesion to concrete of 2.88 N/mm.
- (viii) Tensile strength of 27.60 Mpa(as per ASTM D412)
- (ix) The membrane shall be installed with standard 75 mm selvedge laps and 75 mm end laps taped with Preprufe Tape HC or equivalent, **adouble side coated adhesive tape over the entire area and turnedup on to a vertical timber form work or any other suitable formwork as approved by the NCCF/Architect as per manufacturer's recommendation and drawings.**
- (xi) The membrane shall be laid over the concrete blinding having uniform cleaned and dried surface including necessary removal of membrane release linear while applying, necessary over laps between the membrane and fixing overlapped by 'Preprufe tape' or equivalent, firm rolling on to the surface to get a tight seal etc complete as directed by NCCF/Architect at all locations.
- (xii) All system to be installed as per manufacturer's specifications complete with all lead and lift for all materials and labor as directed by NCCF/Architect.
- (xiii) Work shall be carried out as per the manufacturer's method statement of waterproofing as approved by the NCCF/Architect. Work shall be guaranteed for 10 years against any leakageswith joint agreement between main contractor and associated specialized agency.

- (xiv) The contractor shall ensure that the basement of the building shall be absolutely water tight and seepage/leak proof. In case any seepage/leakage is noticed the contractor shall make it water tight & seepage/leak proof at his own cost.
- (xv) Pre stressed Anchor penetration or Pressure Release Pipes to be sealed with Preprufe tape or equivalent and Bituthene Liquid or equivalent Membrane. Place Adcor 500S or equivalent at the centrewrapping all around the anchor sleeve stuck with suitable adhesive.

2.0.3 Vertical Water proofing

- (i) The work shall be executed as per manufacturer's specifications.
- (ii) Clean and dry condition is to be ensured before applying the water proofing membrane over Bitumastic primer as per manufacturer's specifications.
- (iii) Bituthene 8000 of grace construction products or equivalent, adhesive, cold applied flexible 1.5 mm thick water proofing membrane comprising of self adhesive rubberized asphalt with crosslaminated HDPE film with a solar reflective film on top surface shall be applied on the vertical retaining wall by manufacturer's certified applicator.
- (iv) The membrane shall have pre-marked overlaps of 50 mm and shall be applied on the uniform concrete surface.
- (v) The self adhesive membrane shall be BBA certified and confirm to all grades of BS: 8102 : 2009 and shall have following minimum properties : (i) puncture resistance of 290 N (ii) resistance to hydrostatic head up to 70 m (ASTMD 5385) (iii) should be resistant to sulphates nitrates and salt in soil.
- (vi) For membrane termination a chase / rebate of 25 mm X 25 mm on the vertical wall shall be made. The chase/ rebate shall be adequately sealed with Grace approved or equivalent material.
- (vii) The laid membrane shall be protected with extruded polystyrene of 24 Kg/cum density to be placed directly on water proofing membrane.
- (viii) All system to be installed as per manufacturer's specifications etc. complete with all lead and lift for all materials and labor as directed by NCCF/Architect.
- (ix) Work shall be carried out as per the manufacturer's/Applicator's method statement of waterproofing accepted by the NCCF/Architect.

Work shall be guaranteed for 10 years against any leakages with joint agreement between main contractor and associated specialized agency.

- (x) The contractor shall ensure that the basement of the building shall be absolutely water tight and seepage/leak proof. In case any seepage/leakage etc. is noticed the contractor shall make it watertight & seepage/leak proof at his own cost.

- (xi) Primer is to be applied on a clean dry surface of wall.
- (xii) Screed concrete over water proofing membrane shall be provided on projected raft beyond retaining wall to protect the membrane.
- (xiii) A controlled backfilling should be carried out carefully in layers of 150 mm to 300 mm lifts to avoid damage to the membrane.
- (xiv) Drainage pipes and penetrations are to be treated with Bituthene LM or equivalent applied to clean, dry surfaces, with a fillet and extending 100 mm onto the penetration and the Bituthene 8000 or equivalent.

2.0.4 WATER PROOFING/ ROOFING

2.0.4.1 Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of **balconies, W.C, kitchen, stilt etc** and the like consisting of the following operations:

- a. 1st course of applying cement slurry @ 4.4 kg/sq m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.
- b. 2nd course of 20 mm cement plaster 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.
- c. 3 rd course of applying three coats of tapecrete or equivalent waterproofing, each coat shall be mixed with cement in the proportions recommended by the manufacturer.
- d. 4th course of 10 mm cement plaster 1:4 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.
- e. The rat includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer modified slurry.

2.0.4.2 Providing and laying integral cement based treatment for water proofing on **horizontal surface** at all depth below ground level for under ground structures like retaining wall, UG tank etc as directed by NCCF/Architect and consisting :

- a. 1st layer of 22mm to 25mm thick approved and specified rough stone slab over a 25mm thick base of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound conforming to IS 2645 in the recommended proportion over the leveling course. Joints sealed and grouted with cement slurry mixed with water proofing compound.
- b. 2nd layer of 25mm thick cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportions.
- c. Finishing top with stone aggregate of 10mm to 12mm nominal size spreading @ 8 cum/sqm thoroughly embedded in Using rough kota stone

2.0.4.3 Proofing and laying integral cement based treatment for water proofing on the **vertical surface of under ground structures like UG tank, Retaining walls etc** by fixing specified stone slab 22 mm to 25 mm thick with cement slurry mixed with water proofing compound conforming to IS :2645 in recommended proportions with a gap of 20 mm (minimum) between stone slabs and the receiving surfaces and filling the gaps with neat cement slurry mixed with water proofing compound and finishing the exterior of stone slab with cement mortar 1:3 (1 cement : 3 coarse sand) 20 mm thick with neat cement punning mixed with water proofing compound in recommended proportion complete at all levels and as directed by NCCF/Architect.
Using rough kota stone

2.0.4.4 INTEGRAL CRYSTALLINE WATER PROOFING

Providing and laying **Integral crystalline water proofing** material for horizontal and vertical surface and entire thickness of Under ground Structures like U G Tank, Retaining wall, Stitch Slab, Raft etc in specified proportions (minimum 2 % of weight of cement or as specified by the manufacturer). Properly Mixing in RMC/BMC/RCC in specified proportions as per the approved brand of crystalline waterproofing material like **Xypex 2000 NF/ Panetron/Kryotone** etc with RMC/BMC. Thoroughly mixing to workable consistency and pouring and casting in position within 20 minutes, Vibrating with mechanical vibrators and compaction etc. complete as per direction of NCCF/Architect.

The water proofing compound used in integral crystalline water proofing treatment shall satisfy all the requirements indicated in relevant BIS standards and shall be got tested before and after its use. Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the NCCF/Architect in writing. Materials shall be kept under double lock and key and proper account of water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements. Contractor shall associate himself with anyone of the specialist firms mentioned in approved list of specialized agencies for the work relating to the Water Proofing Treatment. In case the contractor intends to get the water proofing work executed from an agency other than as specified, he shall apply to the NCCF/Architect in writing along with the credentials and relevant details including name of owner/company, its location, capacity technical establishment, past experience etc. NCCF/Architect shall give approval in writing and the work shall not be started without said written approval of the NCCF/Architect. The entire responsibility for the quality of this treatment and its efficiency shall however, rest with the main contractor only.

2.0.4.5 TERRACE ROOF TREATMENT

Providing and laying integral cement based water proofing treatment including preparation of surfaces as required for:

2.0.4.5.1 **Treatment of roofs and terraces** consisting of the following operations:

- a. Applying one coat of acrylic polymer modified cement slurry coating over the RCC surface and continued upto height of 250 mm from the roof slab. Laying fibre glass cloth over the applied surface when the coating is still green and thereafter applying one more coat of acrylic polymer modified cement brush topping over the fibre glass cloth.

- b. Laying cement concrete using broken bricks bats 50 mm to 100mm size with 50% cement mortar 1:4 (1 cement : 4 coarse sand) admixed with approved water proofing compound over 20 mm thick layer of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with approved acrylic polymer based water proofing compound and top layer with 25 mm thick cement mortar 1:4 (1 cement:4 coarse sand) admixed with above water proofing compound to required slope and treating similarly the adjoining walls upto 300mm height including rounding of the junctions of wall and slabs.
- c. After two days of proper curing a second coat of cement slurry admixed with approved water proofing compound shall be laid, finishing the surface with 20 mm thick joint less layer of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with approved water proofing compound conforming to IS 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300x300 square.
- d. The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for the final test. All above operations to be done in order and as directed and specified by the NCCF/Architect.
- e. RCC surface to be cleared of all dirt, loose material and kept dry and holes/cracks to be repaired With average thickness of 120 mm and minimum thickness at shurra as 65 mm.

2.0.4.5.3 Grading Roof for water proofing treatment with:

2.0.4.5.4 Cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)

2.0.4.6 Brick bat coba water proofing of 110mm average thickness with brick aggregate and admixture of water proofing etc. Necessary gradient for easy flow of water shall be provided and the treated surface shall be covered with joint less water proof layer finished smooth.

2.0.4.6.1 For additional thickness where required over and above 110 mm (average) thickness.

2.0.4.7 EXTENDED BASEMENT WATER PROOFING TREATMENT (HORIZONTAL AND VERTICAL)

Providing and laying **APP (Atactic Polypropylene Polymer)** modified prefabricated five layer 3 mm thick water proofing membrane, black finished reinforced with non-woven polyester matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufacture of density of 25°C, 0.87-0.89 kg/ litre and viscosity 70-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc, and preparing the surface complete. The vital physical and chemical parameters of the membrane shall be as under: Joint strength in longitudinal and transverse direction at 23°C as 650/ 450N/5cm. Tear strength in longitudinal and transverse direction as 300/250N. Softening point of membrane not less than 150°C. Cold flexibility shall be upto -2°C when tested in accordance with ASTM, D-5147. The laying of membrane shall be got done through the authorised applicator of the manufacturer of membrane:

2.0.4.7.1 3mm thick

- 2.0.4.8 Covering top of membrane with **Geotextile**, 120 gsm non woven, 100% polyester of thickness 1 to 1.25 mm bonded to the membrane with intermittent touch by heating the membrane by Butane Torch where ever required or as per manufactures recommendation.
- 2.0.4.9 Covering subsoil water/rain water drains in landscape area/podium with **Geotextile**, 120 gsm non woven, 100% polyester of thickness 1 to 1.25 mm where ever required or as per manufactures recommendation.
- 2.0.4.10 Providing and laying minimum 50 mm **Screed** concrete 1:2:4 (1 cement:2 coarse sand:4 graded stone aggregate 20 mm nominal size) above the water proofing membrane as a protection layer to water proofing in slope as per drawing including welded wire mesh of weight 1.5 kg/ sq m and 50mm thickness pressure guniting on top complete as per specification
- 2.0.4.11 Polyurethane **foam over deck insulation** on roof with cement based integral brick bat coba with waterproofing compound with specialised agency.
- 2.0.4.12 Making **khurras** 60 x 60 cm with average minimum thickness of 5cm cement concrete 1:2:4 (1 cement : coarse sand : 4 graded stone aggregate of 10 mm nominal size) over P.V.C sheet 1m X 1m X400 micron, finished with 12 mm cement plaster 1:3 (1 cement :3 coarse sand) and a coat of neat cement rounding the edges and making and finishing the outlet complete.

2.0.4 Guarantee Bond

Ten years guarantee bond in prescribed proforma shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liability/liabilities under the guarantee bond. However, the sole responsibility about efficiency of water proofing treatment shall rest with the building contractor.

Separate guarantee bonds shall be submitted by the Contractor for different type of water proofing work. Ten per cent of the cost of water proofing work shall be retained as security deposit and the amount so withheld would be released after ten years from the date of expiry of maintenance period under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended within the specified period, the same will be got done from other agency at the risk and cost of contractor. The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

2.1.0 SPECIFICATIONS FOR ANTITERMITE TREATMENT

2.2.0 GENERAL

Prevention of termite from reaching the super -structure shall achieved by creating a chemical barrier between the ground and the building by treating the soil beneath the building and around the foundations. The work shall be carried out as per IS 6313 Par II of 1981 or the latest edition.

This shall be provided to sides and bottom of trenches and footings including treating the backfill of foundations up to ground level and the vertical surfaces of wall, and filling of earth under floors and treating the surface at ground level up to 1000mm all around the building.

2.2.0 MATERIAL

Anti termite treatment shall be carried out strictly in accordance with CPWD specifications using Chloro-pyrifos (CPP) an emulsified concentrate @ 1 % or any other approved Chemical concentrate shall be used as per IS: 1307 and as directed by NCCF/Architect.

2.3.0 PRE-CONSTRUCTION CHEMICAL TREATMENT

This will be done with chemical treatment applied to a building in the early stages of its construction at the rate specified in IS 6313 Part II of 1981 or the latest edition.

Hand operated pressure pump shall be used for uniform spraying of the chemical. To have proper check for uniform spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required areas during the operation.

2.4.0 TIME OF APPLICATION

Soil treatment shall start when foundation trenches and pits are ready to take lean concrete in foundations. Laying of lean concrete shall start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the sub grade for the floor.

2.5.0 DISTURBANCE

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.6.0 TREATMENT

2.6.1 TREATMENT OF WALL-TRENCHES

The bottom surface and the sides (up to a height of above 300mm) of the excavation made for Retaining Wall trenches shall be treated with the chemical at the rate specified in IS 6313 Part II of 1981 or latest edition.

After the foundations and the wall foundations come up, the backfill in immediate contact with the foundation structure shall be treated at the rate specified in IS 6313 Part II of 1981 or the latest edition of the vertical surface of the sub-structure for each side. If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation

is done by Roding the earth at 150 mm centers close to the wall surface and spraying the chemical with the above dose. The earth shall be returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete to masonry surfaces of the columns and walls so that the earth in contact with these surface is well treated with the chemical.

2.6.2 TREATMENT OF TOP SURFACE OF PLINTH FILLING

The top surface of the filled earth within plinth shall be treated with chemical emulsion at the rate as per IS 6313 Part II of 1981 or the latest edition (surface area) before the sand/sub-grade is laid. Holes up to 50 to 75mm deep at 150mm centers both ways shall be made with crow bars on the surface to facilitate saturation of the soil with chemical emulsion.

2.6.3 TREATMENT OF JUNCTION OF WALL AND FLOOR

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level, small channel 30x30mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel up to ground level 150mm apart and the chemical emulsion poured along the channel as per rate of application, mentioned in IS 6313 Part II (1981) or the latest edition so as to soak the soil right up to bottom. The soil shall be tamped back into place after this operation.

2.6.4 TREATMENT OF SOIL ALONG EXTERNAL PERIMETER OF BUILDING

During progress of work, provide holes in the soil with iron rods along the external perimeter of the building at intervals of about 150mm and depth 300mm and filling these holes with chemical emulsion at the rate (as per IS 6313 Part II of 1981 or the latest edition) per meter of perimeter of the external wall.

2.6.5 TREATMENT FOR EXPANSION JOINTS

Anti-termite treatment shall be supplemented by treating through the expansion joint after the sub-grade has been laid as per IS 6313 Part II of 1981 or the latest edition.

2.6.6 TREATMENT OF SOIL SURROUNDING PIPES AND CONDUITS

When pipes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipes or conduit for a distance of 150mm and up to a depth of 75mm before treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 75mm for distance of over 300mm from ground level.

2.7.0 SAFETY PRECAUTIONS

All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapors or spray mists or swallowed.

Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given below.

These chemicals are usually brought to site in the form of emulsifiable concentrates. The containers should be clearly labeled and should be stored carefully so that children and pets cannot get at them. They should be kept securely closed.

Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they should be flushed with plenty of fresh water and immediate medical attention should be sought.

The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed nearby during the mixing.

Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs which serve as sources of drinking water.

The contractor shall undertake all reasonable care and safety precautions to protect his workmen, other sub contractors/ specialist construction agencies working on the site, Employers/Architects and their representatives against damages due to harmful exposure to the chemical and all such damages if any the cost of the same shall be borne by the contractor. The Contractor shall furnish purchase vouchers of the Chemicals to the NCCF/Architect as and when purchased and record of the same shall be maintained at site of work.

2.8.0 Blank

3.0 SPECIFICATIONS FOR CAST-IN-PLACE REINFORCED CONCRETE

3.1 GENERAL

3.1.1 DESCRIPTION

This section covers the requirements for furnishing of cement concrete, proportioning, batching, mixing, testing, placing, compacting, finishing, joining, curing and all other work as required for cast-in-place reinforced concrete. The contractor shall provide all the materials, labor, equipment, form work, scaffolding etc. required for completion of all reinforced concrete work as per drawing & specifications and contract documents.

Cement concrete shall be composed of cement as specified , fine aggregate, coarse aggregate, water, with or without admixture as approved, proportioned and mixed as specified herein and elsewhere.

3.1.2 RELATED WORK SPECIFIED ELSEWHERE

- a) Steel reinforcement
- b) Formwork

3.1.3 APPLICABLE CODES AND STANDARDS

The codes and standards generally applicable to the work of this section are listed hereinafter.

IS	:	269	Ordinary and low heat Portland cement
IS	:	383	Coarse and fine aggregates from natural sources for concrete
IS	:	455	Portland Slag Cement
IS	:	456	Code of practice for plain and reinforced concrete
IS	:	516	Methods of testing for strength of concrete
IS	:	1199	Methods of sampling and analysis of concrete
IS	:	1489	Portland - pozzolana cement
IS	:	1838	Preformed fillers for expansion joints in concrete Non-extruding and resilient type
IS	:	1946	Code of practice for use of fixing devices in walls, ceilings and floors of solid construction.
IS	:	2386	Methods of testing of aggregates for concretes
IS	:	2505	Concrete vibrators, immersion type
IS	:	2645	Integral cement waterproofing compounds
IS	:	3414	Code of practice for design and installation of joints in buildings
IS	:	3558	Code of practice for use of immersion vibrators for Consolidating concrete
IS	:	4082	Recommendations on stacking and storage of Construction materials at site

IS : 7861 Code of practice for extreme weather concreting

IS : 7861 recommended practice for hot weather concreting(Part I)

The following clauses are intended to amplify the requirements of the reference documents listed above and contractor shall comply with these clauses.

3.2 SUBMITTALS

3.2.1 Material Report

Prior to start of delivery of materials required, the following shall be submitted by the contractor to the NCCF/Architect for approval:

Suppliers and/or sources of all consumable materials including cement, fine and coarse aggregates, water additives, cement concrete blocks and timber, etc.

Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting to the NCCF/Architect on the quality of materials being supplied.

3.3 PLANT AND EQUIPMENT

The contractor shall submit the following to the NCCF/Architect well in advance:

The proposed program, methods and details of plant and equipment to be used in testing ingredients, mix design and concrete samples.

The proposed program, methods and details of plant and equipment to be used for batching and mixing of concrete.

3.4 REPORTS FOR INSPECTION AND TESTING

During concreting operations, the Contractor shall conduct inspection and testing as described in aforesaid conditions and all reports shall be submitted in summary form to the NCCF.

3.5 SCHEDULES

Before commencement of the work the contractor shall prepare working schedules of concreting giving dates and date of pour for each item of work and submit the same to the NCCF/Architect for the approval of NCCF.

3.6 MATERIALS

Before bringing to the site, all materials for cement concrete shall be approved by the NCCF. All approved samples shall be deposited in the office of the NCCF/Architect before placing

orders for the materials with suppliers. The materials brought on to the works shall conform in every respect to their approved samples.

Fresh samples shall be deposited with the NCCF/Architect whenever type or source of any material changes. The contractor shall check each fresh consignment of materials as it is brought on to the works to ensure that they conform to the specifications and/or approved samples.

The NCCF/Architect shall have the option to have any of the materials tested to find whether they are in accordance with specifications. The contractor shall arrange and get the materials tested as required. All bills vouchers and test certificates which in the opinion of the NCCF/Architect are necessary to convince him as to the quality of materials or their suitability shall be produced for his inspection when required.

Any materials which have not been found to confirm to the specifications and not approved by the NCCF/Architect shall be rejected forthwith and shall be removed from the site by the contractor at his own cost within the time stipulated by the NCCF. The NCCF have the powers to cause the contractors to purchase and use materials from any particular source, as may in their opinion be necessary for the proper execution of work.

3.6.1 CEMENT

Ordinary Portland cement shall conform the IS specification IS: 269. Portland Pozzolana Cement shall conform to IS: 1489. Portland Slag Cement shall conform to IS: 455:1989. Sulphate Resistant Cement shall conform to the necessary IS codes. Cement at site shall be stored in dry weatherproof godowns (or shed) with lifting arrangements built by the Contractor at his own costs in stacks, which are not higher than 10 bags. Sufficient space shall be provided for circulation and rotation of bags in order to minimize the stacks on a masonry base, or in bulk storage as specified elsewhere in these documents.

3.6.2 AGGREGATES

Aggregates from natural sources shall be in accordance with IS: 383. The contractor shall submit to the NCCF/Architect certificates of grading and compliance from the suppliers for all consignments of aggregate. In addition at site from time to time, the contractor shall test the aggregates in accordance with IS: 2386 Parts I, II and III. The contractor shall allow for and provide all necessary apparatus for carrying out each test and for supplying test records to the NCCF.

For fair faced concrete, the contractor shall ensure that aggregate are free from iron pyrites and impurities, which may cause discoloration.

The fine aggregate shall be pit sand, stone dust or other approved sand. It shall be free from clay, loam, earth or vegetable matter and from salt or other harmful chemical impurities. It shall be clean, sharp, strong, angular and composed of hard siliceous material.

The grading of sand as determined by the method prescribed in IS: 2386 Part I shall be within the limits of grading Zone III given in Table 1. When the grading falls outside the percentage

limits given for sieves other than 600 micron, 300 micron and 150 micron (I.S) sieves by not more than 5 percent. It shall be regarded as falling within this zone. The 5 percent can be excess summation on one or more sieves.

TABLE 1 - FINE AGGREGATE

I.S. Sieve	Percentage Passing for Grading			
	Zone I	Zone II	Zone III	Zone IV
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	35-60	80-100
300 micron	5-20	8-30	8-30	20-65
150 micron	0-10	0-10	0-10	0-15

The maximum quantity of silt as determined by the method prescribed in IS: 2386 Part II shall not exceed 7%.

Approved stone dust if used after obtaining prior permission of the NCCF/ Architects shall be within the limits of Grading Zone III given in Table 1. When the grading falls outside the percentage limits given for the sieves other than 600 micron and 300 micron (I.S.) sieves by not more than 5 percent and on 150-micron sieves by not more than 20 percent it shall be regarded as falling within this zone. The 5 percent can be excess accumulation on one or more sieves.

3.6.2.1 COARSE AGGREGATE

The coarse aggregate shall be crushed stone, river shingle or approved pit gravel.

Coarse aggregate obtained from crushed or broken stone shall be angular, hard, strong, dense, durable, clean and free from soft, friable, thin, flat, elongated or flaky pieces. The coarse aggregate should be from the approved source/ quarry.

River shingle or pit gravel shall be rounded, sound, hard, clean, non porous, suitable graded in size with or without broken fragments and free from flat particles of shale, clay, silt, loam and other impurities.

Expect where it can be shown to the satisfaction of the NCCF/Architect’s representative that a supply of properly graded aggregate of uniform quality can be maintained over the period of the works, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in correct proportions as and when required.

The maximum size of coarse aggregate shall be such that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of formwork.

3.6.3 WATER

Water used in the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and/or washing aggregate shall be fresh and clean, free from injurious amounts of oil, salts, acids, alkali, other chemicals and organic matter.

Water shall be from the source approved by the NCCF/Architect and shall be in accordance with clause 4.3 of IS: 456.

Before starting any concreting work and whenever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the NCCF. No water shall be used until tested and found suitable by the contractor.

3.6.4 ADMIXTURES AND ADDITIVES

Chemical admixtures are not to be used until permitted by the NCCF. In case their use is permitted, the type, amount and method of use of any admixture proposed by the contractor shall be submitted to the NCCF/Architect for approval.

The contractor shall further provide the following information concerning each admixture to the NCCF/Architect.

Normal dosage and detrimental effect, if any, of under dosage and over dosage.

The chemical names of the main ingredients in the admixture.

The chloride ion content, if any, expressed as a percentage by weight of admixture.

Whether or not the admixture leads to the entrainment of air when used in the manufacturer's recommended dosage.

Where two or more admixtures are proposed to be used in any one mix, the manufacturer's written confirmation of their compatibility.

In reinforced concrete, the chloride ion of any admixture used shall not exceed 2 percent by weight of the admixture as determined in accordance with IS: 6925 and the total chloride ion in all admixtures used in concrete mix shall not exceed 0.03 percent by weight of cement.

The admixtures when used shall conform to IS: 9103. The suitability of all admixtures shall be verified by trial mixes.

The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances.

Retarding admixtures when used shall be based on lignosulphonates with due consideration to clause 5.2 and 5.3 of IS: 7861.

Waterproofing admixtures shall comply with IS: 2645.

3.7 PLANTS

The contractor shall obtain the approval of the NCCF/Architect for all plant items he proposes to use for the manufacture and placing of concrete.

The arrangement and setting of plant for the manufacture of concrete shall be agreed with the NCCF.

The contractor shall maintain all items of plant at all times in clean and efficient working conditions.

3.8 STORAGE

All goods and products including NCCF's supply if any covered by these specifications shall be procured well in advance and stored as specified below

3.8.1 CEMENT

Cement shall be stored on a raised floor in dry weather proof and draught free but well ventilated shed.

Cement bags shall be stacked close together away from external walls and in stacks of not more than ten bags to avoid lumping under pressure.

Cement stored during monsoons or cement expected to be in store for more than eight weeks shall be completely enclosed in 700 gauge polythene sheet so arranged that the flap; closes on the top stack. The contractor shall ensure that protective polythene sheet is not damaged at any time during use.

Ordinary Portland cement and Portland pozzolana cement shall be stored in separate sheds or separate compartment of a shed. If the above two types of cement are found mixed when being used by the contractor, the NCCF/Architect shall have the discretion to condemn all the cement concerned.

Consignments of cement shall be used in order of delivery. A record shall be kept of the batch numbers of cement deliveries in such a form that the part of the works in which the cement is used can be readily identified. If during delivery or by test, the cement is found to be defective, the same shall be returned back forthwith.

The contractor shall be responsible for the storage of cement at the site or otherwise at any other place, no claim will be entertained in the event of any damage occurring to cement due to faulty storage by the contractors or on account of his negligence.

Cement stored on site for a period longer than eight weeks shall be tested to the satisfaction of the NCCF/Architect before it is used in the works. Cement that has failed the tests conducted shall not be used in the works.

The contractor shall have proper storage facility to ensure safe storage besides shall have his own arrangements to transport the same from the place designated by the NCCF. All this shall be deemed to be included in the quoted price and no claim shall be entertained in this regard whatsoever.

3.8.2 AGGREGATES

Aggregates shall be stored on a suitable well-drained raft of concrete, timber, metal or other approved material. The storage of aggregates on the ground will not be permitted.

Each size of aggregate shall be stored separately in such a manner as to prevent spillage and mixing of one aggregate with an adjacent aggregate. The dividing walls of any bin shall be of sufficient height and the aggregate shall be so deposited that a distance of 100 mm shall be left between the top of the division wall and any part of the aggregate stack.

When stack piling, the aggregate shall not form pyramids resulting in segregating of different size particles. The stacks shall be regular and of a height not exceeding two meters.

3.9 GRADE OF CONCRETE

The controlled concrete where specified shall be in grades designated as M-10, M-15, M-20, M-25, M-30 and M-40 or as required as per drawing and design.

3.9.1 ORDINARY CONCRETE

All cement concrete not designated by strength shall be treated as ordinary concrete of nominal mix as specified. The aggregate and cement shall be measured by volume. Mixing water shall be measured in graduated litre cans. The quantity of water to be used for each mix of 50 kg cement shall not be more than as given below:

Mix	Water to be used
1:3:6	34 litre
1:2:4	30 litre
1:1.5:3	27 litre
1:1:2	25 litre

3.9.2 NOMINAL VOLUMETRIC MIXES

Whenever concrete is specified in volumetric proportions such as 1:4:8, 1:3:6, 1:1.5:3, 1:1:2, etc., without designating the same under the grade mentioned above, it shall be taken to mean that the proportions by volume of the cement:sand: aggregate shall be in the order in which the mix is specified. For example, where concrete of 1:2:4 mix is specified it shall be made from

one part of cement, two parts of sand and four parts of aggregates, cement shall, however be batched by weight.

3.9.3 DESIGN MIX CONCRETE

Following parameters shall be adopted for mix design as per IS-456-2000 (Latest Edition)

3.9.3.1 Approved admixtures conforming to IS 9103 shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed concrete shall satisfy the requirement of IS 456-2000.

3.9.3.2 The Fly ash/mineral based admixtures shall not be permitted in Design Mix Concrete unless otherwise specifically mentioned.

3.9.3.3 The cement arranged by the contractor will be PPC. The fly ash used in the fly ash admixed cement concrete shall conform to CDO circular no. CDO/SE(RR)/Fly ash (Main)/ 102 dated 09.04.2009. Batch mix concrete produced from batch mix plant at site shall only be used for all RCC works.

However, NCCF/Architect may allow RMC from RMC producer till the batch mix plant is installed at site, design mix (Ready mix) shall be as per CPWD specification 2009 vol I & II. RMC as per approved design mix from approved RMC plant may be used.

3.9.3.4 The concrete mix design with and without admixture will be carried out by the contractor, at his own cost, through one of the following laboratories/Test houses to be approved by NCCF/Architect: - NCCF/Architect of the work will proof check the mix design submitted by the contractor and in the event of proof check found to be incorrect the cost of same shall be owned by the contractor.

- (i) IIT, Delhi
- (ii) National Council for Cement & Building Materials, Ballabgarh.
- (iii) CRRI, Delhi
- (iv) Delhi College of Engineering

3.9.3.5 In the event of all the four laboratories being unable to carry out the requisite design/testing; the contractor shall have to get the same done from any other reputed laboratory with prior approval of the Architect-PMC.

3.9.3.6 The various ingredients for mix design/laboratory tests shall be sent to the approved lab/test houses through the NCCF/Architect and the samples of such ingredients sent shall be preserved at site by the contractor till completion of work or change in Design Mix whichever is earlier. The sample shall be taken from the approved materials which are proposed to be used in the work.

3.9.3.7 The Contractor shall submit the mix design report from approved laboratory for approval of NCCF/Architect within 45 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the mix design is approved by NCCF/Architect. The contractor shall make cubes of trial mixes as per approved mix design at site laboratory for all grades of concrete in presence of the NCCF/Architect using same ingredients as adopted for design mix, prior to commencement of concreting and get them tested in presence of NCCF/Architect . The testing and the acceptance of the trial mixes shall be as per CPWD

Specifications. The conformity of mix design should be established by conducting three repeat trial mix tests. In each repeat trial mix test six cubes of standard size 15 cm x 15 cm x 15 cm shall be cast, out of which three cubes shall be tested after 7 days & 3 cubes shall be tested after 28 days. This provision shall be as per relevant paras of CPWD specifications 2009.

3.9.4 90% of the total trial mix tests shall be done in the laboratory established at site by the contractor and remaining 10% in the laboratory of Central Design Organization, CPWD or in any other laboratory as directed by Engineer-in Charge. Samples of various materials required for testing shall be provided free of cost by the contractor. Testing charges, if any, shall be borne by the department provided the sample passes the test, otherwise it shall be borne by the contractor. All other expenditures required to be incurred for taking the samples; conveyance, packing etc. shall be borne by the contractor himself. (This supersedes provision of clause 10A of General Conditions of Contract for CPWD works (CPWD-8). The contractor shall produce all the materials in advance so that there is sufficient time for testing and approval of the materials and clearance before use in work. The NCCF/Architect shall be at liberty to test representative sample(s) of each item of schedule of quantity in any approved laboratory as decided by him. The sample of testing shall be provided by the contractor free of cost. Any expenditure required to be incurred for taking sample; conveyance and packing shall be borne by the contractor. In case of any sample of particular lot fails in testing the contractor shall be bound to replace the entire lot with fresh material of prescribed specifications. The rejected lot shall be returned to the contractor only after fresh lot is supplied. Testing charge in respect of failed sample will be recovered from the contractor.

3.9.5 For each change of source or quality / characteristic properties of the ingredients from that approved & used in the concrete mix during the work, a fresh mix shall be got done by the contractor. However, maximum two such changes shall be permitted in the whole work. For any change, the Contractor shall bear the cost of fresh Mix Design. Revised trial mix tests shall be conducted at Laboratory established at site or NCCF/Architect may order for testing of these cubes from the independent laboratory and shall be submitted by the contractor as per the direction of the Architect/PMC.

3.9.6 The cost of packaging, sealing, transportation, loading, unloading, cost of samples and the testing charges for mix design in all cases shall be borne by the contractor.

3.9.7 WORK STRENGTH TEST & ACCEPTANCE CRITERIA

(a) Acceptance of concrete, work strength test & cube test shall be carried out as per CPWD specification 2009 Vol-I with up to date correction slips.

3.9.8 READY MIX CONCRETE (RMC)/BATCH MIX CONCRETE FROM RMC PRODUCER

3.9.8.1 Contractor shall install batch mix plant at site immediately after the work is awarded. However the contractor shall be allowed to arrange Ready Mix Concrete (RMC) from the approved listed RMC producing plants as given in the approved list.

The use of fly ash in RMC is permitted, as per IS code and approved design mix.

Minimum cement content for design mix shall be as per BIS.

3.9.8.2 The contractor shall, within a period of 26 days of award of the work, submit text of MOU proposed to be entered between purchaser (the contractor) and supplier (RMC) producer to the NCCF/Architect for his approval. The contractor shall draw the MOU with approved RMC producer and submit to the NCCF/Architect within a week of such approval. The contractor will not be allowed to use ready mix concrete without completion of above stated formalities.

3.9.9 Notwithstanding the approval granted by the NCCF/Architect in aforesaid manner or provisions in CPWD specifications 2009, the contractor shall be fully responsible for quality of concrete including input control, transportation and placement etc.

3.9.10 For all purpose the contractor shall carry out fully, the responsibilities of the placement contractor and the manufacturer of concrete.

3.9.11 The NCCF/Architect will reserve right to inspect at any stage and reject the concrete if he is not satisfied about quality of product at the user's end.

3.9.12 The NCCF/Architect reserves the right to exercise control over the:-

(i) Ingredients water and admixtures purchased stored and to be used in the concrete including conducting of tests for checking quality of materials recording of test result and declaring the materials fit or unfit for use in production of mix.

(ii) Calibration check of the RMC plant.

(iii) Weight and quantity check on the ingredients, water and admixture added for batch mixing.

(iv) Time of mixing of concrete.

(v) Testing of fresh concrete, recording of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action, if required.

(vi) For exercising such control, the NCCF/Architect shall periodically depute his authorized representative at the RMC plant. It shall be responsibility of the contractor to ensure that all necessary equipment, manpower & facilities are made available to the NCCF/Architect and/or his authorized representative at RMC plant.

3.9.13 The contractor should therefore draw MOU/agreement with RMC producer very carefully keeping in view all terms and conditions/specifications forming part of this document.

3.9.14 All required relevant records of RMC shall be made available to the Architect/PMC or his authorized representative. The NCCF/Architect shall as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production & transportation of concrete mix which shall be binding on the contractor & the RMC plant. Only concrete as approved in design mix by the NCCF/Architect shall be produced in RMC plant and transported to the site.

3.9.15 OPC/Containing to IS: 862 of brand/make/source as approved by the Architect/PMC shall only be used for production of RMC.

3.9.16 QUALITY CONTROL OF READY MIXED CONCRETE

It shall be the responsibility of the contractor to ensure that RMC producer provides all necessary testing equipments and takes all necessary measures to ensure quality control of ready mixed concrete. In general the required measures shall be:-

(i) Control of purchased material quality

RMC producer shall ensure that all the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards and the requirements of the concrete mix design and quality control procedures. This shall be accomplished by visual checks, sampling and testing, certification from material supplier and information/date from materials supplier. Necessary equipment for the testing of all materials shall be provided and maintained in calibrated condition at the plant by the RMC producer.

(ii) Control of material storage

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for reliable transfer and feed systems, drainage of aggregate, prevention of freezing or excessive solar heating of aggregate, prevention from contamination etc.

(iii) Record of mix design and mix design modification

RMC producer shall ensure that record of mix design and mix design modification is readily available in his computer at RMC plant for inspection of Architect/PMC or his authorized representative at any time. Any modification in mix design shall be done only after the approval of the Architect-PMC.

(iv) Transfer and weighing equipment

RMC producer shall ensure that a documented calibration procedure is in place. Proper calibration records shall be made available indicating date of next calibration due & corrective action taken. RMC producer shall ensure additional calibration checks whenever required by the NCCF/Architect in writing to contractor. RMC producer shall also maintain a daily production record including details of customers to whom RMC was supplied including details of mixes supplied. Record shall also be maintained of materials used for each day's production including water and admixtures. The accuracy of measuring equipment shall be within + 2% of quantity of cement & + 3% of quantity of aggregate, admixture and water being measured.

(v) Maintenance of Plant, Truck Mixers and Pumps:

Plant, Truck Mixers and Pumps should be well maintained so as to not hamper any operation of production, transportation and placement of concrete.

(vi) Production of concrete at RMC producing plant

- I. Weighing (correct reading of batch date and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimate slumps, the total amount of water added to the load, the delivery ticket numbers for that load and the time of loading the concrete into the truck.
- II. Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete (assessment of uniformity cohesion, workability, adjustment to water content:- The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.
- III. Adequate testing equipments at the plant including equipment for measuring surface moisture content of aggregates shall be provided by the RMC producer.
- IV. Making corresponding adjustments at the plant automatically or manually to batched quantities to allow for observed measured or reported changes in materials or concrete qualities.

- V. Sampling of concrete, testing, monitoring of results.
- VI. Diagnosis and correction of faults identified from observation/complaints.
- VII. Control of designed and the prescribed mixes: a quality control system shall be operated to control the strength of designed mixes to the required levels. The system shall include continuous analysis of results from cube tests.
- VIII. Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by NCCF/Architect. Noting extra shall be payable on this account.
- IX. NCCF/ Architect reserves the right to approve RMC producing plants not mentioned in the list of approved RMC plants if they fulfill all the necessary conditions.
- X. In case of rejection of concrete as governed by the para "Standard of Acceptance" as above, the work for which samples have failed shall be redone at the cost of the contractor. However, the NCCF/Architect may order for additional tests (like cutting cores, ultrasonic pulse velocity, and rebound hammer test etc.) to be carried out at the cost of contractor to ascertain, if the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The contractor shall take remedial measures necessary to retain the structure as approved by the NCCF/Architect without any extra cost. However, for payment, the basis of rate payable to contractor shall be governed by the 28 days cube test result and reduced rates shall be regulated in accordance with para 5.4.10.5 D(D-3) of CPWD specifications.

3.9.17 Laying of RMC concrete- All ready mixed designed concrete shall be laid with the help of concrete pump of adequate capacity.

3.9.18 Transportation, Placing and Compaction of Concrete

Mixed concrete from the RMC shall be transported to the point of placement by transit mixers and placed in position through concrete pumps and/or steel closed bottom buckets capable of carrying minimum 0.6 cum concrete is proposed to be transported by transit mixer, the mixing speed shall not be less than 4 rev/min. of the drum nor greater than a speed resulting in a peripheral velocity of the drum 70 m/minutes at its largest diameter. The agitating speed for the agitator shall be not less than 2 rev/min nor more than 6 rev/min of the drum. The numbers of revolution for a uniform mix, after all ingredients, have been charged into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev/min and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirement shall conform to IS: 5892.

In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the line is liable to cause a plug. The operator shall ensure that some concrete is always there in the pump receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents. At all stages, special precaution shall be taken that surrounding temperature during concreting shall not

exceed 30 degree centigrade. Except where otherwise agreed to by the NCCF/Architect, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450mm. unless agreed to by the NCCF/Architect; concrete shall not be dropped into place from a height exceeding 1.5m. In order to avoid such situations chutes, termite pipe or closed bottom buckets shall be used. These shall be kept clean and used in such a way as to avoid segregation. Slope of the chute shall be so adjusted that concrete flows without the use of excessive quantity of water. The delivery end of chute shall be as close as possible to the point of deposit; the chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork. The concrete shall be compacted by using immersion type vibrators. When the concrete is being continuously deposited to a uniform depth along a member, vibrator shall not be operated within one meter of free end of the advancing concrete. Every effort shall be made to keep the surface of the previously placed layer of concrete alive so that the succeeding layer can be amalgamated with it by the vibration process.

In case the concrete in underlying layer has hardened to such an extent that it cannot be penetrated by the vibrator but is still fresh (that is, just after initial set), un-imposed bond shall be achieved between the top and underlying layer by first scarifying the lower layer before the new concrete is placed by systematically and thoroughly vibrating the new concrete. The points of insertion of vibrator in the concrete shall be so spaced that the range of action overlap to some extent and the freshly filled concrete is sufficiently consolidated at all locations. The spacing between the dipping positions of vibrator shall be maintained uniformly throughout the surface of concrete so that concrete is uniformly vibrated. The vibrating head shall be regularly and uniformly inserted in the concrete so that it penetrates of its own accord and shall be withdrawn slowly whilst running so as to allow redistribution of concrete in its way and allow the concrete to flow back into the hole behind the vibratory. The vibrator head shall be kept in one position till the concrete within its influence is completely consolidated. Vibration shall be continued until the coarse aggregate particles have blended into the surface but have disappeared. The contractor shall keep at least one additional vibrator in serviceable condition to be used in the event of breakdowns and maintenance problems. The vibrator head shall be kept in one position till the concrete within its influence is completely consolidated. Vibration shall be continued until the coarse aggregate particles have blended into the surface but have disappeared. The contractor shall keep at least one additional vibrator in serviceable condition to be used in the event of breakdowns and maintenance problems. The vibrator head shall stagnate. The formwork shall be strong and great care shall be exercised in its assembly. It shall be designed to take up increased pressure of concrete and pressure variations caused in the neighborhood of vibrating head, which may result in excessive local stress on the formwork. The joints of the formwork shall be made and maintained tight and close enough to prevent the squeezing out slurry or sucking in of air during vibration. The formwork to receive concrete shall be cleaned and made free from standing water, dust, etc. The contractor shall keep provision for screed and shutter vibrators at site.

3.10 STRENGTH REQUIREMENTS OF CONCRETE

Where ordinary Portland cement is used, the compressive strength requirements for various grades shall be as given in Table 2. It shall be Contractor's responsibility to obtain specified strengths for the various grades of concrete.

As far as strength requirements of concrete referred to in 3.9 above specified in volumetric proportions like 1:2:4 etc., they shall conform to clause IS specifications table which is reproduced below:

Table 1:

Concrete Mix	Compressive strength (Kg./sq. cm) at
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1:2:2	7 days	28 days
1:2.5:2.5	210	315
1:1.5:3	195	290
1:1.75:3.5	160	240
1:2:4	140	210

TABLE 2 - STRENGTH REQUIREMENTS OF CONTROLLED CONCRETE WHERE SPECIFIED (ALL Values in Kg/Sq. cm.)

Grade of concrete	Compressive Strength on 15 cm. Cubes Mix at 7 days (work Test only)	Compressive Strength of 15 cm. Cubes at 28 days after mixing, conducted in accordance with IS: 456-1978	
		Preliminary Test	Works Test
M 10	70	135	100
M 15	100	200	100
M 20	135	260	200
M 25	170	320	250
M 30	200	380	300
M 35	235	440	350
M 40	270	500	400

3.11 CRITERIA REGARDING STRENGTH

Although the works test cubes are specified to be conducted at the age of 7 and 28 days, in all cases 28 days compressive strength specified above shall alone be the criteria for acceptance or rejection of concrete.

3.12 CLASSIFICATION OF CONCRETE OF LOWER OR HIGHER STRENGTH THAN SPECIFIED

Where the strength mix (for ordinary concrete or Controlled Concrete), as indicated by tests, lies in between the strengths of any two grades specified as above, such concrete shall be classified as a grade belonging to the lower of the two grades between which its strength lies. In case the cube test strengths show higher strengths than those specified for the particular grade of concrete, concrete shall not be placed in any higher grade nor shall contractor be entitled for any extra payment on such account.

3.13 DAMP PROOF COURSE

Damp proof course shall be of 40mm thick PCC of specified grade or as directed by NCCF/ Architect with water proof compound CEMSEAL or equivalent at the rate of 1 litre per 50 Kg of cement including centering and shuttering. The top surface of DPC shall be finished even and not smooth.

DPC as specified above shall be provided 40mm below finished floor to the full width of walls. No DPC shall be provided on the walls where tie/plinth beams are being provided.

No DPC shall be provided over dwarf walls but floor shall be carried over the full width of the dwarf wall/ and finished 10mm projecting from plastered surface of the wall.

Vertical damp proof course shall be provided at ground floor on common walls between floors at different levels of specified thickness using CEMSEL or equivalent waterproofing compound mixed at the rate specified by the manufacturer.

Over horizontal and vertical DPC as described above, a coat of bitumen 80/100 at the rate of 1.7kg/Sq. m shall be provided

3.14 WATER CEMENT RATIO

The quantity of water added to the cement and aggregates during mixing shall be such as to produce a concrete having sufficient workability to enable it to be properly compacted to be worked into the corners of the shuttering and around reinforcement.

Due account shall be taken of the variation of moisture content, within any consignment of aggregate and any variations due to watering, exposure to rain or drying weather. The contractor shall carry out regular moisture content tests in accordance IS:2386 Part III on stacked aggregates as directed by the NCCF/ Architect and results submitted to them.

In case of ordinary concrete the maximum value of water cement ration shall be 0.50 and in the case of controlled concrete the water cement ration is determined by the mix design.

The contractor shall exercise particularly tight control on the water content for fair-faced concrete if required the color of which is sensitive to small variations of water in the mix.

When a suitable water cement ratio has been determined and agreed with the NCCF, it shall be maintained throughout the corresponding part of works. Approved tests shall be undertaken periodically by the contractor to satisfy the NCCF/Architect of the maintenance of the consistency. However the amount of water added to a mix other than for fair faced concrete may be reduced below the agreed mix amount with the consent of the Architect if the contractor is able to demonstrate that such a reduction is consistent with producing concrete of the required workability and characteristic strength.

The contractor shall frequently test the concrete for slump-cone test. The slump at the point of placing as measured in accordance with the methods laid down IS: 1199 shall not be more than 75mm and not less than 50mm except for concrete containing a retarding/plasticizer admixture when the initial slump shall be 10mm + 25mm.

3.15 CONCRETE TESTING

3.15.1 TEST CUBES

The strength of concrete when placed in the works shall be determined from 150mm cubes made, cured, stored, transported and tested in accordance with IS: 516.

Test cubes shall be made as, where and when the NCCF/Architect may require or alternatively for a batch of every 50 cubic meter of reinforced cement concrete.

Test cubes shall be made under the direct supervision of the competent person appointed by the contractor to supervise all stage of the preparation and placing of concrete. They shall be made by the contractor in the presence of the NCCF/Architect generally from concrete taken at the point of discharge from the mixer and the contractor shall provide suitable facilities in the form of a hut or other covered protection as agreed with or directed by the NCCF/Architect for the storing and curing of the test cubes during the first 24 hours after making them and until they are dispatched to the testing laboratory as approved by NCCF.

Test cubes be marked and dated in such a manner that the grade and the part of the works from which they have been sampled can be readily identified.

Testing shall also be done in an approved laboratory at the site itself and the results shall be submitted promptly by the contractor to the NCCF.

All expenses for setting up the laboratory and conducting tests at site or in an approved laboratory shall be borne by the contractor within his quoted rates / prices.

3.15.2 WORKS TESTS

When concrete of a particular grade is first used in the works, one sample consisting of six cubes 15x15x15 cm shall be taken for every 20 cum or part thereof, during each of the first 7 days of using that grade. Such samples of concrete shall be representative of the entire days work. Of the 6 cubes so sampled daily, 3 cubes shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days as above.

If the mean concrete strength determined from such 28 days cube tests does not reach the characteristic strength for that grade, the materials and/or their proportions for that grade shall be modified by the contractor to the satisfaction of the Architect.

In addition the contractor shall at his own expense take such actions as the Architect may consider necessary on the concrete placed in the part of the works represented by the set of cubes so found to be below the characteristic strength. The architect at his sole discretion may either reject or devalue the work as he deems fit.

3.15.3 CONCRETE MIXING

All concrete, whether ordinary or controlled shall be mixed in an approved mixer for the minimum time necessary to ensure adequate quality and uniform distribution of the materials.

The cement and aggregates shall normally be first mixed dry until all particles of aggregate are coated with cement after which the water shall be added.

Allowance shall be made for the moisture content of the aggregates when calculating the amount of water to be added for each mix.

The temperature of the aggregate, water and cement when added to the mixer shall be such that the temperature of the concrete at the time of placement is less than 40 degree Celsius.

Materials for concrete shall be deposited into the drum while it is in rotation. Mixers shall not be loaded beyond their rated capacity and batch shall be completely discharged from the drum before recharging takes place.

Facilities shall be provided to spray the mixer drum with cool water between batches and on the completion of concreting the drum shall be washed down. The surface of the mixer drum shall be maintained in a clean condition at all time.

Re tempering and / or mixing of concrete, which has partially hardened and set will not be permitted under any circumstances.

3.15.4 TRANSPORTING

The period between mixing the concrete and placing it in the final position shall be kept to a minimum and the delivery of concrete shall be coordinated with the rate of placement to avoid delays in delivery and placement.

Concrete shall be handled from the place of mixing to the place of final deposit by methods, which prevent segregation, loss of ingredients and contamination and maintain the required workability.

Should any segregation have occurred in any batches arriving at the place of deposition, such batches shall be deposited and thoroughly turned over by hand before placing in the works.

Where concrete is conveyed by chutes, the chutes shall be made of metal or fitted with metal linings. The approval of the Architect shall be obtained for the use of chutes in excess of 3 metre long and in such cases the concrete shall be remixed, if so required by the Architect.

All plant and equipment used in the transportation of concrete shall be thoroughly cleaned before and after each working period and at all changes of concrete mixes. Water used for this purpose shall be discharged well clear of formwork or the concrete already in places.

3.16 PREPARATION BEFORE CONCRETING

The inside surface of the forms against which concrete is to be placed shall be clean and free from dried or hardened spattering or coatings of concrete. The forms shall be well wetted before placing concrete.

When the work has to be resumed on a surface, which has hardened, such surface shall be roughened. It shall then be swept clean, thoroughly wetted and covered with 12mm layer of

freshly mixed mortar composed of cement and sand (in the same ratio as the cement and sand in the concrete mix) immediately before placing of concrete.

Before any concrete is placed on the sub grade, the sub grade shall be checked and approved for degree of compaction and alignment. The sub grade shall be kept damp ahead of concreting.

Concrete shall not be placed in the works until the NCCF/Architect has inspected the formwork, reinforcement, inserts and sleeves if any and given his permission to place concrete. Concreting work that has been carried out without prior approval of NCCF/Architect liable to be rejected and no payment shall be made to the contractor on account of such works.

3.17 PLACING

Concreting of any portion of the works shall be done only in the presence of the representatives of the NCCF/ Architect.

Concreting shall be carried out continuously between contraction or expansion joints shown on the drawings or agreed by NCCF in consultation with Architect. The contractor shall closely follow the sequence of concreting is interrupted before reaching the predetermined joint an approved construction joint shall be provided.

Immediately before placing of concrete for columns and walls, the reinforcement within and the old concrete at the bottom of the formwork shall be given a coating of cement and mortar of the identical materials and proportions to be used in the subsequent concrete, to prevent the loss of fine material from the initial concrete pour.

Concrete shall not be dropped into position from a height greater than 1.5 meters or shall be deposited as nearly as is practicable to its final position and shall not be dumped in a large quantity at any point to be run or worked along the formwork manually or with vibrators. Concrete shall not be deposited at a faster rate than it can be placed and compacted.

Concrete shall be thoroughly worked into the forms so that they are entirely filled; reinforcing bars adequately and tightly surrounded and entrained air released from the mass of concrete. Placing shall be carried out by hand roding as well as vibrators in a manner directed by the Architect.

The concrete shall be placed in layers not greater than 450mm thickness and thoroughly compacted before succeeding layers are placed. Concrete shall be placed in a single operation to the full thickness of slabs, beams and similar members. No concrete shall be placed on concrete which has set sufficiently to cause the formation of planes of weakness and where these are likely to occur due to unforeseen circumstances the procedure to be followed shall be as for clause 3.17 of this specification. During concreting, care shall be taken to see that position of inserts/embedment is not disturbed.

PLACING CONCRETE BY PUMPING

General

Concrete conveyed by pressure through either rigid pipes or flexible hoses and discharged directly into the desired area is termed as pumped concrete.

Method of applying pressure to concrete is by pumps. Pumps to be used shall be either of the to types as mentioned below:-

- (a) Piston type pumps
- (b) Squeeze pressure type pumps.

Compressed air pressure pumps shall not be used in the works. (As per C.P.W.D. Specification)

3.18 COMPACTION

Each layer of concrete while being deposited shall be compacted by approved methods to form a dense material with all surface free from honey combing, air holes or other blemishes. There should be no signs of segregation in compacted concrete.

The contractor shall use mechanical vibration for all concrete, shall take care that internal vibrators shall not be brought into contact with the reinforcement or the formwork. Where external vibration of the forms is not adopted for fair faced surfaces, the concrete shall be roded adjacent to such surface in addition to internal vibrating.

An adequate number of vibrators shall be used to ensure that compaction of concrete is achieved within 10 minutes of placing. Particular attention shall be given to the compaction of the concrete around the water bars to ensure that no voids or porous areas are left.

Compacting shall cease as soon as excess water appears on the face of concrete. Any water accumulating on the surface of newly placed concrete shall be removed by approved methods and no further concrete shall be placed thereon until such water has been removed.

Notwithstanding the requirements regarding mix design, should it be found that the proportion of water in the mix is such that laitance forms before compaction (i.e. completion of expulsion of air) is complete; the quantity of water in the mix shall be reduced. No water shall be added to concrete after mixing has been completed, but before the proportion of water in the mix is such that it has impossible to achieve complete compaction, the quantities of aggregate shall be reduced without any alteration to the quantities of cement and water. Whenever either of the aforesaid procedures are to be adopted, an additional set of 6 cubes for testing at 7 and 28 days shall be made from the adjusted mix.

The time elapsing between the discharges of the concrete from the mixer and the completion of compaction shall not exceed 30 minutes.

A sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.

3.19 FINISHES

All concrete surfaces have a good, dense finish, except for slabs, the exposed faces of concrete for which formwork is not provided shall be smoothed with a steel or wooden trowel to provide a finish equal to that face where formwork is provided.

The top surfaces of all floor and roof slabs specified as smooth shall be leveled and trowelled finish at the levels or falls shown on the drawings. The trowelling shall be done at such a time and in such a manner that an excess of mortar is not brought to the surface of concrete nor the aggregate displaced. The top surfaces of concrete slabs specified to receive an integral finish shall be uniformly roughened by deep hacking before the finish is laid.

Immediately after striking the formwork and removing any superficial water, honeycombed areas in normal unfinished concrete shall be inspected by the Architect and where directed the contractor shall immediately make good at his own expense such honeycombing whilst the concrete is still green to the satisfaction of the Architect. All air holes shall be similarly filled in.

The contractor shall be responsible for providing an adequate key in concrete where plastering or rendering is specified to be applied. Hacking of the concrete surface immediately after striking the formwork will be permitted.

The faces of all fair-faced concrete shall be of even color throughout, free from air bubbles, cracks, honeycombing or other blemishes and will be got approved from the Architect immediately after the formwork has been struck. Such faces shall not be rubbed down after striking the formwork to remove fines, efflorescence or any similar imperfections without the prior permission of the NCCF/Architect.

Concrete surface finishes shall be according to the requirements and all instructions by the Architect with regard to the method of achieving such finishes shall be implemented.

3.20 CURING AND PROTECTING

Walling on concrete shall not be permitted for at least 24 hours after it has been placed in position, or for such additional length of time as the Architect may direct. Immediately after compaction and completion of any surface finishes, the concrete shall be protected from the evaporation of moisture by means of polythene sheeting, wet hessian or other similar material kept soaked by spraying. As soon as the concrete has attained a degree of hardening sufficient to withstand surface damage, moist curing shall be implemented and maintained for a period of at least 15 days after casting.

Method of curing and their duration shall be such that the concrete will have satisfactory durability and strength and members will suffer a minimum distortion, be free from excessive efflorescence and will not cause, by its shrinkage, undue cracking in the works.

The top surfaces of slabs and other horizontal surfaces shall be cured by impounding water in cement mortar bunds. Steeply sloping and vertical formed surfaces shall be kept completely and continuously moist prior to and during the striking of formwork by applying water to the surface and allowing it to pass down between the formwork and the concrete.

The contractor shall give careful consideration to the curing methods and conditions for fair-faced concrete. Components, which are specified to have exposed concrete finish, shall receive the same curing treatment. Moreover water used for curing shall be clean so as not to discolor the concrete.

All fair faced concrete shall be protected from damage from the time of striking the formwork. All edges and surfaces of such concrete shall be protected from chipping using notched timber corner pieces or other suitable covers which shall be maintained in place until the completion of the works.

The contractor shall be responsible for ensuring all fair-faced concrete free of stains from concrete materials and shall clean all such staining as may occur at his own cost as soon as possible to the satisfaction of the Architect.

3.21 CONSTRUCTION JOINTS

Construction joints shall be made only where shown on the drawings, where the contractor wishes to form joints in concrete other than those shown on the drawings, he shall submit his proposals giving the position, form and treatment of such joints to the NCCFs for his approval.

Vertical construction joints shall be formed against a stop board and horizontal construction joints shall be level.

Except where shown otherwise on the drawings, reinforcement shall continue through construction joints.

As soon as possible after the formwork has been struck for vertical joints or after the concrete has set in horizontal joints, the surface laitance of the hardened concrete on the face of the joint shall be removed to expose the coarse aggregate in such a manner that the loosened particles of aggregate and damaged concrete are not left on the surface. The exposed face shall be swept clean of foreign matter and laitance. Feathered construction joints will not be permitted. Immediately before placing the new concrete, neat cement grout shall be poured over the old concrete followed for horizontal joints by a 12mm thickness of sand cement mortar of the same materials and proportions to be used in the new concrete.

3.22 CONTRACTION JOINTS

Contraction joints required will be as shown on the drawings.

Contraction joints shall not be hacked, wetted or mortared before concrete is placed against them.

3.23 EXPANTION JOINTS

3.23.1 GENERAL

Expansion joints shall be provided where shown on the drawings or as directed by NCCF/ Architect. They shall be constructed with an initial gap between the adjoining parts of the works of the width specified in the drawings.

The contractor shall ensure that no debris is allowed to enter expansion joints. Expansion joints shall be provided as per drawing.

Contractor shall ensure that expansion joints are made watertight and that no leakage occurs through these joints for which he shall be responsible to re do at his own cost.

3.23.2 OPEN JOINT FILLERS

Where shown on the drawings, open joints in the structure shall be filled with joint fillers.

The joint fillers shall be easily and uniformly compressible to its original thickness, tappable, easily cut or sawn, durable resistant to decay due to termite or weathering unaffected by water and free of any constituent, which will bleed into or stain the concrete.

The joint filler shall be of same thickness of the joint width, it shall extend through the full thickness of the concrete unless otherwise specified and shall be sufficiently rigid during handling and placing to permit the formation of straight joints.

3.23.3 JOINT SEALING COMPOUNDS

Joint sealing compounds shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering.

Polysulphide joints where specified on the drawings shall be sealed with polysulphide liquid polymer, stored, mixed, handled, applied and cured strictly in accordance with the manufacture's written instructions. Such joint shall be formed to the correct dimensions, thoroughly cleaned and treated with recommended primer strictly in accordance with the manufacturer's written instructions prior to sealing. The Contractor shall use only competent personnel experienced in the application of polysulphide for such work.

Where specified in the drawings, rubber/bituminous based sealants shall be of an approved manufacturer's written instructions.

3.24 WATERBARS

Where water bars are shown on the drawings, the joints shall incorporate an approved PVC external type water-bar complete with all necessary molded or prefabricated intersection pieces assembled in accordance with the drawings with bends and butt joints in running lengths made by heat welding in an electrically headed jig.

Jointing and fixing of water bars shall be carried out strictly in accordance with the manufacturer's written instructions.

The water bars shall be installed so that they are securely held in their correct position during the placing and compacting of the concrete.

Where reinforcement is present adjacent to water bars, adequate clearance shall be left between the reinforcement and water bars to facilitate compaction of the concrete.

During headed nails may be used in the edge of the water bar outside the line of the external grooves for fixing purposes, but no other holes shall be permitted through the water bar.

3.25 INSERTS

The contractors shall fix all necessary inserts such as steel plates, pipe sleeves, bolts etc. and make provision of holes, pockets, dowels etc. in the formwork to enable subsequent fixing of supports, brackets, ceilings, pre cast members etc. as indicated on the drawings, called for in schedule of items or as required by the NCCF/Architect.

Nothing extra over and above the provision as per the priced schedule shall be paid to the contractor on this account.

With the prior agreement of the Architect, expansion type fasteners may be used by the Contractor in hardened concrete.

3.26 CRACKS

If any cracks develop in the reinforced cement concrete construction, which in the opinion of the NCCF/ Architect may be detrimental to the strength of the construction, the contractor at his own expense shall test the structural element in question. If under these test loads the contractor shall dismantle the construction and carryout all consequential work there to at no extra cost.

If the cracks are not detrimental to the stability of the construction in the opinion of the NCCF/Architect, the contractor at his own expense shall grout the cracks with pneumatically applied mortar. At his own expense and risk he shall also make good all other building works such as plaster, molding, Surface finish of floors, roofs, ceiling etc. which in the opinion of the NCCF/Architect have suffered damage either in appearance or stability owing to such cracks.

The repair work shall be carried out to the satisfaction of the NCCF/Architect. The decision of the NCCF/Architect as to the extent of the liability of the contractor in the above matter shall be final and binding on the contractor.

3.27 LOAD TESTING ON COMPLETED STRUCTURES

During the period of construction or within the defect liability period the NCCF/Architect may at his discretion order the load testing of any completed structure or any part thereof if he has reasonable doubts about the adequacy of the strength of such structure for any of the following reasons:-

Results of compressive strength on concrete test cubes falling below the specified strength.

Premature removal of formwork.

Inadequate curing of concrete

Over loading during the construction of the structure or part thereof

Carrying out concreting of any portion without prior approval of the NCCF.

Honey combed or damaged concrete which in the opinion of the NCCF/Architect is weak and will adversely affect the stability of the structure to carry the design load, particularly in important or critical areas of the structure.

Any other circumstances attributable to alleged negligence of the contractor which in the opinion of the Architect may result in the structure or any part thereof being less than the expected designed strength.

All the loading tests shall be carried out by the contractor strictly in accordance with the instructions of the NCCF/Architect. Such tests should be carried out only after expiry of minimum 28 days or such longer period as directed by the NCCF.

The structure should be subjected to a superimposed load equal to 1.25 times the specified superimposed load assumed in the design. This load shall be maintained for a period of 24 hours before removal. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap under the members as directed.

The deflection due to the superimposed load shall be recorded by sufficient number of approved deflecto-meters capable of reading up to 1/500 of a cm and located suitably under the structure as directed by the Architect. If within 24 hours of removal of the superimposed load, the structure does not recover at least 75% of the deflection under the superimposed load, the test loading shall be repeated after a lapse of 72 hours. If the recovery after the second test is less than 80% of the maximum deflection shown during the second test, the structure shall be considered to have failed to pass the test and shall be deemed to be unacceptable.

In such cases the part of the work concerned shall be taken down or cut out and reconstructed to comply with the specification. Other remedial measures may be taken to make the structure secure at the discretion of the Architect. However such remedial measures shall be carried out to the complete satisfaction of the NCCF/Architect.

All costs involved in carrying out the tests and other incidental expenses there to shall be borne by the contractor and he shall take down or cut out and reconstruct the defective work or shall carry out the remedial measures at his own cost.

In addition to the above load tests, non-destructive test methods such as core test and ultrasonic pulse velocity test shall be carried out by the contractor at his own expense if so desired by the NCCF. Such tests shall be carried out by an agency approved by the Architect and shall be done under expert guidance using only recommended testing equipment. The acceptance criteria for these tests shall be mutually agreed between the NCCF/Architect and the Contractor.

3.28 SUPERVISION

All concreting work shall be done under strict supervision of the qualified and experienced representatives of the contractor as well as those of the NCCF/Architect. The contractor's Engineer and supervisor who are in charge of concreting work shall be skilled in this class of work and shall personally supervise all the concreting operations. Special attention shall be paid to the following:

Proportioning, mixing and quality testing of the materials with particular control on the water cement ratio.

Laying of material in place and through compaction of the concrete to ensure solidity and freedom from voids and honeycombing.

Proper curing for the requisite period.

Reinforcement and inserts/embedment position are not disturbed during concreting and consolidation by vibration.

Notwithstanding the supervision by the NCCF/Architector their representatives, the contractor shall be fully responsible for the entire work.

3.29 QUALITY CONTROL

The NCCF/Architect reserves the right to make changes in the mix proportions including the increased cement content or/and a change in the Contractor's control procedure, should the quality control during progress of the works prove to be inadequate in his opinion.

All the concrete work shall be true to level, plumb and square within the acceptable tolerance. The corners, edges and rises in all cases shall be unbroken and finished properly and carefully.

3.30 TOLERANCES

The acceptable tolerances for formed concrete surfaces shall be as given below:-

- a) Variation from plumb for
 - i) Columns and walls to be rendered 6mm in 3 metre
 - ii) Exposed columns and walls 3mm in 3 metre
- b) Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls - 6mm + 12mm

All the works executed beyond the tolerance limits are liable to be rejected and no extra cost shall be paid to the contractor for reconstructing the same.

3.31 CONCRETING DURING HOT WEATHER

3.31.1 PREPARATION

Well in advance of hot weather, preparation shall be done with necessary equipment and material as under:-

Ample water supply for sprinkling sub grades, wood forms, reinforcing steel, aggregates and for curing Tarpaulin or polythene sheets and lumber for sunshades and windbreaks.

3.31.2 SCHEDULING

The work shall be scheduled so that concrete is placed in position with the least delay. During extremely hot periods, concreting work shall be started in the morning to take advantage of lower morning temperatures and the wind factor if any shall also be taken into consideration.

3.31.3 COOLING OF MATERIALS

All materials used for concreting shall be kept cool by storing them in shade wherever possible, sprinkling coarse aggregate with water and protecting water supply from direct sunrays. Mixing water shall be chilled in very hot weather by refrigeration or by using ice as a part of mixing water. The ice should be melted by the time the concrete is discharged from the mixer.

For concrete on ground, the sub grade shall be dampened the evening before the concreting. However prior to placing of concrete there should not be any standing water or puddles on the sub grade. Reinforcing steel and formwork shall be thoroughly moistened just before placing of concrete so that they will not absorb water from the mix.

3.31.4 TEMPORARY COVERS

Immediately after the concrete is placed, vibrated and leveled, temporary covers such as burlap shall be placed over the fresh concrete and kept continuously wet. When ready for floating and/or final, finish, uncover only a small section immediately ahead of finishing. Cover again at once after final finish and keep the cover wet.

3.31.5 PROTECTION FROM WIND AND SUN

When high winds also prevail along with hot weather, the fresh concrete shall be protected by placing a windbreak on the windward side. The contractor shall uncover only a small section immediately prior to carrying out floating and/or final finish and he shall without any delay, cover the section after final finish and keep the cover wet.

3.31.6 CURING

As soon as the concrete surface is hard enough to resist marring, it shall be kept covered with polythene sheet, waterproof paper or water holding materials such as burlap or by spraying on a curing compound. If curing compound is used, it should be applied immediately after final finishing. Care should be taken that adequate and uniform coverage is obtained.

The concrete surface shall be kept constantly wet to avoid alternate wetting and drying during the curing period.

3.31.7 TESTING AND RECORDING

In hot weather it is absolutely necessary that sampling (making and curing test specimens) shall be done in strict conformance to standards specifications. More over test cubes must be kept damp and in a shaded place. They shall receive continuous standard moist curing until tested.

Weather conditions like humidity, temperature, wind and clouds shall be recorded and made a part of the permanent job record.

3.31.8 TESTING ROOM / LABORATORY

A testing room of not less than 10 sqm equipped with the following apparatus and qualified concrete technician, labor and materials required for carrying out tests therein shall be provided by the contractor at his own expense and within his quoted rates:

- 1) Sieve set (for aggregate 20 mm down)

40 mm	dia	45 cms.
20 mm	''	
16 mm	''	
12.5 mm	''	
10 mm	''	
4.75 mm	''	
600 micron.....	dia	20 cms
300 micron	''	
150 micron	''	
75 micron	''	

- 2) Weighing

physical balance cap. 200 gm with weight box (accuracy 0.5 gm)
 counter scale cap. 20 kg.
 weights

5 kg.....	1 No.
2 kg.....	2 Nos.
1 kg.....	1 No.
500 gms.....	1 No.
200 gms.....	1 No.
100 gms.....	1 No.

- 3) Slump Cones2 Nos.
- 4) 15 cm moulds... 18 Nos.
- 5) Electric/Kerosene Heater.
- 6) Plants etc. as directed by the NCCF/ Architect.
- 7) Vicat apparatus with needles, test tubes, breakers, thick glass plate etc.
- 8) Measuring Cylinders 1000 ml, 500 ml, 100 ml.
- 9) Wash bottles capacity 500 ml 2 Nos.
- 10) Laboratory Sink

- 11) Work benches, shelves, desks and any other furniture and lighting as required by the Architect.
- 12) Spring balance dial type cap. 100 kg
- 13) Litre measures
 - a) 10 lit _____ 1 No.
 - b) 5 lit _____ 1 No.
 - c) 2 lit _____ 2 No.
 - d) 1 lit _____ 1 No.
 - ½ lit _____ 1 No.
- 14) Cube Testing Machine 100 Tones.
- 15) Oven
- 16) Cores/Apparatus for conduction of proctor density test

3.31.9 COORDINATION OF WORK

The contractor is fully responsible for coordinating with the other or his own agencies for sanitary, electrical, HVAC, Fire fighting installation works, etc. to ensure execution of their work related to commencement of concreting. Nothing extra shall be payable to the contractor, if the works pertaining to concreting have to be dismantled & redone due to lack of co-ordination on the part of the contractor in ensuring completion of works of such agencies before concreting had been undertaken.

The contractor shall suitably ensure to stack the materials within the site and not create any hindrances to other coordinating agencies and shall also work in conjunction with external development details, plans and layouts as marked by the Architect during execution of work.

3.33.1 MORTAR

CEMENT MORTAR

SCOPE

This shall be cover cement mortars used in general building works for masonry work and plastering.

MATERIALS

Cement, water and waterproofing compound as specified in Material Specifications.

SAND

For plastering purpose sand as specified in clause 10.8.3 and 3.6.2 of material section shall be used. For other purposes sand as specified in clause 3.6.2 of materials section shall be used.

PROPORTIONING

Proportions of sand and cement shall be as specified. The unit of measurement for cement shall be a bag of cement weighing 50 kg and this shall be taken as 0.035 cum. Sand in specified proportion shall be measured in boxes of suitable sizes. It shall be measured on the basis of its dry volume. If the sand is wet, the quantities shall be increased suitably to allow for bulk age.

If the sand as specified for plastering is not available, proper sieving shall be carried out at site to obtain the required fineness modulus only such sieved sand shall be used for plastering work.

MIXING

The mixing of mortar shall be done in mechanical mixer operated manually or by power. NCCF/ Architect may however relax this condition taking into account the nature and location of the work.

MIXING IN MECHANICAL MIXTURE

Cement and sand in specified proportion shall be mixed dry thoroughly in a mixer and then water shall be added gradually and wet mixing shall continue for at least one minute. Water shall be added only in such proportion to bring the mortar to the consistency of a stiff paste. Only the quantity of mortar which can be used within 30 minute of its mixing shall be prepared at a time. The mixer shall be cleaned with water each time before suspending the work.

HAND MIXING

Hand mixing shall be restored only in specific case with the approval of NCCF/ Architect. The measured quantity of sand shall be leveled on clean masonry platform and cement bags empties on top. The cement and sand shall be thoroughly mixed dry by turning over backwards and forwards several times till the dry mixture is of uniform color. The quality of dry mixture is of uniform color. The quantity of dry mix, which can be used within 30 minute, shall then be mixed in masonry troughs with just sufficient quantity of water to bring the mortar to the consistency of a stiff paste.

4. SPECIFICATION FOR STEEL REINFORCEMENT

4.1 GENERAL

4.1.1 DESCRIPTION

This section covers the requirements for storage, straightening, cutting, binding, fabricating, delivering and placing of steel reinforcement in position for casting all types of concrete work.

4.1.2 RELATED WORK SPECIFIED ELSEWHERE

- a) Cast- in- place Reinforced Concrete.

Applicable Codes and Standards

The codes and standards generally applicable to the work of this section are listed hereinafter:

IS	:	280	Mild steel wire for general engineering purposes.
IS	:	432	Part I mild steel and medium tensile steel bars. Part II Hard drawn steel wire.
IS	:	456	Code of practice for plain and reinforced concrete.
IS	:	1139	Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.
IS	:	1566	hard-drawn steel wire fabric for concrete reinforcement.
IS	:	1786	Cold-twisted steel bars for concrete reinforcement.
IS	:	2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS	:	3370	Code of practice for concrete structure for (part I to Part IV) the storage of liquids.

The following clauses are intended to amplify the requirements of the reference documents listed above and the contractor shall comply with these clauses.

4.2 SUBMITTALS

4.2.1 BAR BENDING SCHEDULE

Before commencement of fabrication of any steel reinforcement, the contractor shall submit the bar bending schedule to the NCCF/Architect for the approval if required by the NCCF/Architect. No extra payments shall be admissible on this account.

4.3 MATERIALS

4.3.1 STEEL REINFORCEMENT

- A) Steel reinforcement used shall be either of the following types and necessarily as specified in the:
- B) Mild steel of Grade 1 tested quality conforming to IS: 432-part I.
- C) High yield strength cold worked deformed steel bars of tested Quality conforming to IS: 1786 or hot rolled high tensile deformed steel bars of tested quality conforming to IS : 1139.

Hard drawn steel wire fabric conforming to IS: 1566

D) Where galvanized reinforcement is specified in the drawings, the bars or mesh shall be hot-dip galvanized after bending generally in accordance with IS : 2629 and IS : 4759. Galvanized reinforcement shall be coated with a layer of zinc nowhere less than 0.05 mm in thickness.

All reinforcement shall be stored horizontally above ground level on supports, skids or other approved supports, clear of any running or standing water. Contact with soil should be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion.

Before steel reinforcement is placed in position, the surface of the reinforcement shall be cleaned of rust, dust, grease and other objectionable substances.

4.3.2 BINDING WIRE

Binding wire shall be black annealed steel wire conforming to IS : 280 and of minimum 18 gauge.

4.3.3 WELDING ELECTRODES

Electrodes used for welding of steel bars shall be ordinary mild steel grade electrodes conforming to IS: 814 and shall be of the best quality approved by the Architect.

4.4 STORAGE

Reinforcement steel shall be handled and stored in a manner that bending or distortion of the bars is avoided and contamination of steel is prevented.

All reinforcement shall be stored horizontally above ground level on supports, skids or other approved supports, clear of any running or standing water. Contact with water should be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion.

Bars of different classifications and diameters shall be stored separately.

A record shall be kept of the batch numbers of reinforcement deliveries in such a form that the part of the work in which particular reinforcement is used can be readily identified.

Welding electrodes shall be stored in moisture controlled environment in accordance with the manufacturer's recommendations.

4.5 FABRICATION

Reinforcement steel shall be carefully and accurately cut, bent or formed to the dimensions and configurations shown on the drawings and as per bar bending schedules approved by the NCCF/Architect.

All reinforcement shall be bent cold using appropriate pin sizes. Bars may be preheated only on approval of the NCCF/Architect. Hot bars shall not be cooled by quenching. Bends shall be in accordance with IS: 2502.

It shall be ensured that the bars are not bent or straightened in any manner that will injure the material. Any bars incorrectly bent shall be used only if means for straightening and re bending be such as not to effect adversely the material. Reinforcement shall not be re bent or straightened without prior review by the Architect. No reinforcement shall be bent when in position on the works whether or not it is partially embedded in hardened concrete.

Reinforcement steel having a reduced section, visible transverse cracks in bends, or otherwise damaged in anyway shall not be used.

Spiral reinforcement shall be accurately fabricated to the diameter and pitch shown on the drawings. One and one half finishing turns shall be provided at both top and bottom unless shown otherwise.

Cut ends of galvanized rods shall be given a protective coat of approved zinc paint immediately after cutting.

4.6 LAPPING

As far as possible, bars of maximum length available shall be used. All bars shall be in one length unless otherwise shown on the drawings or agreed with the NCCF/Architect.

Laps shown on the drawings or otherwise specified by the Architect shall be based on the use of bars of maximum length by the contractor. In case the Contractor wishes to use shorter bars, laps shall be provided at the contractor's cost in the manner and locations approved by the NCCF/Architect.

Not more than 1/3rd of the bars or as specified in the drawings shall be lapped at one section.

Reinforcement bars shall not be welded unless shown on the drawings or instructed by the NCCF/Architect.

4.7 PLACEMENT

All reinforcement shall be placed accurately and maintained in the position indicated on the drawings.

The contractor shall provide approved type of supports for maintaining the bars in position and ensuring required spacing and correct cover of concrete to the reinforcement as called for in drawings. Precast cement concrete blocks of required shapes and size, M.S. chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Precast concrete blocks shall be cast well in advance and shall be at least equal in quality to the class of concrete specified in the work.

In fair faces of concrete, temporary spacers only shall be used and removed or with-drawn as compaction of concrete proceeds. Spacers will not be permitted to be left in fair faces of concrete.

All intersections of the reinforcement shall be securely tied with two strands of binding wire twisted tight to make the skeleton or net work rigid so that the reinforcement is not displaced during placing of concrete.

Tack welding of crossing bars shall not be done except as authorized or directed by the NCCF/Architect. Nothing extra will be paid for tack welding.

The contractor shall take all reasonable precautions to ensure that when handling or erecting reinforcement no damage shall be done to finished concrete. Bars that are partially embedded in concrete shall not be field bend unless concurrence has been obtained from the NCCF/Architect/Architect.

Walkways and borrow bunds for placing and compacting the concrete shall be independent of the reinforcement.

Loose binding wire and other extraneous metal shall be removed from inside the formwork prior to concrete placing.

Without relieving the Contractor of the responsibilities for the correctness thereof, the reinforcement shall be inspected and approved by the NCCF/Architect in writing before any concrete is placed and the contractor shall allow sufficient time for such inspection and any subsequent remedial action to be carried out.

No part of the reinforcement shall be used for conducting electrical currents.

4.8 COVER TO REINFORCEMENT

Unless shown otherwise on the drawings, minimum cover for all reinforcement shall be provided as per IS: 456. Care shall be taken to maintain the correct cover for reinforcement.

For concrete members exposed to weather, earth / sand, action of harmful chemicals, acid vapor, saline atmosphere, sulphurous smoke etc. minimum cover for reinforcement shall be increased by 15 mm to 40 mm as directed by the NCCF/Architect. No extra payment shall be admissible on this account.

The maximum cover for reinforcement shall not be greater than that specified above or shown on the drawings plus 10 mm except for bundled bars.

For bundled bars, minimum concrete cover shall be equal to the equivalent diameter of the bundled but need not be greater than 50 mm or as shown on the drawings.

Exposed reinforcement intended for binding with future extensions shall be protected from corrosion as per specifications and / or as directed by the NCCF/Architect. No extra payment shall be admissible on this account.

4.9 CLEANING

After placing, the reinforcement shall be maintained in a clean condition until the concrete is placed. On no account the bars shall be oiled or painted or mold oil used on the formwork be allowed to come in contact with the bars.

Before concreting is commenced, the bars shall be thoroughly cleaned with dry gunny bags if they are coated lightly with rust or other impurities.

4.10 WORK WILL INCLUDE

- (a) All straightening, cutting to lengths, labor in bending and cranking , forming hook ends, handling, hoisting and all that is necessary to fix reinforcement in work and in position and as per drawings and specifications within the contractors quoted price. This shall also include all that is fairly intended and is necessary for completion of work.
- (b) Cost of precast concrete cover blocks to maintain cover and holding reinforcement in position, chairs, spacers, dowels, pins, laps, etc.
- (c) For fabricating and fixing reinforcement in any structural member irrespective of its location, dimension and level.
- (d) Work at all levels and heights.
- (e) All the above mentioned works shall be included in the quoted rates. Nothing extra shall be payable to the contractor on this account.
- (f) Providing shop drawings / bar bending schedules for approval.

5. SPECIFICATION FOR FORMWORK

5.1 GENERAL

5.1.1 DESCRIPTION

This specification covers the requirements for providing, fabrication and erecting of formwork including propping, bracing, shoring, strutting, rising, bolting, wedging and all other temporary supports to the concrete during the process of setting and subsequent removal of forms.

5.1.2 RELATED WORK SPECIFIED ELSEWHERE

- a) Cast-in- place Reinforced Concrete

5.1.3 APPLICABLE CODES AND STANDARDS

The codes and standards generally applicable to the work of this section are listed hereinafter
IS: 456 Code of practice for plain and reinforced concrete.
IS: 4990 plywood for concrete shuttering work.

5.2 SUBMITTALS

5.2.1 TYPE OF FORMWORK

Prior to start of delivery of material for formwork, the contractor shall prepare samples of different types of formwork for about 10 sqm and obtain approval of the NCCF/Architect.

5.2.2 DESIGN OF FORMS

Before fabricating of forms, the contractor shall submit design calculations for proposed formwork to the NCCF/Architect for his approval. However, the approval of the formwork design in no way will relieve the contractor of his responsibility for adequately constructing and maintaining the forms so that they will function properly.

5.2.3 TIE BOLTS

In case the contractor proposes to use tie bolts running through the concrete, the location and size of such tie bolts shall be submitted to the NCCF/Architect for his approval.

5.3 MATERIALS

5.3.1 FORMWORK

Formwork shall be of approved timber, plywood, steel capable of resisting damage to the contact faces under normal conditions of erecting forms, fixing steel and placing concrete. The selection of materials suitable for formwork shall be made by the contractor based on the maximum quality consistent with the specified finishes, safety and with due approval of the Architect.

5.3.2 TIMBER

Timber used for formwork shall be easily workable with nails without splitting. It shall be stable and not liable to warp when exposed to sun and rain or wetted during concreting.

5.3.3 PLYWOOD

Plywood used for formwork shall be 12 mm thick shuttering quality plywood complying with IS: 4990 and of make approved by the Architect.

5.3.4 STEEL

Steel formwork shall be made of 4mm thick black sheets stiffened with angle iron frame made out of M.S. angles 40mm x 40mm x 6mm.

5.4 DESIGN CRITERIA

Formwork shall be designed for the loads and lateral pressures due to dead weight of concrete, superimposed live loads of workmen, materials and plants and for other loads as indicated on the drawings.

Forms shall be designed to have sufficient strength to carry the hydrostatic head of concrete as a liquid without deflection tolerances exceeding the acceptable limits.

Where necessary to maintain the tolerances indicated on the drawings or the specifications, the formwork shall be cambered to compensate for anticipated deflections due to the weight and pressure of the fresh concrete, and also due to any other construction loads. Unless otherwise shown for specified, the camber shall be provided as below:-

Types of member	Compression steel as % of tensile steel	Camber co-efficient
Simple span	0%	0.066
	50%	0.037
Continuous	0%	0.032
Restrained span	50%	0.020
Cantilever	0%	0.086
	50%	0.046
Camber in cm	$(kxLx2.54) / D$	

Where
 k = camber coefficient
 L = Length of member in metre
 D = Depth of member in metre

5.5 ERECTION OF FORMWORK

Forms shall be used wherever necessary to confine the concrete during vibration and to shape it to the required lines. The formwork shall conform to shapes, lines, levels and dimensions of the concrete sections shown on the drawings.

Forms shall have sufficient strength to withstand the pressures resulting from placement and vibration of concrete and shall be maintained rigidly in position. Formwork shall be adequately supported by adequate number and size of struts, braces, ties, and props to ensure rigidity of forms during concreting. Where props rest on natural or filled up ground, to avoid any settlement, the soil shall be thoroughly compacted and bases of props shall be of sufficient size so as to restrict the bearing pressure on the ground to 5.0 t / sqm or as directed by the NCCF/Architect.

Forms shall be tight enough to prevent loss of mortar from the concrete and to produce a dense, homogeneous and uniformly colored concrete completely free from honey-combing or surface roughness. Joints in formwork shall be designed to prevent leakage, not only

between individual elements forming the panels but also from the horizontal and vertical junction between the panels themselves.

If formwork is held together by bolts or wires, those shall be so fixed that no reinforcement bar is exposed on surface against which concrete is to be laid. The Architect may at his discretion allow the contractor to use tie bolts running through the concrete at the contractor's cost.

Holes left in the concrete by these tie-bolts shall be filled as specified by him at the Contractor's expense.

Formwork shall be constructed so as to facilitate loosening and permit removal without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

All formwork erected shall be approved by the NCCF/Architect before concreting is started.

5.6 CLEANING AND OILING OF FORMS

At the time concrete is placed in the forms, the surface of the forms in contact with the concrete shall be free from encrustations of mortar, grout or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire cuttings and other foreign material to be worked out from the interior of the forms before the concrete is placed.

The surface of the forms to be in contact with the concrete shall be coated with an approved coating that will effectively prevent sticking and will not stain the concrete surfaces. After each use the surfaces of forms in contact with concrete shall be cleaned, well wetted and treated with form oil approved by the Architect. Lubricating (machine) oils shall not be used.

Oil shall be done before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position.

Immediately before concreting is commenced the formwork shall be carefully examined to see that all dirt, shavings, sawdust and other refuse have been removed and the formwork shall be wetted thoroughly to prevent absorption of water from concrete. The formwork shall be kept wet during concreting and for the whole time that it is left in place.

5.7 REMOVAL OF FORMWORK

Formwork shall be removed carefully so as to prevent damage to the concrete. Wooden wedge only shall be used between the concrete surface and the form where force is necessary to separate the form from the concrete. Metal wedge, bars or tools shall not be used for this purpose. Any concrete damaged in the process of removing the forms shall be repaired in accordance with the provision of concrete specifications.

Unless otherwise permitted in writing by the NCCF/Architect, the forms shall not be stripped in less than the minimum periods specified in IS: 456. However, the NCCF/Architect may increase the above period if he considers it necessary for structural stability.

All non-supporting forms shall be loosened and removed during regular working hours, and as soon as the concrete has hardened sufficiently to prevent damage from the removal of the forms. All false work and forms supporting concrete beams and slabs, or other members subject to direct bending stress, shall not be removed or released until the concrete has attained sufficient strength to ensure structural stability and to carry both the dead and live loads including any construction loads which may be placed upon it.

No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any unshored portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads.

Formwork shall be removed in such a manner so as not to impair safety and serviceability of the structure. It shall be removed gradually to prevent sudden application of loads to the concrete. All concrete to be exposed, shall have sufficient strength to prevent any damage caused by removal of formwork.

STRIPPING TIME

Forms shall not be struck until the concrete has attained a strength at least twice the stress to which the concrete may be subjected at the time of removal of formwork. The strength referred to shall be that of concrete using the same cement and aggregate with the same proportions and cured under conditions of temperature and moisture similar to those existing on the work. Where so required form work shall be left longer in normal circumstances and where ordinary Portland cement is used, form may generally be removed after the expiry of the following period:

- | | |
|--|---------|
| a) Walls, Columns and Vertical faces of all structural members | 2 days |
| b) Removal of props under slabs | |
| (i) Spanning up to 4.5 metre | 7 days |
| (ii) Spanning over 4.5 metre | 14 days |

5.8 REUSE OF FORMS

Immediately after the forms are removed, they shall be cleaned with jet of water and a soft brush before they are reused.

The contractor shall not be permitted reuse of any forms which in the opinion of the Architect has worn out and has become unfit for formwork.

The NCCF/Architect may in his absolute discretion, order rejection of any forms he considers unfit for use in the works, and order their removal from the site.

5.9 FORMWORK FOR SLOPED SURFACES

Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration, inspection and repair of the concrete.

The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surface of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be formed as required herein.

5.10 FORMWORK FOR CURVED SURFACES

The contractor shall interpolate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form lumber shall be build up of laminated splices cut to make tight, smooth form surfaces.

After the forms have been constructed, all surface imperfections shall be corrected an all surface irregularities at matching faces of form material shall be dressed for the specified curvature.

5.11 FORMWORK FOR EXPOSED CONCRETE SURFACES

Where it is desired, directed or shown on the drawings to have original fair face finish of concrete surface without any rendering of plastering, formwork shall be carried out by using wood planks, plywood or steel plates of approved quality and as per directed of the Architect.

The Contractor shall use one type of material for all exposed concrete surfaces and the forms shall be constructed so as to produce a uniform and consistent texture and pattern on the face of the concrete. Patches on forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface. If forms are constructed of lumber and are not paneled the formwork shall be staggered.

To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features, sills, window heads or change in direction of the surface. All joints between panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall in an average be 150mm wide, securely jointed with tongued and grooved joints if required to prevent grout loss with tie rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at an inclination as shown in the drawings. All bolt holes shall be accurately aligned horizontally and vertical and shall be filled with matching mortar recesses 5mm back from the surrounding concrete face.

Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicates top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift. Sheathing

of reset forms shall be tightened against the concrete so that the forms will not spread and permit abrupt irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

For fair faced concrete, the position of through bolts will be restricted and generally indicated on the drawings.

Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20mm beveled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be beveled unless shown on the drawings. Mouldings for grooves, drip courses and bands shall be made in the form itself.

The wood planks, plywood and steel plates used in form work for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for refuse, if in the opinion of the Architect it is doubtful to produce desired texture or irregularities of exposed concrete.

In order to obtain exposed concrete work of uniform color it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform color. Moreover the cement used in the concrete for any complete element shall be from single consignment.

No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall not be permitted, except in the case of minor porosity on the surface the Architect may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and color as for the concrete. This treatment shall be made immediately after removing the formwork.

The contractor shall also take all precautionary measures to prevent breaking and chipping of concrete of corners and edges of completed work until the building is handed over.

6. SPECIFICATIONS FOR BRICKWORK

6.1 SCOPE

The contractor shall provide within his quoted price all labor, materials, scaffolding operations equipment and incidentals necessary and required for the completion of all brickwork called for in the drawings and documents and that which is fairly intended for smooth completion of the work.

6.2 BRICK MASONRY

Bricks shall be of uniform deep red or copper color, thoroughly burnt without being vitrified, regular in shape and size and shall have sharp and square sides and edges and parallel faces to ensure uniformity in the thickness of the courses of brickwork.

Bricks shall be free from cracks, chips flaws, stones or lumps of any kind. They shall be sound, hard homogenous in texture and shall conform to the requirements of first class bricks stipulated in IS: 1077 'Common Burnt Clay Building Bricks'. Bricks used shall be best quality local bricks of minimum class designation 75. The size of the bricks shall be (22.9cm x 11.2cm x 7.0cm) unless otherwise specified, with a tolerance of + 1/8 inch (3mm) in each direction. The bricks shall be provided with frogs.

6.2.1 SAMPLES

Samples of each type of brick taken at random from the load shall be deposited with the NCCF/Architect for his approval before being used in the work. All subsequent deliveries shall be up to the standard of the sample approved.

6.2.2 SOAKING OF BRICKS

All bricks shall be thoroughly soaked before use, in specially prepared vats, tubes or tanks for not less than two hours and until air bubbles stop being given off. The soaked bricks shall be kept on wooden planks or bricks platforms to avoid earth being smeared on them. No bricks after 24 hours immersion in water shall absorb more than 15% of its weight.

6.2.3 MORTAR

Mortar for all brickwork shall consist of cement and clean sharp, coarse sand.

6.2.4 CEMENT

Portland cement conforming to IS : 269 shall be used, unless otherwise specified.

6.2.5 SAND

Sand shall be clean, not too fine nor too coarse and shall fall within the grading zones III to IV given in table III of IS: 383. The silt content of sand shall not exceed 4% by weight.

6.2.6 WATER

Water used for mixing mortar shall be in accordance with clause 4.3 of IS: 456.

6.2.7 MIX PROPORTION

The mortar shall consist of one part cement and six parts sand (or as specified) for brickwork 230mm thick and above. For brick piers, half brick walls, honey combed brickwork and hollow (cavity) walls, the mortar mix shall consist of one part cement and four parts sand.

6.2.8 MORTAR MIXING

Mixing of mortar shall be done in a mechanical mixer. Hand mixing may also be allowed by the NCCF/Architect.

Cement and sand shall be mixed dry thoroughly and then water shall be added gradually. Wet mixing shall be continued till mortar of the consistency of a stiff paste and uniform color is obtained.

Only that quantity of mortar which can be used up within 30 minutes of its mixing shall be prepared at a time.

Mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within 30 minutes after the water is added to the dry mixture. Mortar left unused for more than 30 minutes after mixing shall be rejected and removed from the site of work and the quantity of cement thus wasted shall be recovered from the contractor.

6.2.9 LAYING BRICKWORK

The bricks used in brick work shall be sufficiently soaked in water before laying. All brick shall be laid in English bond with frog upwards. Each brick shall be set with bed and vertical joints filled thoroughly with mortar. Selected bricks shall be used for the exposed brickwork and same shall be paid separately. The walls shall be taken up truly plumb. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate course shall come directly over the other. The thickness of brick courses shall be kept uniform and for this purpose wooden straight edge with graduation giving thickness of each brick courses including joints shall be used. Necessary tools comparing of wooden straight edge, masons spirit level, square, foot rule, plumb, line and pins etc. shall be frequently and fully used by the masons to ensure that the walls are taken up true to plumb, line and levels. The brick course just below the DPC shall be laid bricks on edge in proper level.

Both the faces of walls of thickness greater than 23cm shall be kept in proper plans. All the connected brickwork shall be carried up nearly at one level and no portion of work shall be raised more than one metre above the rest of the work. Any dislodged brick shall be removed and reset in fresh mortar.

Before commencing any brickwork, the Contractor shall confer with other trades to ensure that all pipes, conduits, drains, sleeves, bolts, hangers, or any other materials necessary to be installed in the brickwork at the time it is built, have been fixed or provided for.

6.2.10 JOINTS

Bricks shall be so laid that all joints are full of mortar. The thickness of joints shall not be more than 10mm. The face joints shall be raked to a minimum depth of 8mm by a raking tool during the progress of the work when the mortar is still green so as to provide proper key for the plaster of pointing to be done. Where plastering or pointing is not to be done, the joints shall be struck flush and finished at the time of laying. The face of brickwork shall be kept clean and mortar droppings removed.

6.3 REINFORCED BRICKWORK

All half brickwork shall be reinforced with 2 Nos.- 6mm M. S. round or equivalent reinforcement at every fourth course. The reinforcement cleaned of rust and loose flakes with a wire brush, shall be embedded thoroughly in cement mortar at every fourth course, it shall be cast in or securely fixed to adjoining columns or walls, in manner approved by the NCCF/Architect.

6.4 CURING

All fresh brickwork shall be protected from the effects of sun, rain, etc. by suitably covering. All brickwork shall be kept constantly moist on all the faces for at least ten days.

6.5 SCAFFOLDING

Unless otherwise instructed by the NCCF/Architect double scaffolding having two sets of vertical supports shall be provided for all building work. The supports shall be sound, strong and tied together with horizontal pieces over which the scaffolding planks shall be fixed. The Contractor shall be responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it. All the external walls shall be constructed from outside only and the contractors rate shall include the cost of scaffolding from outside.

6.6 OPENING

Openings in brickwork for air conditioning ducts, grills, pipes etc. shall be provided at the time of laying brickwork without any extra cost.

After installation of piping, grills, etc. all openings left around pipes grills etc. shall be checked and finished with cement concrete/mortar to render the whole work vermin proof and tidily finished.

6.7 CO-ORDINATION OF WORK

The contractor shall fully coordinate with all other agencies for ensuring completion of their work so that brickwork does not need to be dismantled at a later stage for executing work pertaining to other related agencies. If the brickwork has to be dismantled for executing works fairly intended for the projects, the contractor shall not be entitled for any extra payment on this account and shall also make good at his own cost.

6.9 RUBBLE MASONRY

MATERIAL

The stones to be used for the masonry shall be hard, sound, free from cracks, flaws etc. and shall be from approved quarries. They shall generally be freshly quarried with sharp edges and

clean face. They shall be free from rounded, worn, or weathered surfaces or skin or costing which prevents the adherence of mortar. Size and shape of stone shall be as per the requirement.

The stones to be used as headers, quoins, coping etc., shall comply with the requirements of facing and hearted as may be relevant and shall further comply with the facing stones shall be selected from the mass of quarry stones for their greater size, goods beds, close grain and uniform color. The beds and joints shall have an average bearing of not less than 2 cm. the quoins shall be selected stone and normally be 10 cm. X 24 cm. X 39 cm or as directed by NCCF/ Architect. The faces of quoins shall be rough tooled with 40 mm. chisel drafts at the corner edges. The bedsand tops shall be dressed square to the face and rough tooled to 10 cm. from the face and vertical joints similarly dressed to 4 cm. from the face in the embedded portion the length of side shall not be less than that of exposed side apposite by more than 8 cm for the longer side and 50 m. for the shorter side.

One through stone shall be provided per half Sqm of facing evenly distributed in a staggered pattern. They shall be about 0.03 Sqm in face area and shall have a tailing of the full width of the masonry when the width of the masonry is 60 cm. or less. If the wall or masonry be over 60 cm. thick a line of headers overlapping each other be at least 15 cm. shall be laid right through the wall a face to back. The length of the interior headers shall not be less than 45 cm. and their average cross section area shall not be less than 0.025 Sqm. Face header shall be distinctly marked on its face.

MORTAR

Unless otherwise mentioned the mortar for masonry work shall be composed of 1 part of cement and 6 parts of coarse approved sand. The sand for mortar shall be as per IS:2116 – 1965.

SCAFFOLDING

It shall be single or double as is warranted for the particular work. Put log holes shall be made good by bricks to match the face work when put logs are removed after ensuring that the holes behind are solidly filled with 1:4:8 cement concretes.

CONSTRUCTIONS

The masonry shall be laid to lines level curve and shape as shown on the drawing fixtures plugs, pipes, conduits etc., if any shall be built in at places when on the plans which laying the masonry and not later by removing the stones already laid.

- I. Stones in the hearting shall be laid on their broadest face which gives better opportunity to fill the space between stones.
- II. Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.
- III. In battered walls the beds of stone and the plane of course should be at right angles to the better.

- IV. If masonry is to be laid directly on excavated bed or concrete footing, the bed shall be cleared or all loose materials cleaned and wetted just before laying masonry. Bushings shall not project more than 40 mm. in faces where joints are to be pointed or stuck and 12 mm. in faces proposed to be plastered. Quoins in the unexposed portions shall have the same facing as the rubble stones and shall have uniform chisel drafts of 40 mm in the exposed portions and up to 15 cm. below the finished ground level quoins shall be rough tooled with 40 mm chisel drafts at the corner edges.
- V. The face stones shall be laid without any pining on the exposed faces. In each course the headers or line of headers as the case may be shall kept in portion as specified intervals and will specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required number and intervals. They shall be embedded in mortar as masonry in that layer progress. Quoins shall be laid stretcher and header wise as seen on each face and shall correspond to the arrangement of quoins in the same course.
- VI. The stones shall be wetted before laying in mortar. Each masonry shall be supplied by the contractor with a vessel full of water and tumbler for wetting stones, care being taken not to spill any water on green masonry. The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settle carefully in place with a wooden mallet immediately on placement and solidly bedded in mortar before it has set. Clean spalls carefully selected to fit in the spaces shall be wedged in to mortar joints and beds wherever necessary to avoid thick beds or joints of and beds necessary to avoid thick bed or joints mortar .When the foundation masonry is laid directly on rock the face stones of the first coarse shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. If a portion of masonry is dismantled, every stone must be found with mortar adhering fast to all its embedded surface and there shall be no hollows. This will be one of the tests in deciding if the masonry is good or bad, if need arises where hollows or other defects are suspected a stone here or there may be removed for confirmation. If these are confirmed such portions shall be dismantled and rebuilt at the cost of the contractor.
- VII. Face work and heating shall be brought up evenly but the top of each course shall not be leveled up by use of flat chips.
- VIII. No face joints exceed 16 mm. and the same shall be stuck while mortar is fresh.
- IX. The face joints should be properly struck while the mortar is fresh. When no pointing or is to be done. But if plastering or pointing is required to be done then joint shall be raked out when mortar is fresh.
- X. Stones in corners of walls and angles which are to be plastered shall be rounded. The corners shall also be rounded in plaster while plastering. The frames of doors windows cup boards etc. shall be housed in to the masonry while laying the masonry only: Chisel dressing for the width of door and window frame shall be done to obtain good fit between the frame and masonry.

- Jambs shall be made up of quoins only. Where shown to other than square the jambs shall be splayed to conform to the drawings or the instructions of NCCF/ Architect and shall be true to the templates. Quoins of the full thickness of the wall shall be provided at the rate of 3 for each side of the door opening and 2 for each side of the window opening when the wall is 40 cm. thick or make up full thickness of the wall with break of joint of not less than 8 cm. with stones above and below.
- XI. Holes of the required size and shape shall be left in the masonry during construction for fixing pipes service lines, passage of water etc, and extra hollows left shall be filled with 1:3 cement mortar or 1:3:6 cement concrete and the face shall be finished with matching stones.
 - XII. The top of masonry on which coping R.C.C slab or other flooring is to be laid shall be finished level of the required slope with stones and mortar to give an even bearing. Bed blocks of stone or R.C.C. shall be built-up in the masonry under the beams.
 - XIII. The rate of raising un-coursed rubble masonry brought up in uniform levels may be limited to a height of 69 cm. per day in case of cement mortar and 45 cm. in case of lime mortar.
 - XIV. All masonry work shall be kept well watered for 14 days after laying. Where pozzolana cement is used for mortar the curing shall be extended by one week more at Contractor's expenses.

SCAFFOLDING

Unless otherwise instructed by the Architect double scaffolding having two sets of vertical supports shall be provided for all building work. The supports shall be sound strong and tied together with horizontal pieces over which the scaffolding planks shall be fixed. The contractor shall be responsible for providing and maintaining sufficiently strong scaffolding so as to with stand all loads likely to come upon it.

OPENING

Opening in brickwork for air conditioning ducts, grills pipes etc, shall be provided at the time of laying brickwork without any extra cost.

After installation of piping grills etc all opening left around pipes grills etc, shall be checked and finished with cement concrete/ mortar to render the whole work vermin proof and tidily finished.

CO-ORDINATION OF WORK

The Contractor shall fully co-ordinate with all other agencies for ensuring completion of their work so that brickwork does not need to be dismantled at a later stage for executing work pertaining to other related agencies. If the brick work has to be dismantled for executing works fairly intended for the project, the Contractor shall not be entitled for any extra payment on this account.

7. SPECIFICATION FOR WOOD WORK

7.1 GENERAL

It is intended to include in this specification all kind of carpentry and joinery work in connection with doors, windows, paneling and other items of wood work called for in the drawings and specifications. Carpentry and materials, equipment, incidentals and appliances required completing the work including the provision and installation of fastening devices and hardware in accordance with the drawings and specifications and the directions of the NCCF/Architectas required.

All timber intended to be used at the site of work shall be cut from seasoned logs, shall be brought on the site and stacked a month before using, to obtain uniform grains free from all kinds of knots, decay and spots etc.

Teak/ Hollock/ Champ wood or Timber as specified shall be kiln seasoned, the contractor shall get the same done from an approved timber seasoning kiln, by the Architect and produce satisfactory evidence of having got the timber seasoned. No extra payment shall be made to the contractor on this account.

7.2 TIMBER

Timber shall be of selected best quality. All timber shall be uniform in texture, free from large, loose, dead or cluster knots, waness, injurious open shakes, bore holes, rot, decay, discoloration, soft or spongy spots, hollow, pockets, pits or center heart and all other defects and blemishes. Finishing timber should be well seasoned. The contractor should submit the seasoning certificate to the NCCF/Architect for approval.

The type of the wood to be used shall be as shown in the working drawings, as per particular specifications.

7.2.1 MIRANDI WOOD

Timber shall be of good quality and well seasoned. It shall have fairly uniform color, reasonably straight grains and shall be free from dead knots, cracks, shakes and sapwood. No individual hard and sound knot shall exceed 25 mm. in diameter and the aggregate area off all the knots shall not exceed 1% of the area of the piece. There shall not be less than 5 growth rings per 2 cm of width.

7.3 SAMPLES AND SHOP DRAWINGS

The contractor shall before proceeding with the work, submit to NCCF/Architect for the approval complete samples of the various materials including hardware and fastening devices and shop drawings and large scale details covering all joinery work, if required. Contractor before proceeding to fabrication of finished wood work shall have to get the approval of NCCF/Architect. No extra payment on account of this shall be admissible.

7.4 ROUGH CARPENTRY

All framing and other concealed wood members shall be of specified quality of timber as shown on drawings and as specified and as per the directions of NCCF/Architect. It shall be seasoned to a moisture content of not less than 10% or more than 15%. Wood of greater moisture content shall not be used in any part of the structure.

7.5 WORKMANSHIP

All carpenter's work shall be done by skilled workmen using proper tools. All joints shall as far as possible be mortised and tenoned and glued with best quality approved waterproof glue. Where mortise and tenon joints are not possible, the joints shall be securely nailed or screwed as called for with the longest nails or screws that may be used without splitting the wood. Wherever it is necessary or an adequate joint cannot be formed by nailing, the members shall be lapped or joined by G.I. straps or extra wood blocks. All joints shall be done with neatness and as approved and directed by the NCCF/Architect, cross bracing, solid blocking and bracing shall be provided according to the best practice. The nails shall conform to the relevant I.S. Code. All the wood work shall be finished to the satisfaction of the NCCF/Architect.

7.6 JOINERY

7.6.1 MATERIALS

Finished wood work and joinery which shall be factory made including frames for doors, windows, shutters, etc. shall be surfaced with straight grained best quality Timber as specified, free from knots and other blemishes and imperfection. All finished woodwork and joinery shall be seasoned to not less than 10% or more than 12.5% moisture contents.

All joinery work shall be securely mortised and tanned and glued with best quality waterproof glue. All sections and dimensions are to be that shown on drawings. For all joinery work use of nails shall not be permitted, and wood screws of appropriate size and of approved make shall be used. Wherever practicable, means of fastening the various parts together shall be concealed. All work (both carpentry and joinery) shall be to the dimensions shown on drawings and shall be to the satisfaction of the NCCF/Architect

All interior wood finish, doors and windows work shall be smoothly treated and sanded at the building after erection, until all defects are entirely removed. Any material showing splits saw, sand paper or other defacing marks or other defects shall be rejected. All exposed wood and plywood shall be straight grained or matched grain and color and shall be approved by NCCF/Architect before being fabricated.

7.6.2 INSTALLATION

Doors, windows for shutters shall be installed in position after the plaster in the section for which it is intended is sufficiently dry. All interior and exterior doors, windows and other fixed wooden equipment shall be properly installed, level, plumb and true.

Butt joints shall be avoided wherever possible; if unavoidable the joint shall be beveled. All exterior angles shall be mitered. Adjoining interior wood members shall match and harmonize.

7.7 WOOD FRAMES FOR DOOR AND WINDOW SHUTTERS

7.7.1 GENERAL

All the frames and shutters of doors, windows/ventilators (external or internal) shall be factory made and shall be produced from one of the factories as approved by the NCCF/Architect and shall be rebated or as shown in the drawings. There shall be as per details shown on drawings including a coat of primer and shall be of Timber as specified styles, top, bottom, lock rail of required thickness.

Wood frames for doors and window shutters shall be factory made where called for shall be of best, selected quality timber as per particular specifications properly seasoned as described for joinery and free from knots, cracks and other defects. It shall have uniform color and straight grains. The frame member shall be of one piece and to the dimensions and profile shown on the drawings. All rebates, rounding, moulding etc. shall be placed smooth to the correct dimensions called for, subject to allowable tolerances as per IS.

All joints shall be simple, neat and strong; all mortised and tanned joints shall fix in fully and accurately, without wedging or filling and shall be neatly done.

7.8 FLUSH DOOR SHUTTERS

Door shutters shall be as specified 35mm thick or as per drawings and particular specifications solid core phenol formaldehyde resin bonded flush shutters, commercial ply faced on both faces, unless otherwise specified in particular specifications or drawings. The shutters shall conform to Indian Standard Specification IS: 2202 (part-1). Shutter shall be obtained from the manufacturer approved by the NCCF/Architect.

Shutters shall be ordered on the manufacturer to sizes as called for and shall be provided with first class Timber as per specifications edging, glued and nailed on all the edges of the shutter, as shown on drawings.

SKIN DOOR

Providing and fixing skin moulded door shutter will be made in approved factory with high density Fiberboard (HDF). These will have HDF skin (Boiling water proof as per IS 15380-2003) which will be boiling water resistant, termite resistant and with embossed authentic wood grain texture. The core shall be imported flex Core (with 2 years warranty). The adhesive used shall be conforming to BWP grade of IS 848. The Stile & Rail shall be Lock block shall be made of hard wood. The Stile and Rail shall be of 50-60mm wide, 26-28mm thick and lock Block shall be 101 x 380mm. The door shutter shall be of 1 Panel/2Pannestype as directed by NCCF/Architect complete in all respects.

- (a) 35mm thick (inside doors of DU.) Double skin moulded.
- (b) 35mm thick (inside doors of DU.) Single skin moulded. (Toilets)

7.9 DOOR & WINDOWS FRAMES & SHUTTERS: As per drawings and specifications.

7.10 HARDWARE FITTINGS

Hinges, handles, knobs, locks, ball catchers, adjustable self fitting and other hardware fittings for doors and windows work shall be as specified in the drawings or of Stain less steel of the best quality and specified make as approved by the NCCF/Architect. The Hardware number, size etc. shall be as per the hardware schedules shown on drawings and the contract documents.

PROTECTION OF WORK

The contractor shall be responsible for the temporary doors and closing in openings necessary for the protection of the work during progress or for safety reasons. He shall also provide and maintain any other temporary covering required for the protection of finished wood work that may be damaged during the progress of the work if left unprotected. No extra payment shall be admissible on account of this.

7.11 ALUMINIUM DOOR & WINDOW FRAMES & SHUTTERS

All door & window frames & shutters as specified in specifications & drawings.

8. SPECIFICATION FOR FLOOR WORK

8.1 CEMENT CONCRETE FLOORING

The contractor shall furnish all labor, materials, tools for operations including fixing devices, equipment and incidentals necessary and required for the completion of all flooring and paving work.

The contractor shall pave the areas indicated on the drawings and schedule of finishes with materials therein called for. All flooring shall be laid to the best practice known to the trade. The flooring shall be laid to the level except where slopes shall be uniform and arranged to drain into the indicated outlets. Particular care shall be exercised to ensure that all flooring, skirting and dados are perfectly matched for color and finish

8.1.1 CEMENT CONCRETE

Cement concrete of specification mix shall be used and it shall be generally conform to the specification described under section pertaining to concrete work. All labor, material tools for operations including fixing devices, equipments, scaffolding and incidentals necessary and

required for completion of work shall be arranged for by the Contractor and nothing extra shall be payable to the Contractor on this account.

8.1.2 SUB GRADE UNDER FLOOR OF GROUND FLOOR

This shall be lean concrete of 1:5:10 (1 cement: 5 coarse sand: 10 parts aggregate of 20 mm nominal size). Thickness of lean concrete shall be 75mm. This layer shall be laid over soling. There after concrete of 1:2:4 (1 cement: 2 coarse sand: 4 aggregate of 20 mm nominal size).

8.1.3 PREPARATION

If the flooring is laid on concrete sub grade the same shall be roughened with steel wire brushes without disturbing the concrete. However if the flooring is laid directly of R.C.C. slab the surface of R.C.C. slab shall be cleaned and the laitance shall be removed.

8.1.4 LAYING

Flooring of specified thickness shall be laid in the pattern as given as in the drawings or as directed by the Architect. The panels shall be of uniform size and no dimensions of the panel shall exceed 2 m and the area of a panel shall not be more than 2 sqm.

Normally cement concrete flooring shall be laid in one operation using A.C. strip at the junction of two panels. 6mm thick plain asbestos sheets strips shall be fix with their top at proper level giving required slopes including fixing 75 mm wide, 20mm thick kota stone as dividing strips in parking area.

8.1.5 CONCRETING

Before placing the concrete in position cement slurry at 2 kg of cement per sqm of floor area shall be applied on the concrete sub grade or on the R.C.C slab as the case may be cement concrete shall then be placed in position in one operation in panels. It shall then be leveled with the help of straight edge and trowel beaten with a wooden Thappi or mason's trowel. The blows shall be fairly heavy in the beginning but as consolidation takes places, light rapid strokes shall be given. The surface shall be tested with straight edge and made true to required slopes. While laying concrete care shall be taken to see that the strips are not damaged/ disturbed by the workmen. The top of strips shall be clearly visible.

8.1.6 FINISHING

The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time; till moisture gets dried from its joints or top excessive trowelling shall be avoided. Use of dry cement or cement and sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

8.1.7 CURING

The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty cement gunny legs shall be avoided as the color is likely to be bleached with the remnants of cement matter from the bags.

8.2 GRANITE STONE SLAB KITCHEN COUNTER (TOP & FACIA)

Granite stone slabs for kitchen counters shall be of selected quality, hard, sound, dense and homogeneous in texture, free from cracks, decay, weathering and flaws. These shall be from an approved quarry and shall be of the finish and color as approved by the Architect/ NCCF. The thickness of the slabs shall be as shown in drawings. Tolerance $\pm 2\text{mm}$ shall be allowed for thickness. The exposed edges shall be machine cut and shall have uniform thickness. All faces shall mirror polished to render truly smooth & shall reflecting surface.

8.2.1 Laying

The granite slab shall be laid over furrow cement slab & it shall be cleaned, wetted. Mortar of specified mix shall be spread to required thickness over a small area. The slab, washed clean, shall be laid on the mortar, pressed tapped, with a wooden mallet brought to required level. The stone shall be laid as per the pattern shown on the drawings or as approved by Architect/ NCCF.

It shall then be removed and laid a side. The top of the mortar shall then be corrected by adding fresh mortar at hollows. Mortar is then allowed to harden and cement slurry of paste like consistency shall be spread over the same at the rate of 1 bag per sqm.area. The edges of the slab already laid shall be buttered with slurry of cement and pigment to match the shade of slab. The slab to be laid shall then be placed back in position pressed and properly bedded in level with adjoining slab with as fine a joint as possible. Other slabs are also laid in similar manner to correct levels with fine joints. The surplus slurry on the surface shall be cleaned off.

8.3.0 GLAZED TILES IN SKIRTING AND DADO

8.3.1 GLAZED TILES

The tiles shall generally conform to IS 777 shall be procured by the Contractor. They shall be flat, true to shape and free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade and color shall be as shown in the drawings.

The tiles shall be of nominal sizes such as 100 X 200 mm, 150 X 150mm, 200 X 200 or 300 X 300mm or as specified. The thickness of the tiles shall be 5 mm or 6 mm or as specified. The tolerance on facial dimension value shall be $\pm 1.0\text{ mm}$ and $\pm 0.5\text{ mm}$ in thickness.

The top surface of the tiles shall be glazed. The glaze shall be either glossy or matt as specified. The underside of the tiles shall be completely free glaze in order that the tile may adhere properly to the base. Type edges of the tiles shall be preferably free from glaze, however and glaze, if unavoidable shall be permissible on any one edge of the tile.

8.3.2 PREPARATION

The joints shall be raked out to depth of at least 15 mm in masonry walls, while the masonry is being laid in case of concrete walls. The surfaces shall be hacked and roughened with wire brushes. The surfaces shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

8.3.3 Laying

12 mm plaster or mortar as specified in the drawings shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonally at close intervals. The tiles shall be soaked in water, washed clean and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plans and lines. The tiles shall be set in required pattern and butt jointed. The joints shall be as fine as possible. Top of skirting and dado shall be truly horizontal and joints vertical except where otherwise indicated. Skirting and dado shall rest on the top of flooring. Where full size tiles cannot be fixed these shall be cut to the required size and their edges rubbed smooth.

8.4 CURING AND FINISHING

The joints shall be cleaned of the grey cement grout with soft wire brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. The surface shall then be kept wet for 7 days.

After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with wooden mallet.

8.5 KOTA STONE FLOORING

8.5.1 Stone Slabs

The stone slabs shall be hard, sound durable and tough free from cracks, decay and weathering. Before starting the work the Contractor shall get samples of slabs approved by the Architect.

The slabs shall be hand or machine cut to the requisite thickness along planes parallel to the natural bed of stone and should be of uniform size if required.

8.5.2 Dressing of Slabs

Every slab shall be cut to the required size and shapes, and rough chisel dressed on the top so that the dressed surface shall not be more than 6 mm from a straight edge when placed on it. The edge of depressions or projections shall be chisel dressed in a slant so that the surface does not have sharp unevenness. The sides shall also be chisel dressed to a minimum depth of 20 mm so that the dressed edge shall at no place be more than 30 mm from a straight edge butted against it. Beyond this depth the sides may be dressed slightly splayed so as to form inverted "V" shaped joint with adjoining slabs. All angles and edges of the slabs shall be true, square and free from chipping and the surface reasonably true and plane.

Where slabs are used for trades without nosing, the exposed edges shall be rough chisel dressed to full depth and cut to uniform thickness.

The thickness of the slabs after it is dressed shall be 40 mm or as specified in the description of the item with a permissible tolerance of ± 2 mm.

8.5.3 Laying

Base concrete on which the slabs are to be laid shall be cleaned wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 Cement: 4 Coarse Sand).

The average thickness of the bedding mortar under the slabs shall be 20 mm and the thickness at any place under the slabs not be less than 12 mm.

8.5.4 The Slab shall be laid in the Following Manner

Mortar of specified mix shall be spread under each slab. The slab shall be washed clean before laying. It shall then be laid on top pressed so that all hollows underneath get filled and surplus mortar works up through the joint. The top shall be tapped with a wooden mallet and brought to level and close to the adjoining slabs with thickness of joint not exceeding 5 mm. Subsequent slabs shall be laid in the same manner. After laying each slab surplus mortar on the surface of slabs shall be cleaned of the joints finished flush.

In case pointing with other mortar mix is specified the joint shall be left raked out uniformly and to a depth of not less than 12 mm when the mortar is still unset. The point shall be cured for a minimum period of 7 days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the NCCF/Architect.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster skirting and floor shall be finished neatly and without waviness.

The finished floor shall not sound hollow when tapped with wooden mallet.

8.5.5 Finishing

The relevant specifications of item of mosaic tiles flooring mentioned above shall be followed.

8.6 KOTA STONE IN TREADS, RISER OR STEPS, SKIRTING ETC.

The relevant specification of item mentioned above shall be followed except that the Kota stone shall be fixed for risers of steps, dado or skirting in C.M. 1:3 and the polishing shall be done manually instead of machine polishing.

8.7 VITRIFIED GLAZED TILES

Vitrified tiles in different sizes (thickness to be specified), with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shade, in skirting, riser of steps, over 20 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.

9.0 SPECIFICATION FOR TERRACING

9.1 Brick bat coba terracing as per C.P.W.D. specifications.

9.2 WATER PROOFING TO SUNKEN/LOWERED SLAB OF TOILETS/KITCHEN/BALCONIES

Water proofing shall be provided to all sunken/lowered portions of slabs. This shall consist of the following:

- (a) All CI/GI pipes passing through that wall of the sunken floors shall be laid before the water proofing treatment is carried out.
- (b) Clear the sunken/lowered portion of R.C.C. slab surface (including vertical total depth) by wire brush. Chisel out any mortar sticking to the surface.
- (c) Wash it with water and dust it clear and clean.
- (d) All junction points of side walls where CI/GI pipes are passing through shall be sealed with putty made out of epoxy and cement.
- (e) Apply one coat of cement slurry @ 4.4 Kg./Sqm. Mixed with water proofing compound Impermo or Snowcem or equivalent conforming to IS 2645 in recommended proportions.
- (f) Plastering the bottom and sides with 20 mm thick cement mortar (1 cement: 3 coarse sand) over (e) above.
- (g) Applying blown or residual bitumen applied hot at @ 1.7 kg/Sqm. Over (f).
- (h) Applying 400 micron thick PVC sheet over (G) (over lap at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen)
- (i) When the treatment set dry fill the water for seven days and ensures that the treated area is fully water proof. If seepage marks are observed then over the affected area, treatment as per (e) to (h) shall be repeated.
- (j) All C.I./G.I pipes laid in sunken portion shall be covered with 50 mm thick P.C.C. 1:3:6 around after painting with anticorrosive paint (Japan Black). G.I pipes in sunken portion shall be protected by providing treatment as per specified.
- (k) Filling with P.C.C. 1:5:10 as specified.
- (l) One 50 mm dia G.I. pipe sprout with wire gauge on inside mouth shall be provided to each sunken portion irrespective of what is shown on drawings at the time of casting of R.C.C. facias in adjoining balconies.

9.3 WATER PROOFING TO BASEMENT, SUMPS–DRAINS & UNDERGROUND TANK

Water proofing of locations other than covered in Para 9.1 to 9.3 above shall be carried out in the following:

- (a) (i) Basement
- (ii) Under Ground Tank
- (iii) Pump Room
- (iv) Sumps
- (v) Ramps to Basement
- (vi) Drain in Pump Room
- (vii) Lift Pit

(b) Box type system water proofing treatment for all the above said areas shall be carried out before starting the process of raft and column footings which monolithically from part of these structures and area as follows.

(c) FOR BASE

- (i) First Layer
After cleaning the surface of lean concrete with wire brushes and a pad of cloths 1st course of cement slurry mixed with cemseal shall be applied to the surface.
- (ii) Second Layer
A cement mortar layer of 25 mm thickness of mix 1:3 (1 cement: 3 coarse sand) mixed with acrylic water proofing chemical over the layer.
- (iii) Third Layer
Rough kota stone slabs of thickness 20 mm – 30 mm are then laid over mortar layer side by side leaving a gap of about 15 mm to 20 mm between them. These joints thus left raked open and neat cement slurry admixed with acrylic water proofing chemicals is grouted in these) joints. A protective layer of 25 mm thickness of cement mortar 1:3 (1 cement: 3 coarse sand) admixed with acrylic water proofing chemical and stone chips embedded at random is put over the stone layer. The total thickness of water proofing shall be about 75 mm. This treatment is extended up to outer edges of RCC Raft slab/footing as directed by the Project Manager/Architect.

(d) FOR VERTICAL SURFACES

Water proofing of walls and columns abutting the walls of basement ramp going to basement.

- (i) After the RCC Raft slab and RCC side walls along with columns abutting the walls are laid the treatment shall be continued to the external sides of the walls and the column abutting the wall and type up to 300 mm above ground level or up to the cill level of the ventilator. The procedure shall be as follows:
- (ii) Rough/kota stone slab of thickness 20 mm shall be fixed with the help of cement paste applied to the internal face of vertical joints of the stone are fixed side by side without leaving any gap between the edges leaving a gap of 20 mm between the external face of the wall and internal face of the rough stones. In order to fix the bottom most layers of the stones, groove of minimum 25 mm deep is made in the bottom of the RCC Raft and the stones fixed in it to ensure the water tightness at the junction of the walls and Raft.

- (iii) After the later is set the gap between the RCC wall and stone layer is filled with a grout mix made up to cement slurry and acrylic based chemicals which on grouting from an impermeable monolithic layer.
- (iv) Rough cement plaster 20 mm thick of mix 1:4 (1 cement: 4 coarse sand) admixed with chemical water proofing compound is applied to the external face of rough stones. The above treatment shall be carried up to top of plinth protection and in absence of plinth protection up on 300 mm above outside proposed ground level of the filled up soil and top sealed with gola formed with cement mortar 1:4 (1 cement: 4 coarse sand).

(e) **INSIDE FINISH OF UNDERGROUND TANKS**

The water proofing treatment inside the underground tanks floor inside of external walls partition walls ceiling soffits and side of beams columns to and bottom of RCC partition walls shall be carried out as specified in Para 9.3. After the above treatment the floor/base of storage water tank sump shall be clad with 5 mm thick white glazed tiles of first quality of size 300 X150 as approved on a bed of 12 mm thick cement mortar 1:3 (1 cement :3 coarse sand) finishing flush pointing with white cement white glazed tiles of first quality of size 300 X 150 mm shall be provided on RCC walls columns and sides of the sump over cement screed/cement plaster 12 mm thick with cement mortar 1:3 (1 cement: 3 Coarse sand) set and jointed with neat white cement slurry. The joints shall be neat and fine. The height of glazed tiles shall be up to the soffit of the slab. The joints if any left between tiles and any outlets and inlets of pipes around cat ladder between top tile and soffit of the slab shall be filled with water soluble epoxy.

- (f) Water proofing compound to be used - Chemical Hyproof (manufactured Roff Construction Chemicals Pvt. Ltd.) or equivalent conforming to IS – 2645/1965 shall be used as per manufacturer instructions.

- 9.4** Water proofing treatment as specified in Para 9.1 to 9.3 shall be got executed through a specialist firm as approved by the Architect/ Project Manager who shall give guarantee up to 10 years as per annexure IV in volume – I.

10. SPECIFICATIONS FOR PLASTERING WORK

10.1 SCOPE

The contractor shall furnish all labour, materials scaffolding, equipment, tools, plants and incidentals necessary and required for the completion of all plaster work.

10.2 GENERAL

Plaster as herein specified shall be applied to all internal surface called for. All plaster work shall be executed by skilled workmen in a workman like manner and shall be of best workmanship and in strict accordance with the dimensions on drawings subject to the approval of the NCCF/Architect.

The primary requirements of plaster work shall be to provide dense, smooth and hard enclosure and devoid of any cracks on the interior and/ or exterior.

10.3 SCAFFOLDINGS

Double scaffoldings having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed. The contractor shall get the scaffolding approved from the NCCF/Architect well in advance.

10.4 CHASING AND BREAKAGE

All fixing of door and window frames shall be completed before any plastering work is commenced in a surface. No chasing or cutting of plaster shall be permitted normally. However if the same is felt unavoidable at places, written permission shall be obtained from the NCCF/Architect before cutting any such plaster. Broken corners shall be cut back out less than 150mm on both sides and patched with cement mortar as directed. All corners shall be rounded to a radius of 8mm or as directed by the NCCF/Architect.

10.5 PREPARATION

Masonry and concrete surfaces which call for application of plaster shall be clean, free from dust and loose mortar. Efflorescence if any shall be removed by brushing and scraping. For masonry surfaces the joints shall be raked out properly, while the concrete surfaces shall be roughened by wire brushing and hacking to provide the key, thereby ensuring proper bond to the satisfaction of the NCCF/Architect. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commence.

10.6 CHICKEN WIRE MESH

Galvanized chicken mesh (24 gauge, 12mm size) shall be provided at junctions of brick masonry and concrete members, to be plastered and other locations as called for, properly stretched and nailed with galvanized wire nails, ensuring equal thickness of plaster on both sides by the Architect. The chicken mesh wherever specified, shall be fixed in place before plastering. The cost of providing the chicken wire mesh shall be included in the contractors quoted rates.

10.7 SAMPLES

Samples of each type of plaster shall be prepared well in advance of undertaking work for the approval of the architect/NCCF.

10.8 MORTAR

The mortar of the specified mix shall be used. Mortar shall prepared as specified under "Brick work". It shall be made in small quantities, as required, and applied within 15 minutes of adding water to the plaster mix.

10.8.1 CEMENT

Cement shall be as per specifications under “Concrete Work”.

10.8.2 WATER

Water shall be as per specifications under “Concrete Work”.

10.8.3 SAND

For plaster work normally clean fine sand shall be used. However if specified in the drawing or schedule of finishes, coarse sand conforming to the specifications under “concrete work” shall be mixed with fine sand in proportion specified or as directed by the NCCF /Architect.

10.8.4 WATER PROOFING COMPOUND

Water proofing compound as specified in schedule of approved material shall be used.

10.9 CEILING PLASTER

Ceiling plaster shall be completed before commencement of wall plaster.

Surface plaster about 15 x 15 cm shall be first applied, horizontally and vertically, at not more than 2 meters intervals over the entire surface to be plastered to serve as gauges. The surfaces of this gauged area shall be truly in plain of the finished plaster surface. The mortar shall be laid between the gauges with a trowel ensuring through filling of joints. The mortar shall be applied in a uniform surface slightly more than the specified thickness and then brought to a true surface, by working a wooden straight edge reaching across the gauge, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according to a smooth or a sandy granular texture is required. Excessive trowelling or over working the float shall be avoided.

All corners, arises angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises, junctions etc. where required shall be done without extra payment. Such rounding shall be carried out with proper templates to the sizes required. No portion of the surface shall be left out initially to be patched up later on. Grooves shall be provided at the junction of ceiling and wall plaster as shown in drawings or if directed by the Architect without any extra cost.

In suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped, cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to be properly joint together. Plastering work shall be closed at the end of the day on the body of the surface and not nearer than 15 cm to any corners or arises. It shall not be closed on the body of the features such as

pilasters, bands and cornices, nor at the corners arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings, as these invariably lead to leakages.

The mortar of the specified mix shall be used. Mortar shall prepared as specified under "Brick work". It shall be made in small quantities, as required, and applied within 15 minutes of adding water to the plaster mix.

10.10 GROOVES

Wherever directed all joints between concrete and Conc. Block / brick masonry besides other locations as called for shall be expressed by a groove cut in plaster at no extra cost. Size of the grooves shall be **6mm** in width and **10mm** in depth.

10.11 FINISH

The plaster shall be finished to a true and plumb surface and to the proper smoothness as required. The work shall be tested frequently as the work precedes with a true straight edge not less than 2.5m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

10.12 CURING

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of atleast 7 days. During this period, it shall be suitably protected from all damages.

10.13 PRECAUTION

Any cracks which appear in the surface and all portions, which sound hollow when tapped or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the NCCF/Architect.

10.14 FLOATING COAT OF NEAT CEMENT

Where finishing with a floating coat of neat cement is specified in the drawings or directed by the NCCF/Architect, specification, for this item of work shall be same as described above except for the additional floating coat which shall be carried out as below. When the plaster has been brought to a true surface with the wooden straight edge, it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth; so that the whole surface is covered with neat cement coating. The quality of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

10.15 PLASTERING

WALL PLASTER

For all plastering work on walls unless otherwise specified double scaffolding have two sets of vertical support shall be provided. The maintaining sufficiently strong scaffolding so as to with stand all loads likely to come up to it.

All joints in the masonry shall be raked out properly to a minimum depth of 12 mm. Dust and mortar shall be brushed out. The surface shall then be thoroughly washed with water cleaned and kept wet before plastering is commenced,

The type of mortar mix to be used shall be as specified in the description of the item.

The thickness of plaster shall be as specified. The plaster may be applied in 1 or 2 coats as specified or as directed by the Architect, but no single coat shall exceed ½" in thickness.

Ceiling plaster shall be completed before the commencement of wall plaster. All wall plaster shall be started from the top and worked down towards floor.

Gauges of plaster 6" X 6" shall be first applied horizontally and vertically at not more than 6 ft. intervals over the entire surface to serve as guides for plastering and to ensure even thickness and a true surface. The surface of these gauge areas shall be truly in the plane of the finished plaster surface.

The surface shall be finally given the type of finish as specified in the description of the item or as directed by the Architect.

All corners arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners arises, junctions etc. where required shall be done without any extra payment.

In suspending work at the end of the day the plaster shall be left cut clean to line both horizontally and vertically. The work shall be closed on the body of wall and not nearer than 6" to any corners on arises, when recommencing the edge of the old work shall be scraped clean and wetted before plaster is applied to the adjacent areas.

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept for a minimum period of 7 days. The dates of plaster shall be legibly marked on the various sections of wall so that curing for the specified period thereafter can be watched.

Any cracks which appear in the surface and all portions which sound hollow when tapped or are found to be soft or otherwise defective shall be cut out in rectangular shape and redone as directed by the Architect.

10.16 PLASTER OF PARIS PUNNING

10.16.1 SCOPE

The Contractor shall furnish all labor materials scaffolding equipment tools plants and incidentals necessary and required for the completion of all POP punning.

10.16.2 GENERAL

Plaster of Paris punning as herein specified shall be applied to all internal surface where called for. All POP work shall be executed by skilled workmen like manner and shall be of the best workmanship and in strict accordance with the dimensions on drawings subject to the approval of the Architect/ NCCF.

The primary requirement of POP work shall be to provide dense smooth and devoid of any cracks.

10.16.3 MATERIAL

The plaster of Paris shall be of the Calcium - Sulphate semi-hydrate variety.

Its fineness shall be such that when sieved through a sieve designation 3.35 mm for 5 minutes after drying the residue left on it shall be not more than 1 % by weight. It shall not be too quick setting. Initial setting time shall not be less than 13 minutes. The average compressive strength of material determined by testing 5 cm cubes after removal from moulds after 24 hours and dry in an oven at 40 degree C till weight of the cubes is constant shall not be less than 84 kg. per square meter.

10.16.4 APPLICATIONS

The material will be mixed with water to a workable consistency. Plaster of Paris shall be applied in such a manner that it fully fills the voids of plaster. The finished surface shall be smooth and true to plain slopes or curves as required.

11. SPECIFICATIONS FOR PAINTING WORK

11.1 WHITE WASHING WITH LIME

11.1.1 SCAFFOLDING

Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed.

Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

11.1.2 PREPARATION OF SURFACE

Before new work is white washed, the surface shall be thoroughly brushed free from mortar dropping and foreign matter.

11.1.3 PREPARATION OF LIME WASH

The wash shall be prepared from fresh stone white lime. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water) approx. 5 kg of water to one kg of lime) to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 4 kg of gum dissolved in hot water shall be added to each cum of the cream. Indigo (Neel) upto 3 gm per kg of lime dissolved in water shall be added and wash stirred well. Water shall then be added at the rate of about 5 liters per kg of lime to produce a milky solution.

11.1.4 APPLICATION

The washing on ceiling should be done prior to that of walls. The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Architect before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

11.1.5 PROTECTIVE MEASURES

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed by the contractor at his own cost and the surface cleaned. Damage if any to furniture or fittings and fixtures shall be recoverable from the contractor.

11.1.6 SCAFFOLDING

The specifications in respect of scaffolding, protective measures shall be as described above under white washing.

11.2 WATER PROOFING ACRYLIC BASED PAINT

11.2.1 MATERIAL

Cement paint of required color and of approved brand and manufacturer conforming to IS: 5410 shall be used. Before application of the cement paint shall be got approved from the NCCF/Architect. Cement paint shall be mixed with water in two stages. The first stage shall comprise of two parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add cement paint gradually to the water and vice versa. The second stage shall comprise of adding further one part of water to mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

Cement paint shall be mixed in such quantities as can be used up within a hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish.

The lids of cement paint shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

11.2.2 PREPARATION OF SURFACE

For new work the surface shall thoroughly be cleaned of all mortar dropping, dirt, dust, algae, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied.

11.2.3 APPLICATION

For new work, the treatment shall consist of a priming coat of cement paint following by the application of two or more coats of cement paint till the surface shows an even color. For each coat, the entire surface shall be coated with the mixture uniformly, with proper cement paint brushes in horizontal strokes followed immediately by vertical ones which together shall constitute one coat.

The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform and shall show no brush marks.

Enough cement paint shall be mixed to finish one area at a time. The application of a coat in each area shall be finished in one operation and no work shall be started in any area, which cannot be completed the same day. After each day's work, the brushes shall be washed in

hot water and hung down to dry. Old brushes which are dirty or caked with cement paint shall not be used.

11.2.4 SCAFFOLDING

The specifications in respect to scaffolding and protective measures shall be as described above under white washing.

11.3 APPLYING PRIMING COAT

11.3.1 MATERIAL

The primer shall be ready mixed primer of approved brand and manufacturer. For wood work it shall be pink or grey primer conforming to IS: 3536 and for steel work it shall be zinc chromate primer conforming to IS: 104 unless specified otherwise in the specifications.

11.3.2 PREPARATION OF SURFACE

WOODEN SURFACE

The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be dusted. Knots, if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material with same shade as paint shall be used where specified.

IRON & STEEL SURFACE

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken.

11.3.3 APPLICATION

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off in the direction of the grain of wood.

11.3.4 PROTECTIVE MEASURES

All furniture, fixtures, glazing, floors etc. Shall be protected by covering and stains, smears, splashing if any shall be removed and any damage done shall be made good by the contractor at his cost.

12.1 SYNTHETIC ENAMEL PAINT

12.1.1 MATERIAL

Synthetic enamel paint of required color and of approved brand and manufacture conforming to the relevant IS specifications shall be used. Before application of the paint, the shade shall be got approved from the NCCF/Architect.

12.1.2 PREPARATION OF SURFACE

The priming coat shall have dried completely before painting is started. All dust and dirt that has settled on the priming coat shall be carefully and thoroughly wiped away.

12.1.3 APPLICATION

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers, when applying also, the paint shall be continuously stirred in the smaller containers so that the consistency is kept uniform.

The number of coats shall be as specified or directed by the Architect. The paint shall be applied in the usual manner with brushes or spraying machine. The painting consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off has finished. The full process of crossing and laying off will constitute one coat. The painted surface shall present a uniform appearance and glossy finish free from streaks, blisters etc.

The specifications with respect to protective measures shall be as described above under priming coat.

13.1 PAINTING WITH WOOD PRESERVATIVE

Oil type wood preservation of specified quality and approved make, conforming to IS: 218 shall be used. Generally, it shall be creosote oil type - I or anthracene oil.

PREPARATION OF SURFACE

Painting shall be done when the surface is perfectly dry to permit good absorption. All dirt, dust and other foreign matter shall be removed from the surface to be painted. All roughness shall be sand papered and cleaned.

APPLICATION

The preservative shall be applied liberally with a stout brush and not daubed with rags or cotton waste. It shall be applied with a pencil brush at the joints of the wood work. The first coat shall be allowed at least 24 hours to soak in before the second coat is applied. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

The specification with respect to protective measures shall be as described above under priming coat.

14.1 OIL BOUND DISTEMPER

MATERIALS

Oil Emulsion (oil Bound) distemper (see IS-428-1969) of approved brand and manufacture shall be used. The primer where used as on new work shall be cement primer or distemper primer as specified. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared.

The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in custody of the contractor and record be maintained. The empty tins shall not be removed from the site of work, till this item of work has been completed and approved by the NCCF/Architect.

PREPARATION OF SURFACE

For new work the surface shall be thoroughly cleaned of dust, old white or color wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling the undulation on and then sand papering the same after it is dry.

Pitting and patches in plaster shall be made good with plaster of paris mixed with the color to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

APPLICATION

PRIMING COAT

The priming coat shall be with distemper primer or cement primer, as required.

NOTE: - If the wall surface plaster has not dried completely cement primer shall be applied before distemping is done after the wall surface is dried completely, distemper primer shall be applied.

DISTEMPER COAT

For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed by vertical ones which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

A time interval of at least 24 hours shall be allowed between consecutive coats to permit the proper drying of the preceding coat.

For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade.

15cm double bristled distemper brushes shall be used. After each day's work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

DECORATIVE PAINTS

Decorative paints where specifications shall conform to the manufacturers technical specifications and recommendations regarding preparation of surface, paint consumption, finish, etc. The contractor shall forward a copy of manufacturers specifications to the NCCF/Architect for approval before proceeding with the work.

EXTERIOR PAINT TO EXTRIOR WALLS & PROJECTIONS

Exterior weatherproof textured paint two or more coats over a coat of primer, cement based putty and white cement.

15. PILING

GENERAL REQUIREMENTS

The construction and performance of the piles shall conform to the recommendations of the current edition of Indian Standard IS: 2911-Code of Practice for Design and construction of Pile Foundations. Bored cast in situ (part-I/ Section-2 1979 with relevant up-to-date revisions)

concrete piles, load test on piles and to this specification. If they conflict this specification shall take precedence.

15.1 SUBMISSIONS:

The Contractor shall submit the following information to the NCCF/Architect for approval before starting the pile work.

Proposed specialist firm to undertake Piling outline Data including:

- a) Name and address of firm.
Summary of firm's experience with piling system proposed.
Key personnel controlling the piling work, in terms of construction.
- b) Plant Proposed:
Number, type and size of main plant items to be employed on the works
Including:

Cranes,
Piling equipment
Concreting equipment.
- c) Pile Testing:
Outline proposals for installation and testing of trial piles and tests on work piles.

15.2 TOLERANCE:

a) Setting Out:

Setting out shall be carried out from the main grid lines of the proposed structure. Immediately before installation of the pile, the pile position shall be marked with suitable identifiable pins or markers.

b) Position:

For pile head cut-off, at or above ground level, the maximum permitted deviation of the pile head cut off center from the center point, shown on the setting out drawings should not deviate more than 75 mm or $D/6$ whichever is less from their designed positions at working level in any directions.

- c) For pile head cut-off below ground level and additional tolerance will be permitted in accordance with specified clause on the assumption that the pile head would have been within tolerance if the cut-off had been at ground level.

d) Verticality:

Piles should not deviate more than 75mm or deviate $D/6$ mm whichever is less from their designed positions at the working level.

e) Forcible Corrections

Forcible corrections to concrete piles shall not be made.

15.3 PILING PROGRAMME:

The contractor shall inform the NCCF/Architect two days in advance of the programme of piling and shall give adequate notice of his intension to work and obtain permission from NCCF/Architect to work outside normal hours and at weekends.

15.4 NUISANCE AND DAMAGE:

a) Noise and Disturbance:

The Contractor shall carry out the work in such times as to minimize noise and disturbance.

b) Damage to adjacent structures:

If during the execution of the work damages or it likely to be caused to mains services or adjacent structures, the Contractor shall submit to the NCCF/Architect their proposals for repair or avoidance of such damage.

c) Damage to Piles:

The Contractor shall ensure that damage does not occur to completed.

15.5 RECORDS:

The Contractor shall keep records as indicated by an asterisk in attached Table of the installation of each pile and shall submit three signed copies of these records to the NCCF/Architect duly counter signed by NCCF/Architect not later than noon of the next working day after the pile was installed. The signed records will form a record of the work.

Any unexpected boring conditions reported in accordance with particular obligations as specified below shall be briefly noted in the records.

TABLE

S. No.	Data	Bored Cast-in-situ Concrete Piles
a)	Type of Boring	*
b)	Pile reference number (Location)	*
C)	Piles Cut off Level	*

d)	Pile Type	*
e)	Nominal cross-sectional dimensions or diameter	*
f)	Pile Design capacity	*
g)	Standing Groundwater Level	*
h)	Data and time of Driving, Re-driving or boring/ Time taken for concreting	*
i)	Date of Concreting	*
j)	Ground Level at Commencement of Installation of Piles	*
k)	Working Level	*
i)	Depth of boring	*
m)	Type of soil in which pile tip is resting and record of “N” value of conducted	*
n)	Depth from working level to pile head level sequence of piling from center towards periphery of periphery to center	*
o)	Test cubes taken and results	*
p)	Concrete:	
	Mix ration	
	Quality of cement per Cum	
q)	Details of drilling mud used	*
r)	Length and details of reinforcement	*
S)	Grade and Slump of Concrete mix and control test results	*
t)	Volume of concrete installed in pile	*
u)	Method of Placing Concrete	*
v)	Level of water or drilling fluid at commencement of Placing Concrete	*
w)	All information regarding obstructions delays and other interruptions to the sequence of work	*

15.6 BORED CAST-IN-SITU CONCRETE PILES:

Installation of Piles shall be carried out in accordance with the pile construction drawings and as per the directions of the Architect

15.7 SEQUENCE OF INSTALLATION

The sequence of installation of piles shall be subject to the approval of the NCCF/Architect. In particular, within a group piles, the installation sequence shall be such as to minimize the detrimental effects of heave and lateral displacement of the ground.

15.8 EQUIPMENT AND ACCESSORIES:

The equipment and accessories required for the pile shall be of standard type and approved by the NCCF/Architect. The capacity of the pile frame shall be selected after considering the size and weight of the casing to be handled, the location of the work and the hardness of driving. The nominal casing size shall be in accordance with pile dia.

15.9 REINFORCEMENT OF PILE:

- a) The main longitudinal reinforcing bars in piles shall be in one continuous length unless otherwise approved. In long piles, joints will be permitted in main longitudinal bars but these shall be kept to a minimum. Joints in adjacent bars shall be staggered at least 1 meter apart along the length of pile. Joints in reinforcement shall be such that the full strength of the bar is effective across the joint.
- b) Longitudinal reinforcement shall be provided for the full length of the pile and shall extend above pile cut off level to provide adequate bond length in the pile cap. The reinforcement in the piles shall be as per the design drawings. Longitudinal reinforcement shall be formed into a rigid cage to resist deformation during handling and installation by the use of links or helical reinforcement. The longitudinal reinforcement shall project 52 times its diameter above the cut off level of the pile to ensure adequate bond length inside the pipe cap. Reinforcement provided in pile shall be symmetrical about an axis on the pile cross section. Lap or splice joints shall be provided with sufficient link bars to resist eccentric forces.

15.10 COVER:

Minimum cover to main reinforcement in the pile shall be 50mm.

15.11 CONCRETING - GENERAL

The method of placing and the workability of the concrete shall be such that continuous monolithic concrete shaft of the full cross section is formed. Mechanical vibrators shall not be used to compact concrete.

15.12 CONCRETING – MIX PARAMETERS

- a) Irrespective of which is shown on drawings, design mix concrete in piles and all RCC work up to plinth level shall be of grade M-35 with minimum cement given in Section – II as per specification, except that its consistency shall be compatible with the particular method of pile installation proposed. Generally the slump of the concrete shall be within the range 50 to 180 mm. For piling systems which use semi-dry concrete and employ special means for its compaction, the workability criteria shall be agreed with the Architect.
- b) The Contractor will carry out adequate number of pile to ensure the minimum specified strength in accordance with IS:456, IS: 10262 and SP: 23 shall be followed as guidance for minimum design. Compaction of test cubes shall be done under same condition as followed for concreting of piles.

15.13 CONCRETE LEVEL – FINISHING OF PILE HEAD:

The cut-off level shall be as shown on the construction drawings. Concrete shall be cast of minimum of 300mm above the cut-off level, or local ground water level whichever is higher.

15.14 USE OF DRILLING MUD-BENTONITE:

In case bored piles are stabilized by drilling mud it shall be as per IS, Bottom of the hole shall be cleaned very carefully by operation of boring tool/ and or flushing of drilling mud through bottom hole where drilling mud is used. The specific quantity of the fresh supply and contaminated mud in the hole before concreting shall be taken up and recorded for first ten piles and subsequently at approximate intervals of 10 piles or earlier as directed by NCCF/Architect. Density of freshly prepared Bentonite suspension shall be as specified in the IS Code.

15.15 TRIMMING OF PILE HEADS:

Following excavation subsequently for pile cap construction the Contractor shall carefully remove excess concrete above specified cut-off level, without damaging the remainder of the pile including the projection reinforcement. Any cracked or defective concrete occurring below specified cut-off level shall be cut away and made good with new concrete properly bonded to the old.

15.16 TRIAL PILE:

Initially piles which are not working piles shall be installed by Contractor at his own cost to assess the load carrying capacity of a pile. Pile of this category shall be tested to its ultimate load capacity or twice the estimated safe load, as directed by Architect.

15.17 REPLACEMENT OF DEFECTIVE PILES:

The Architect and NCCF reserve the right to reject any pile which is defective in any way. Piles that are defective shall be pulled out or left in place as judged convenient by Architect without affecting

performance of adjacent piles. Also the Contractor shall be bound to install additional piles to substitute the defective ones at no extra cost to NCCF as per the directions of the Architect.

15.18 LOAD TESTS OF PILES:

GENERAL:

- a) Except where specified otherwise the equipment, preparation and procedure for load test shall be in accordance with IS : 2911 Part -IV (latest revision) Initial load tests on 'Trial Piles' Shall be executed in advance of works pile construction and shall comprise vertical load tests at locations as directed. Load test on trial piles shall also include lateral load test and uplift load tests as directed by the Architect. Six number of trial piles shall be tested for each capacity of the pile proposed to be used by the Contractor in the work for establishing load capacity, Out of the six (6) Nos. of piles to be tested for Two (2) Nos. each capacity will be tested for vertical load, two (2) Nos. for lateral load and two (2) Nos. for uplift load.
- b) Routine load test on 'Works Piles' shall be vertical load test and lateral load tests on piles as directed by the NCCF/Architect. Number of routine tests to be conducted on work piles shall be equal to one and half (1 ½) percent of total number of piles used in the work for each of vertical load test and lateral load test for each size pile.
- c) The cost of trial piles and testing them and cost of load testing of piles to establish their capacities shall be borne by Contractor and deemed to be included in his quoted amount.

REQUIREMENTS:

- a) Load tests shall not normally be undertaken by the Contractor within 28 days after the installation of the piles in position. However, the contractor may be allowed by the NCCF/Architect to use rapid hardening cement or add necessary admixtures to enable him to conduct the tests within a lesser period for which no extra payment shall be made to Contractor. Before any load test is done the proposed arrangement for carrying out the load test including the preparation of the structure to receive the loads and the type of loading to be adopted shall be furnished by the Contractor and shall be approved by the NCCF/Architect. The responsibility for carrying out such load tests satisfactorily, safely and on proper lines will rest with the Contractor at his own cost.
- b) A format for recording test information shall be submitted by the Contractor for approval by the NCCF/Architect prior to testing.
- c) A written record and report of each trial test shall be submitted in triplicate to the NCCF/Architect offices duly counter signed by Architect immediately after the completion of each test. The record shall include all relevant information, including construction drawings, full installation details of the pile as specified and full test details, together with an evaluation of the test result in terms of the specified criteria for acceptability.

15.19 VERTICAL LOAD TEST ON TRIAL PILES:

- a) Load test to verify the designed load shall be carried out on piles of different capacities proposed to be used in the work.
- b) The Contractor shall commence testing as early as possible after installing the piles. The test shall be carried out by applying series of loads on RCC cap over single pile. The load shall be applied by means of standard by hydraulic jack reacting against a loaded platform which shall be a preloaded platform which shall a preloaded to three times the estimated safe load carrying capacity of the pile.
- c) Reading of settlement and rebound shall be recorded with the help of four dial gauges of 0.01 mm sensitively and resting on diametrically opposite ends of the pile cap.
- d) The dial gauge shall be fixed to a datum bar ends rest upon non-movable supports. The supports for datum bar with reference to which the settlement of the pile is measured shall be a least 5 times diameter of pile away from the pile.
- e) The test shall be conducted by the cyclic loading method. The test loads shall be applied in equal increments of about one-fifth of the estimated safe load or as per the directions of the Architect. Each stage of loading or unloading shall be maintained till the rate of movement of the pile cap is not more than 0.02 mm per hour. However, loads shall be maintained for longer periods at one and half (1 1/2) times the estimated safe capacity and at final loads as directed by NCCF/Architect.
- f) The loading shall be continued till the settlement of the pile top is one tenth of the diameter of the pile stem or the load is three times the estimated safe load on the pile, whichever is earlier.
 - i) Two Third of the final load at which the total settlement attains the value of 12mm
 - ii) Two third of the final load at which the net settlement attains a value of 6mm
 - iii) 50 percent of the final load at which the total settlement equals one tenth of the pile diameter.

15.20 VERTICAL LOAD TEST ON TRIAL PILES:

- a) The test pile shall be decided by the NCCF/Architect. The test pile shall be cut off at the proper level and provided with a cap with vertical plane sides having an adequate area for proper seating of the jack and dial gauge.
- b) The lateral load shall be applied on the pile at or approximately at cut off level and the deflection shall be measured at a point diametrically opposite to the point of load application.
- c) The loading shall be applied by the hydraulic jack adequate capacity, abutting the pile horizontally and reacting against a suitable system. The reaction may be provided by the well of the excavated pit when the test is being conducted below ground level or by a neighboring pile in which case thrust pieces shall be inserted on either end of the jack to make up the gap.
- d) Lateral load applied on the pile shall be measured by a calibrated pressure gauge mounted on the jack, having a least count of 500kg.

- e) Deflection of the pile head shall be measured by four dial gauges, fixed to datum bars and having a least count of 0.01mm. The datum bars shall be provided with rigid supports.
- f) Loading shall be applied in increments of 500kg. Each stage shall be maintained for a period till the rate of movement of the pile head is not more than 0.02 mm/ hour or 1 hour whichever is greater.
- g) Loading shall be continued till one of the following occurs:
 - 1) Deflection of pile head exceeds 12mm
 - 2) The applied load on the pile is three times the assumed lateral load capacity of the pile
- h) The safe load shall be the smaller of the following:
 - 1) Half the final load for which the total deflection is 12mm
 - 2) Load at which the total displacement corresponds to 5mm.

15.21 PULL-OUT TEST:

- a) The test piles shall be decided by the NCCF/Architect.
- b) The test pile shall be built up to the proper length and the head provided with suitable arrangements for anchoring the load applying system.
- c) Loads shall be applied using an approved reaction system; uplift forces on the pile may be applied directly to the test pile or through a lever system. The reaction may be provided by neighboring piles or blocks may be constructed for the purpose. Hydraulic jacks shall be used for load application.
- d) Load applied by the hydraulic jack shall be measured by a calibrated gauge with a least count of 1000 Kg.
- e) Movement of the pile shall be measured by dial gauges fixed to datum bar and having a least count of 0.01 mm. Four dial gauges placed diametrically opposite shall be used. Datum bars shall be provided with rigid supports.
- f) The load shall be applied along the longitudinal axis of the pile using method approved by the Architect.
- g) Loading shall be applied to the pile top in increment of one-fifth of the expected safe capacity
- h) Each stage shall be maintained for a period till the rate of movement of the pile head is not more than 0.02mm per hour or four hours whichever is greater.
- i) Loading shall be continued till one of the following occurs:
 - 1) Yield of soil pile system occurs causing progressive movement of pile exceeding 12mm

- 2) The loading on the pile top equals three times the estimated safe load or as specified in the case of separate test pile.
- j) The safe capacity of the pile should be least of the following:
 - 1) Two third of the load at which the total displacement is 12mm or the load corresponding to a specified permissible uplift and
 - 2) Half of the load at which the load displacement curve shows clear break (downward trend)

15.22 ROUTINE TEST:

Routine tests shall be carried out on various working piles as decided by the NCCF/Architect.

VERTICAL LOAD TEST:

Pre-loading shall be 1 ½ (one & half) times the estimated safe load carrying capacity of the pile. The loading procedure in other respects shall be similar to the initial test. The safe load shall be assessed similar to the initial test.

Two third of the final load at which the total settlement attains a value of 12mm

LATERAL LOAD TEST:

The loading shall be 1.5 times the lateral load capacity and testing procedure shall be similar to the initial test. The safe load shall be similar to the initial test.

SECTION – B PLUMBING & SANITATION

1. SCOPE OF WORK

- 1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Scope of work and/or shown on the Plumbing Drawings.

This contract is a Lump Sum Contract. All payments are made for the actual work executed. Any variation in the quantities will not have any extra cost implication on the quoted rates.

- 1.2 Without restricting to the generally of the foregoing Sanitary installations shall include the following:-
- a) Sanitary Fixtures
 - b) Soil, Waste, Rain Water and Vent Pipes.
 - c) Water supply system.
 - d) External Sewerage and Drainage system.
- 1.3 Services rendered under sub-section 1.4 shall be done without any extra charge.
- 1.4 The Contractor must get acquainted with the proposed site for the works and study Specifications and Conditions carefully before tendering. The work shall be executed as per programme approved by the Project Manager. If part of site is not available for any reason or there is some unavoidable delay in supply of materials stipulated by the NCCF, the programme of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.
- 1.5 Works area shall be the area shown in the plan attached.

2. SPECIFICATIONS

- 2.1 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.
- 2.2 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with latest amendments as applicable in the contract.
- 2.3 Works not covered above para 2.1 and 2.2 shall be carried out as per relevant Indian Standards Specifications or Codes of Practice or NBC and, if not available, as per British Standards specifications or Codes of Practice or unified Plumbing Code of U.S.A.
- 2.4 The work shall be carried out strictly as specified in Scope of work and Technical Specifications. In case of any ambiguity, the details of particular item as given in Scope of work shall supersede the details in Specifications.

3. EXECUTION OF WORK

- 3.1 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural and Other specialized services drawings and as per coordinated drawings.
- 3.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction programme.
- 3.3 On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Project Manager. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

4. DRAWINGS

- 4.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.
- 4.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.
- 4.3 Contractor shall verify all dimensions at site and bring to the notice of the Architects or Project Manager all discrepancies or deviations noticed. Architects decision shall be final.
- 4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.
- 4.5 All drawings supplied with the tender shall be returned in good conditions along with the tender.
- 4.6 All drawings/sketches issued by the Architects/Consultant for the works are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5. INSPECTION AND TESTING OF MATERIALS

- 5.1 All materials before being allowed to be brought into the store will be preliminary / visually inspected at the entry gate of the project site before the security personnel. All materials shall be inspected by the NCCF/Architect before receiving. This inspection will be conducted with the help of the quality approval format as prepared by the Clients.

- 5.2 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.
- 5.3 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-
- a) Theodolite
 - b) Dumpy level
 - c) Steel tapes
 - d) Weighing machine
 - e) Plumb bobs, Spirit levels, Hammers
 - f) Micrometers
 - g) Thermometers, Stoves
 - h) Hydraulic test machine
 - i) Smoke test machine
- 5.4 All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.
- 5.5 All Testing Equipment shall be preferably located in special room meant for the purpose.

6. METRIC CONVERSION

- 6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.
- 6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

7. REFERENCE POINTS

- 7.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

8. REFERENCE DRAWINGS

- 8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Project Manager.

9. SHOP DRAWINGS

9.1 Shop drawings shall be submitted under following conditions:-

- (a) Typical details for Toilets & Fixtures required.
- (b) Structural supports/hanging/laying and jointing details for all types of pipes as required.
- (c) Plumbing and fire fighting layout plans as required and for any changes in the layout of Plumbing/fire fighting /Architectural Drawings.
- (d) Equipment & piping layout for Mechanical and Electrical equipments as required, SLDs, mounting details of circuit breakers, location of panels, installation of terminals and faucets etc. with respect to finishes, surrounding levels & locations.
- (e) Manufacturer's and Contractor fabrication drawings

10. CONTRACTORS RATES

As per contract documents, drawings & specifications.

11. TESTING

- 11.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.
- 11.2 Tests shall be performed in the presence of the Project Manager/ Architect.
- 11.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.
- 11.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.
- 11.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.
- 11.6 Contractor shall afford all the expenses for the offsite testing of material and equipments.

12. SITE CLEARANCE AND CLEANUP

- 12.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.
- 12.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

- 12.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

13. LICENSE AND PERMITS

- 13.1 Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.
- 13.2 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, storm-water drainage system including rainwater harvesting and complete Fire Fighting system. He shall also be responsible for co-ordination for getting the approval, with other agencies working on the project relating to their scope of work.
- 13.3 Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.
- 13.4 Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.
- 13.5 All inspection fees or submission fees paid by the Contractor shall be reimbursed by the NCCF on production of valid official receipts.

14. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

- 14.1 If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to the NCCF which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. or the actual cost given by the NCCF shall be final and binding on the Contractor.

15. CUTTING & MAKING GOOD

No structural member shall be chased or cut without the written permission of the Project Manager.

16. MATERIALS SUPPLIED BY THE NCCF

- 16.1 The Contractor shall verify that all materials supplied by the NCCF conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the NCCF/Architect.
- 16.2 After receipt of materials, it shall be the responsibility of the Contractor for any damage found and he shall be liable to pay the actual cost of the material as per market rate at that time.

17. MATERIALS (SUPPLIED BY THE CONTRACTOR)

- 17.1 All materials used in the works shall conform to the tender specifications.
- 17.2 As far as possible all materials shall be bearing I.S. certification marks as per approval of the NCCF/Architect.
- 17.3 All materials shall bear the necessary certification marks, conforming to the Tender Specifications / BOQ / Drawings requirements.
- 17.4 Unless otherwise specified and expressly approved in writing by the NCCF/Architect, materials of makes and specifications mentioned with tender shall be used.

18. CASH FLOW STATEMENT

The Contractor should submit along with the Tender, his cash flow statement for timely completion of work.

19. MOCK UP AND TRIAL ASSEMBLY

The installation of Sanitary Fixtures and fittings shall be as per the shop drawings approved by Architect / Consultant.

The Contractor shall have to assemble at least one set of each type of Sanitary Fixtures and Fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc, which will be required for final installation of all Sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect / interior designers.

The Fixtures in the trial assembly can be reused for final installation without any additional payments for fixing or dismantling of the fixtures.

20. FINAL INSTALLATION

The Contractor shall install all Sanitary fixtures and fittings in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal / replacement of Sanitary Fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and true to alignment. The outlet of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting and the receiving pipes before making the joint. It shall be ensured that the receiving pipes are clear of obstruction. When Fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary

anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

Contractor to start a Area wise final installation only after taking clearance from the Site Project Manager.

21. PROTECTION AGAINST DAMAGE

The Contractor shall take every precaution to protect all Sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handing over. At the time of handing over, the Contractor shall clean, disinfect and polish all the fixtures and fittings. Any Fixtures found damped, cracked, clipped, strained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

22. TESTING

All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The Contractor shall block the ends of waste and ventilation pipes and shall conduct air test.

23. COMPLETION DRAWINGS

- 23.1 On completion of work contractor shall submit one complete set of original tracings and two prints of "As Built" drawings for the NCCF/Architect. These drawings shall have the following information.
- a) Run of all pipes with diameters and length on all floors and vertical stacks.
 - b) Ground and Invert levels of all Plumbing services pipes.
 - c) Location of all valves.
 - d) Location of all Mechanical equipment with layout and piping connection.
- 23.2 Contractor shall provide four sets of Test Certificate, Routine Type Test certificates for Motors, Dynamic balancing certificate for Impellers, Calibration certificate for instrument catalogues, Operation and Maintenance Manuals, performance data and list of spare parts supplied together with the name and address of the Manufacturers for all Mechanical and Electrical equipments provided by him in the form of a Book or Manual.
- 23.3 All "Warranty / Guarantee" cards / certificates in original issued by the manufacturers shall be handed over to the NCCF/Architect also in the form of a comprehensive record book / documents.

SECTION - I SANITARY FIXTURES**1. SCOPE OF WORK**

- 1.1 Work under this section shall consist of furnishing all Material and labour as necessary and required to completely install all Sanitary Fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Scope of work.
- 1.2 Without restricting to the generality of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.
- 1.3 Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2. GENERAL REQUIREMENTS

- 2.1 All Fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Scope of work, Specifications and Drawings.
- 2.2 All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/ Interior designers requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.
- 2.3 Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of NCCF/Architect.
- 2.4 All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to Levels and Heights shows on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all Inlet and Outlet Pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractors cost.
- 2.5 When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the NCCF/Architect. Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

3.0 EUROPEAN W.C.

- 3.1 European W.C. shall be wash down, single or double siphoned type, wall mounted set, flushed by means concealed type flushing cistern, as specified in Scope of work. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter.
- 3.2 Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C (As mentioned in drawings).

4. INDIAN W.C.

- 4.1 Indian W.C. pan shall be Orissa pattern of size as specified in the Scope of work. Each W.C. shall be provided with a 100 mm dia cast iron or porcelain P or S trap with or without vent horn.
- 4.2 W.C. shall be flushed by means of an exposed type cistern or as specified in Scope of work.
- 4.3 The W.C. shall be fixed in level in a neat workmanlike manner. The W.C. and trap shall be set in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) joints between W.C. and flush pipe shall be made with a putty or white lead and linseed oil and caulked well or with an approved rubber joint.

5.0 URINALS

- 5.1 Urinals shall be white glazed Vitreous China flat back half stall or lip type as specified in Scope of work.
- 5.2 Half stall Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete and as directed by NCCF/Architect.
- 5.3 Half stall urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.
- 5.4 Urinals shall be flushed by means of automatically sensor operated flushing system as specified in Scope of work.
- 5.5 Waste pipes for urinals shall be of the following:
(a) G.I. Pipes

Waste pipes may be exposed on wall or concealed in chase as directed by the NCCF/Architect. Specifications for waste pipes shall be same as given in Sub Section.

6.0 SINKS

- 6.1 Sinks shall be of stainless steel or any other material as specified in the Scope of work.
- 6.2 Hand Wash Sinks and Process Sinks shall be of stainless steel.
- 6.3 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by NCCF/Architect.
- 6.4 Supply fittings for sinks shall be mixing fittings or C.P. Sensor Operated (Battery/Electrical) taps or as specified in the Scope of work.

7.0 MIRRORS

- 7.1 Mirrors shall be electro coated copper 6 mm thick of guaranteed reputed make. The size shall be as specified in the Scope of work or shown on the drawings. The image shall be clear and without waviness at all angles of vision.
- 7.2 Mirrors shall be provided with backing of 12 mm thick Marine Plywood sheet fixed with C.P. brass semi-round headed screws and cup Washers or C.P. Brass Clamps as specified or instructed by NCCF/Architect.

8.0 SHOWER SET

- 8.1 Shower set shall comprise of single lever mixer or four way diverter with two C.P. brass concealed stop cocks, with bath spout or as given in the Scope of work.
- 8.2 Each shower set shall also be provided with C.P. shower arm with wall flange and shower head of approved quality as specified in the Scope of work.
- 8.3 Concealed stopcocks shall be so fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

9.0 ACCESSORIES

- 9.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by NCCF/Architect, and given in the Scope of work.
- 9.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by NCCF/Architect.
- 9.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

10.0 URINAL PARTITIONS

- 10.1 Urinal partitions shall be white glazed vitreous china or 25mm thick marble of size specified in the Scope of work.
- 10.2 Porcelain partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. clips as recommended by the manufacturer and directed by NCCF/Architect.

11.0 PAN CONNECTOR

The WC pan connector shall be Flexible, soft and shall be made of single body construction with integral fins, made from EVA (Ethyl Vinyl Acetate). The pan connector must conform to the BS: 5627: 1984. The pan connector must be supplied with factory fitted spring loaded seal guard.

The connector shall not be allowed to come in contact with mineral oil, grease, putty or any compound containing mineral oil or grease.

The pan connectors must be stored away from the direct sunlight and flames.

While fixing of the pan connector with the Soil pipe, the pipe must be reasonably clean and smooth on the inner surface; in case the soil piping is in C.I. then supplier supplied bush / adaptor shall be used. The connector socket is pushed fully home onto the pan spigot, thereafter the WC is placed in position gently pushing the fitment to ensure that the connector end fits into the Spigot of the pipe. The pan connector must be pushed in such a easy as to ensure that the seals and fins turn inward to ensure proper sealing.

SECTION - II SOIL, WASTE & VENT PIPES

1. SCOPE OF WORK

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Scope of work.
- 1.2 Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-
 - a) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.
 - b) Connection of pipes to Gully Traps & Manholes etc.
 - c) Rain water pipes as specified
 - d) Testing of all pipes.

2. GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of NCCF/Architect.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- 2.6 All works shall be executed as directed by NCCF/Architect.

3. CAST IRON PIPES & FITTINGS

3.1.1 All pipes shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects. Pipes shall be centrifugally cast (spun) iron pipes conforming to I.S:3989 as specified in Bill of Quantities.

3.1.2 Standard weights&dimensions shall be as per CPWD specifications.

3.1.3 **Tolerance:** As per CPWD specifications

Acceptable tolerance for pipes to I.S: 3989 shall be as follows:-

3.2 **Fittings**

3.2.1 Fittings shall conform to the same Indian Standard. The Contractor shall use pipes and fittings of matching specifications.

3.2.2 Fittings shall be of the required degree of curvature with or without access doors.

3.2.3. Access door shall be made up with 3mm thick insertion rubber washer and white Lead. The bolts shall be lubricated with grease or white Lead for easy removal later. The fixing shall be air and watertight.

3.3 **Fixing**

3.3.1 All vertical pipes shall be fixed by M.S. clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a Cowl (terminal guard).

3.3.2 Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

3.3.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surface.

3.4 **Jointing**

C.I pipes wherever used shall be jointed with refined Drip Seal PJS -43.
The sealant compound shall be of approved make and manufacturer.

The sealant shall be manufactured in two separate compounds of different colors "Black" and "White", and used for jointing of C.I. in place of lead joints, as per approval of the NCCF/Architect.

The compound shall have high bonding strength and shall be non-toxic. The specified density shall be 1.95 grams / c.c. or as per approved manufacturer specifications.

The two separate compounds shall be mixed homogeneously from the supplied packets. In cold conditions both unmixed packets are to be heated in Sun or heated to room temperature (250 C) to make them more workable for mixing. The pipe joint is cleaned to make it free from dust, grease, oil, cement splashes and all other foreign matters and contaminants. The joint is made dry. Hemp yarn is provided as usual in pipe joint as back filler. The mixed compound is to be forced into the lap of pipe joint with Caulking tool, MS Flat piece or by Hand. Proper pressing of compound is necessary to avoid air entrapment. The joint is not to be disturbed till the compound is hardened.

The mixed compound shall not be kept without use for more than 30 to 40 minutes. The expiry date of the material shall also be checked before use and in case of expiry of material, the lot shall be rejected.

The compound shall be allowed to cure at room temperature with a setting time of 4 to 6 hours. Consumption of mixed compound shall be as per the following table:

Diameter of pipe (mm)	Consumption per joint (grams)
50	130 to 150
80	150 to 170
100	200 to 250
150	250 to 300

To ensure proper quantity of compound used in to the joint, three samples shall be made and the quantum of compound per joint shall be approved by the NCCF/Architect.. The actual consumption should be within $\pm 5\%$ of the approved samples.

3.5 **Cast Iron Pipes for Drainage**

3.5.1 Wherever specified, drainage lines passing under building shall be centrifugally cast iron as per IS: 3989, floors and roads, in exposed position above ground or at basement ceiling level shall be Centrifugally cast iron as per IS:3989. Position of such pipes shall be generally shown in the relevant drawings.

3.5.2 Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S: 1536-1976. Quality certificates shall be furnished.

3.5.3 **Fittings and Inspection Chambers**

- (a) Fittings used for C.I. drainage pipe shall conform to I.S. 1538-1976. Wherever possible junction from branch pipes shall be made by a 'Y-tee.'
- (b) Contractor shall provide Cast Iron inspection chamber at all junction as indicated on drawings or directed by Architects Inspection chambers shall be specially cast with inlet, outlet and branches of appropriate and required sizes. Branches shall be Y type wherever possible.
- (c) Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by Architects. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or

fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

Laying

As per CPWD specifications.

4.0 CLAMPS

- 4.1 M.S. clamps shall be of standard design and fabricated from M.S. flat 40x3mm thick. They shall be painted with two coats of black bitumen paint before fixing.
- 4.2 Where M.S. clamps are to be fixed on RCC columns or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron "U" type clamps with anchor fasteners of approved design or 6mm nuts and bolts.
- 4.3 Structural clamps shall be fabricated from M.S. Structural members e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black Enamel paint. Wooden saddles, where required shall be provided free of cost.
- 4.4 Slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in Scope of work, angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
- 4.5 Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 mm stone aggregate 20mm nominal size) as directed by the NCCF/Architect.

5. TRAPS

- 5.1 Floor traps shall deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cm of the required depth.

5.2 Urinal Traps

Urinal traps shall be SCI trap with or without Vent and set in cement concrete block specified in Para above without extra charge.

5.3 Floor Trap Inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Hopper shall be connected to SCI trap with at least 50 mm deep seal (Hopper and traps are included in the quoted rates) floor trap inlet hoppers and the traps shall be set in cement concrete blocks/ or hanged with structure members as specified/ shown on drawing without extra charge.

5.4 C.P./Stainless Steel Gratings

Floor and Urinal Traps shall be provided with 100-150 mm square or round C.P./Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4-5 mm or as specified in the Scope of work.

6.0 CLEANOUT PLUGS

Contractor shall provide brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a male threaded adaptor.

7. WASTE PIPE FROM APPLIANCES

7.1 Waste pipe from appliances e.g. wash basins, sinks, urinals shall be of galvanized steel as given in the Scope of work or as shown on the drawings.

7.2 All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:-

	Vertical	Horizontal
G.I pipes	300 cms	240 cms

7.3 Galvanized Iron Pipes

Pipes shall be galvanized iron tubes conforming to IS: 1239-1979 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, Plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

8.0 CEMENT CONCRETE

8.1 Cast Iron Soil and Waste pipes under floors in sunken slabs and in wall chases (When cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand:

4 stone aggregate 12 mm size) 75 mm in bed and around. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals as directed by NCCF/Architect. Where pipes are running at ceiling level a suitable gradient and required supports of structural clamps shall be provided.

9.0 PAINTING

- 9.1 Wherever CI pipes are used, it shall be painted with two or more coats of synthetic enamel paint to give an even shade. All surfaces shall be thoroughly cleaned before painting.
- 9.2 Paint shall be of approved quality and shade; pipes shall be painted in accordance with approved pipe color code.
- 9.3 Waste pipes in chase shall be painted with two coats of Bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of Synthetic enamel paint.
- 9.4 C.I. pipes below ground and covered in cement concrete shall not be painted.

10.0 CUTTING AND MAKING GOOD

- 10.1 Pipes shall be fixed and tested as buildings proceeds. Contractor shall provide all necessary holes cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

11.0 INSPECTION & TESTING

11.1 Inspection

Work should be inspected during installation and tests applied on completion, care being taken that, all work which is to be encased for concealed is tested before it is finally enclosed.

Inspection should be carried out to ensure the following:

- (a) Work accords with the drawing and specifications.
- (b) All pipe brackets, clips etc. are securely fixed.
- (c) Fixtures are correctly spaced.
- (d) Pipe is protected where necessary by Thermal Insulation.
- (e) Embedded pipe work is properly protected before sealing-in
- (f) All access covers, caps or plugs.
 - Are accessible
 - Are so made that the internal faces truly complete in internal bore.
 - Cause no obstruction in the pipe bore
 - Are well joined.

11.2 Testing

The soil, waste piping system and rain water should be tested after installation as follows:

(a) Water Test

The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m . The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the NCCF/Architect.

(b) Smoke Test

Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under:

Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the NCCF/Architect.

11.3 A test register shall be maintained and all entries shall be signed and dated by Contractors and NCCF/Architect.

SECTION – III WATER SUPPLY SYSTEM**1.0 SCOPE OF WORK**

1.1. Work under this section consists of furnishing all labor, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Scope of work.

1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- a) All water lines to different parts of building and making connection from source etc.
- b) Pipe protection and painting.
- c) Providing Hot water supply lines and insulation of hot water pipe lines.
- d) Control valves, masonry chambers and other appurtenances.
- e) Connections to all toilets, kitchen equipments, storage tanks and appliances.

- f) Excavation and refilling of pipe trenches, wherever required.
- g) Trenches for taking pipe lines for these services.
- h) The solar water heater shall be provided only for kitchen tap.

2.0 GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the NCCF/Architect.
- 2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections.
As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.
- 2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- 2.7 The Contractor shall deploy Plumbers who possess a valid Plumbing license from local Authorities.

3.0 CPVC PIPES AND FITTINGS

3.1 DESCRIPTION

CPVC piping shall be Fire Proof, Corrosion resistance even under harshest of water quality, its smooth, friction free interior surfaces result in no scaling, lower pressure loss, higher flow rates and least possibility for bacterial growth.

3.2 JOINING TUBING & FITTINGS

3.2.1 CUTTING

CPVC tubing can be easily cut with a wheel-type plastic tubing cutter, a hack saw or other fine toothed hand or power saws. Use of ratchet cutters is permitted, provided blades are sharpened regularly. A milter box should be used to ensure a square cut when using a saw.

3.2.2 DEBURRING/BEVELLING

Burrs and fillings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool is preferred but a pocket knife or file is suitable for this purpose. A slight bevel on the end of the tubing will ease entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

3.2.3 FITTING PREPARATION

Wipe any dirt or moisture from the fitting sockets and tubing end. Check the dry fit of the tubing and fitting. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

3.2.4 SOLVENT CEMENT APPLICATION

Solvent Cement is used for jointing the CPVC pipes. Apply an even coat of Cement Solvent on the Pipe end after cleaning of whole pipe and also inside the fittings socket. Do not use thickened or Lumpy Solvent Cement.

3.2.5 ASSEMBLY

Immediately insert the pipe into fitting socket, rotate the pipe ¼ to ½ turn while inserting. This motion ensures an even distribution of cement within the joint. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set-up. An even bead of cement should be evident around the socket edge; it may indicate that sufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and fitting surfaces for an attractive, professional appearance.

3.2.6 RATING AND DIMENSIONAL DETAILS OF CPVC PIPES SDR 11

Nominal Pipe Size		Average Outside Diameter		Wall Thickness		Pressure Rating	
inch	mm	inch	mm	inch	mm	73.4° F psi	23° C kg/cm ²
½	12.70	0.625	(15.9)	0.068	(1.73)	400	28
¾	19.05	0.875	(22.2)	0.080	(2.03)	400	28
1	25.40	1.125	(28.6)	0.102	(2.59)	400	28
1 ¼	31.75	1.375	(34.9)	0.125	(3.18)	400	28
1 ½	38.10	1.625	(41.3)	0.148	(3.76)	400	28
2	50.80	2.215	(54.0)	0.193	(4.90)	400	28

4.0 G.I. PIPES & FITTINGS

- 4.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to I.S. 1239-1979 of class specified. When class is not specified they shall be medium class.
- 4.2 Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include Couplings, Bends, Tees, Reducers, Nipples, Unions, Bushes. Fittings shall be of I.S:1879 - (part I to X) 1975.
- 4.3 Pipes and fittings shall be jointed with screwed fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.

5.0 CLAMPS

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by NCCF/Architect. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

6.0 UNIONS

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by NCCF/Architect.

7.0 FLANGES

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by NCCF/Architect. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by NCCF/Architect. Bolt holedia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

8.0 TRENCHES

The galvanized iron pipes and fittings shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:

Dia of Pipe	Width of Trench	Depth of Trench
15mm to 50mm	30 cms	60 cms
65mm to 100mm	45 cms	75 cms

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

9.0 PAINTING

- 9.1 All surfaces shall be thoroughly cleaned before painting.
- 9.2 All pipes above ground shall be painted with one coat of Red Lead and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by NCCF/Architect.
- 9.3 All pipes in chases and below floor shall be provided Anti-corrosive treatment.

10.0 PIPE PROTECTION

Where specified in the Scope of work all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe.

11.0 GUNMETAL VALVES

- 11.1 Valves 65mm dia and below shall be heavy Gunmetal Fullway Valves or Globe Valves or Ball valves conforming to I.S. 778-1971 of 20 Kg/cm² class. Valves shall be tested at manufacturer's works and the same stamped on it.
- 11.2 All Valves shall be approved by the NCCF/Architect before they are allowed to be used on work.

12.0 SLUICE VALVES

- 12.1 All valves 80mm dia and above shall be C.I. Double Flanged Sluice Valves. Sluice valves shall be Cast Iron double flanged, with rising spindle. Each sluice valve shall be provided with wheel for valves in exposed positions and Cap Top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with Cap Tops.
- 12.2 Sluice valves shall be of best quality conforming to I.S: 780-1969 of class specified.
- 12.3 Sluice valves shall be socketed type or double flanged type conforming to I.S: 780.

- a) Joints for double flanged sluice valves shall be made with suitable flanged tail/socket pieces on the pipeline and flanges joints made with 3 mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.
- b) Sluice valves shall be installed at all branches and as shown on the drawings.

13.0 SCOUR VALVES:

Scour valves shall be C.I. sluice valves as specified above. They shall be installed at the lowest level or tail end of the system as shown on drawings and directed by NCCF/Architect.

14.0 AIR RELEASE VALVES

- a) Air release valves shall be single acting type air valves with cast iron body and bronze/gunmetal internal parts and plastic float.
- b) Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

15.0 INSULATION

15.1 The insulation for hot water pipes shall be done as specified in Bill of Quantities and accordingly following guidelines shall be followed:

15.1.1 For Chased Internal Pipes

Hot water pipes fixed in chase shall be insulated by wrapping 6 mm thick "KAIFLEX" thermal insulation tubings OR Supercera Ceramic Rope made up of Ceramic fibres laid parallel to each other with stainless steel wire wrapped around for reinforcing the fibre complete as per requirement and finishing it with 6mm rough cement plaster 1:3 mixed with Rapid Hardening Cement.

15.1.2 For External Piping

External hot water line laid in trenches, exposed in shafts, on terrace and along ceiling level shall be insulated with either "KAIFLEX" thermal tubings of specified thickness OR fibre glass wool blankets/mats, as specified in Bill of Quantities. After the insulation, all the pipes shall be protected with either 12mm thick smooth finished cement plaster (two layers of 6 mm thick of mix 1:2 Portland cement and fine sand) OR they shall be clad with 24 SWG aluminum sheet as specified in Bill of Quantities.

15.1.3 The specifications of the material shall be generally as follows, unless specified:

- a) Fibre glass wool -- Blankets/mats of 50 mm thickness in the density of 24 kg/m³
- b) Elastomeric Flexible Material -- Thermal Insulation tubings of 6mm thickness with density of 60-90 Kg/m³.

15.1.4 Generally, following procedure shall be adopted:

- (i) Cleaning the pipe surface to be insulated to make it free from dust & oil.
- (ii) Applying a layer of zinc chromate/anti-rust Japanese primer.
- (iii) Fixing fibre glass wool blankets or mats/Elastomeric Flexible Tubings as specified.
- (iv) Covering it allround with 24 gauge x □□□" wire netting with proper butt joint and tightly wrapped.
- (v) Applying two layers of 6 mm thick each cement plaster in the ratio of 1:2 (1 cement: 2 fine sand).
- (vi) Applying weatherproofing coating of Insulkote OR of approved material over the cement plaster.
- (vii) For certain places, where exposed insulation is not to be plastered as specified in item (v) and (vi), then aluminum foil sheet of 24 gauge with 50 mm overlapping, fixed with self tapping recessed screwed shall be provided.

16.0 DUCTILE IRON PIPES

16.1 Pipes for water supply mains shall be DI pipes conforming to I.S. 9523. Quality certificates shall be furnished.

16.2 Fittings and Inspection Chambers

Fittings used for D.I. drainage pipe shall conform to I.S. Whenever possible junctions from branch pipes shall be made by a 'Y-tee'.

16.3 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

16.4 Rubber Joints

Joints between two pipes shall be made by pre moulded rubber joints with suitable tackles in a manner recommended & approved by the manufacturer. No joints shall be covered until the lines are hydraulically tested.

17.0 VALVE CHAMBERS

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 12 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside RCC slab with cast iron surface box as approved or as specified in Scope of work and in drawings including excavation, back filling complete.

18.0 TESTING

- 18.1** All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm² in any case and with the consent of NCCF/Architect.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. ($\pm 10\%$). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

- 18.2** In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.
- 18.3** After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

19.0 DISINFECTION

- 19.1** After completion of the work Contractor shall flush clean the entire system with the city's filtered water after connection has been made.
- 19.2** After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

20.0 PRE COMMISSIONING

- 20.1** Ensure that all pipes are free from debris and obstructions.
- 20.2** Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.
- 20.3** Ensure that all Connections to Branches has been made.
- 20.4** Ensure that mains have been connected to the respective pumps, underground and Overhead tanks.
- 20.5** Water supply should be available at main Underground tank.
- 20.6** All main line Valves should be closed.

21.0 COMMISSIONING

- 21.1** Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

- 21.2 Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.
- 21.3 After filling Overhead Reservoir drain the same to its one forth capacity through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).
- 21.4 Fill Overhead tank to full.
- 21.5 Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.
- 21.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.
- 21.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.
- 21.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.
- 21.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

22.0 RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

SECTION - IV SEWERAGE / DRAINAGE SYSTEM

1.0 SCOPE OF WORK

- 1.1 Work under this section shall consist of furnishing all Labour, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Scope of work.
- 1.2 Without restricting to the generality of the foregoing, the sewerage system shall include:
- a) Connection to First Man Hole and Gully Trap & Storm Water chamber.

2.0 GENERAL REQUIREMENTS

- 2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the NCCF/Architect.
- 2.2 Drainage lines shall be laid to the required gradients and profiles.
- 2.3 All drainage work shall be done in accordance with the local Municipal byelaws.
- 2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the NCCF/Architect before the actual execution of work at site.
- 2.5 All works shall be executed as directed by NCCF/Architect.

3.0 ALIGNMENT AND GRADE

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the NCCF/Architect from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the NCCF/Architect.

4.0 Blank

5.0 GREASE TRAP

Grease Trap shall be provided on Kitchen waste lines before discharging the waste into the main sewer line. Grease Trap shall be built in brick masonry and shall be similar in construction to manholes. The grease trap shall be constructed to size as shown at the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanised wrought iron sediment pan and a baffle wall. Grease trap shall be provided with 2 Nos, double seal manhole cover and frame which shall be identified with lettering 'Grease trap'.

6.0 REINFORCED CEMENT CONCRETE PIPES

6.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of specified class. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

6.2 Laying

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall than be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the NCCF/Architect.

6.3 Jointing

After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

7.0 CAST IRON PIPES FOR DRAINAGE

7.1 All drainage lines passing under building, floors and roads with heavy traffic, in exposed position above ground e.g. service floor and basement ceiling shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.

7.2 Cast iron pipes shall be centrifugally spun iron pipes conforming to I.S: 1536. Quality certificates shall be furnished.

7.3 Fittings and Inspection Chambers

a) Fittings used for C.I. drainage pipe shall conform to I.S: 1538. Wherever possible junction from branch pipes shall be made by a 'Y tee'. Jointing shall be done with deep seal compound.

b) Cleanout plugs shall be provided on head of each drain and at location indicated on plans or directed by NCCF/Architect. Cleanout plugs shall be of size matching the full bore of the pipe. Plugs shall be made out with G.I. coupling caulked into the socket of the pipe or fittings. The end shall be provided with a brass screwed plug with suitable key for opening.

7.4 Laying: As per CPWD specifications

7.5 Testing

- a) All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole. All pipes shall be subjected to a test pressure of at least 1.5 metre head of water. The test pressure shall, however, not exceed 1.5 metre head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two liters per centimeter of dia per kilometer may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes.
- (i) Absorption by pipes and joints
 - (ii) Sweating of pipe or joints
 - (iii) Leakage at joints or from defective pipes
- b) Trapped Air
- Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.
- c) Sewer and Drain Pipelines shall be tested for straightness by:
- (i) Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invent of the pipe and emerge at the lower end.
 - (ii) Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.
- d) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the NCCF/Architect.
- e) A test register shall be maintained which shall be signed and dated by Contractor, NCCF/Architect and representative of Architects/ Consultants.

8.0 CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC

8.1 Materials

a) Water

Acidity, Alkalinity and percentage of Solids shall be in accordance with IS: 3025. The Ph value shall generally be not less than 6. In general potable water is considered satisfactory for use.

Sea water shall not be used.

Testing shall be done individually for different source points before the start of the work and there after once in every three months.

b) Aggregate for Concrete

It shall be strong, durable and free from adherent coatings, sea shell, organic impurities, and disintegrated pieces.

If dirty, shall be washed with water before actual use. Flaky and elongated piece shall be avoided. It shall confirm to IS: 383 and IS: 2386.

c) Sand

It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities and shall confirm IS: 2386. It shall not contain more than 8 % of silt as per the field test.

Grading for masonry, plaster and concrete shall be as per IS: 2116, IS: 1542, IS: 383 respectively, Sea sand shall not be used.

Testing for bulk age to be done and allowance be made at the time of use.

d) Cement

The cement used for all the constructional purposes shall be Portland pozzolana cement confirming to I.S. 1489 OR rapid hardening, Portland cement conforming to I.S. 269.

Different types of Cement shall not be mixed together, shall be stacked and stored separately. Cement Bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received.

The site where it is stored shall be dry, leak proof and as far as possible moisture proof.

Necessary precautions to be taken to avoid dampness through floor and walls. Stacking shall not be more than 10 bags high.

e) Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round/ twisted/deformed bars conforming to all requirements of I.S. 432 (Grade I).

f) Bricks

Brick shall have uniform color, thoroughly burnt, smooth rectangular faces, with parallel slab, sharp and right angled edges, but not over-burnt.

When struck should give clear ringing sound.

The maximum permissible area of perceptible deposit of efflorescence shall be 50% of the surface area of the Bricks. The affected bricks should not be more than 80% of the lot. There shall be no powdering or flaking of the surface.

The average water absorption shall not exceed 22% by weight after 24 hours immersion in water.

The average minimum compressive strength for bricks of class designation 75 shall not be less than 75 kg / cm².

g) Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the NCCF/Architect before use.

8.2 Cement Concrete (Plain or Reinforced)

- a) Cement concrete pipes bedding, cradles, foundations and RCC slabs for all works shall be mixed by a Mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the NCCF/Architect. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.
- b) Concrete work shall be of such thickness and mix as given in the Scope of work.
- c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny Bags at all times. All pipe trenches and foundations shall be kept dry during the curing period.

8.3 Masonry Work

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks as specified in the Scope of work in cement mortar 1:4 mix (1 cement: 4 coarse sand). All joints shall be properly raked to receive plaster.

8.4 Cement Concrete for Support / Around / Haunches of Pipes

- a) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed all round or in haunches. The thickness and mix of the concrete shall be given in the Scope of work. Type of the bedding is as described as follows:
- b) Unless otherwise directed by the NCCF/Architect cement concrete for bed, all round or in haunches shall be laid as follows:-

Description	<i>Upto 3 M depth</i>
Pipes in open ground (No sub soil water)	All round (1:4:8)
Pipes (all) in sub soil water condition	All round (1:3:6)
Pipes under the building or at road crossing or under public places	All round (1:2:4)

(1=1 cement, 2-4=coarse sand, 4-8 stone aggregate 20 / 40mm nominal size)

- c) R.C.C. pipes or C.I. pipes ,may be supported on brick masonry or precast R.C.C or Cast in situ cradles. Cradles shall be as shown on the drawings.

- d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.
- e) The Concrete or Haunching around pipes to be done as per NBC specifications / Drawings.

9.0 MANHOLES AND CHAMBERS

- 9.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Scope of work.
- 9.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix as given in the Scope of work or shown on the drawings.

Where not specified, Manholes may be constructed as follows:-

(All dimensions internal clear in cms)

Size of Manhole	90x80 Rect.	120x90 Rect.	91 dia Circular	122 dia Circular	150 dia Circular
Maximum depth	150	230	167	229	Any depth beyond 230
Average thickness of R.C.C slab	15	15	15	15	15
Size of cover and frame (Internal dia)	61x45.5	56 dia	56 dia	56 dia	56 dia
Weight of cover and frame not less than	38 Kg. or as specified	116 Kg. or 208 Kg. or as specified in BOQ	182 Kg. or as specified in BOQ	182 Kg. or as specified in BOQ	182 Kg. or as specified in BOQ
Type of Cover & Frame	SFRC	SFRC or as specified in BOQ.	SFRC (Heavy duty or as specified in BOQ)	SFRC (Heavy duty or as specified in BOQ)	SFRC (Heavy duty or as specified in BOQ)

- 9.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.
- 9.4 All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.
- 9.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated 20mm square or 25mm round rods foot rungs set in cement concrete blocks 25 x 10 x 10cms in 1:2:4 mix 30cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.
- 9.6 All manholes shall be provided with SFRC precast concrete covers & frames and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per

instructions of the NCCF/Architect. Weight of cover, frame and thickness of slab shall be as specified in the Scope of work or as given above.

- 9.7 All catch basins shall be having SFRC precast Gully Grating as per instructions of NCCF/Architect. The grating along with frame shall be of approved design and quality as per instruction of NCCF/Architect.

10.0 MAKING CONNECTIONS

Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

10.2 Manholes

- (a) All manholes shall be measured by numbers and shall include all items specified above and necessary Excavation, Refilling & Disposal of surplus earth.
- (b) Manholes with depths greater than specified under the main item shall include all items as given for manholes. Measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of Channel.

10.3 Drop Connections

Drop connections shall be measured by number for a depth of 60 cms or part thereof between invert levels. Additional depth is included for as extra per metre depth as per the actual length of the drop connection, measured to the nearest cm.

10.4 Making Connections

Item for making connection to municipal sewer is included for by number and shall include all items given in the Scope of work and Specifications.

10.5 Masonry Drains

As per CPWD specifications.

11.0 COMMISSIONING

- 11.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/Consultant, whenever and as may be required. Generally, the following test/inspection has to be carried out:-

- (a) For any Leakages/seepages in the external sewerage and drainage pipes.

- (b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.
- (c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

REFER VOLUME III.

SECTION – C INTERNAL ELECTRICAL WORK

SUB-HEAD: A. CONDUIT, ACCESSORIES & FIXING ARRANGEMENT

1. RIGID PVC CONDUIT & ACCESSORIES

PVC conduits shall be high impact, rigid, FRLS PVC, heavy-duty type and shall comply with relevant Indian Standards.

Conduits upto 32mm dia shall be 2mm thick and above that shall be 2.5mm thick.

Plain conduits shall be jointed by slip type of couplers with approved sealing cement. All conduit entries to outlet boxes are to be made with adaptors female thread and screwed male bushes. Conduit fittings and accessories such as inspection boxes, draw boxes and junction boxes shall be of heavy duty rigid PVC installed in such a manner that they can remain accessible for existing wires or for the installation of the additional wires. Fan hook box shall be of M.S. Inspection boxes shall be covered with suitable covers.

Conduit runs shall be so arranged that the cables connected to separate main circuits shall be enclosed in separate conduits and that all lead and return wires of each circuit shall be run with the same circuit.

PVC conduits shall be smooth in bore, true in size and all ends where conduits are cut shall be made carefully smooth. Sharp edges shall be trimmed. All joints between lengths of conduits or between conduits and fittings and boxes shall be held firmly together and glued properly. All joints shall be fully water tight. All jointing of PVC conduits shall be by means of adhesive jointing.

2. RIGID MS CONDUIT/GI CONDUIT & ACCESSORIES

Rigid MS conduits shall conform to relevant Indian Standards. MS ERW conduits protected inside & outside by black stove enamel shall be used as called for in the scope of work.

Conduit upto 32mm dia shall be of 16 G and above that shall be of 14 G.

Joints between conduits and accessories shall be securely made, to ensure earth continuity (screwed joints). All joints shall be fully watertight. Threads and Sockets shall be free from grease and oil.

Conduit fittings and accessories such as inspection boxes, draw boxes and junction boxes shall be of G.I. for concealed conducting and shall be of M.S. for surface conducting. Fan hook box shall be of M.S. Inspection boxes shall be covered with 16 SWG GI covers. All conduit accessories shall be threaded type only.

Conduit runs shall be so arranged that the cables connected to separate main circuits shall be enclosed in separate conduits and that all lead and return wires of each circuit shall be run with the same circuit.

MS conduits shall be smooth in bore, true in size and all ends where conduits are cut shall be made carefully smooth. Sharp edges shall be trimmed. All joints between lengths of conduits or between conduits and fittings and boxes shall be held firmly together and screwed properly. Connection between screwed conduit and sheet metal boxes shall be by means a brass / GI hexagonal check nut fixed from inside the box and another check nut from outside the box. Smooth PVC bushes from inside the box to be used to avoid damage to wires.

GI conduits if called for in the scope of work shall conform to relevant Indian Standards. These conduits shall be protected by hot dip galvanized coating both inside and outside.

3. FLEXIBLE CONDUITS

Flexible conduits shall be made of heavy gauge MS strip galvanized after making the spiral. Both edges of the strip to have interlocking to avoid opening up.

4. LAYING / FIXING OF CONDUITS.

Conduits shall be installed so as to avoid steam and hot water pipes. Conduits for LV systems shall be at least 150mm away from the electrical conduits.

Wires shall not be drawn into conduits until the conduits are erected, firmly fixed and cleaned out. Not more than two right angle bends or the equivalent shall be permitted between draw or junction boxes. Bending radius shall not be less than 2.5 times the outer diameter of the conduit.

Conduits concealed in the ceiling slab shall run parallel to walls and beams and conduit concealed in the walls shall be vertical or horizontal.

The chase in the walls required for the recessed conduit system shall be neatly made and shall be of ample dimensions to permit the conduits to be fixed in the manner desired. Conduits in chase shall be held by steel clamps of approved design. The chase shall be filled up neatly after erection of conduits and brought to the original finish of the wall with cement plaster/cement concrete. The spacing between each clamp shall be 60 cm center to center.

Surface conduits shall be fixed by means of spacer bar saddles at intervals of not more than 500 mm from both sides of fittings/accessories. The saddles shall be of 3mm x 19mm galvanized M.S. flat properly treated, primed and painted securely fixed to support by means of nuts & bolts / raw plugs and brass machine screws.

Where conduits cross expansion joints in the buildings, adequate expansion fittings shall be used to take care of any relative movement.

Separate conduits shall be laid for the following systems:

- a) Normal light, Fan and 6 A socket outlets.
- b) Power points.
- c) TV outlets.
- d) PA/ Paging system.

- e) Telephone points and Data Points
- f) Fire alarm system.
- g) UPS points.
- h) CCTV System
- i) Access Control System
- j) Emergency Lighting

Contractor shall submit the conducting layout to NCCF/Architect for approval before start of work. While laying conduiting, care should be taken that water; mortar and dirt etc. do not enter the conduits and boxes.

Conduiting system should be such that it shall facilitate easy drawing of new wires/additional wires at any stage. All junction boxes/pull boxes/ draw boxes shall be completely accessible for inspection, maintenance or for future expansion. While drawing of wires, care shall be taken to avoid damage to the wire insulation.

All joints in the wiring shall be made only at switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joint shall be made in conduits and junction boxes.

SUB-HEAD: B. WIRING AND WIRING ACCESSORIES

1. GENERAL

All the internal wiring shall be with 1100 V grade, single or multi core HR FRLS, PVC insulated, unsheathed stranded copper conductor wires conforming to IS: 694/1990 amended & revised to date and wiring installation should confirm to IS: 732.

2. COLOUR CODING

Colour coding of wiring shall be done as per IS specifications, for identification of different circuits and phases. All wiring shall be in concealed or surface conduits as called for.

In three phase feeder circuit, three phase wire, with or without neutral wire, shall be taken through any single conduit. In lighting and power socket outlets wiring, in no case two lives wires of different phases shall be drawn through the same conduit.

3. SWITCH

All switches shall be connected to live wire and neutral of each circuit shall be continuous everywhere having no fuse or switch installed in the line except at the main switch board.

4. INSTALLATION

The conduits and wiring installation are to be installed such that modifications or repairs can be carried out in future without disturbing the building fabric in any way.

For wiring accessories partly recessed in wall, special care must be taken to ensure that the final position of all switch\ socket plates are set symmetrical with the pattern of the wall finish as

required by the architect. All switch socket-mounting plates shall be set square to the vertical and horizontal axis.

5. FISH WIRE

GI Fish wire / Pull wire of 14G shall be provided in the recessed conduiting to facilitate pulling of wires through conduits.

6. INSPECTION BOXES

Inspection boxes / Pull boxes shall be provided as required and approved by the Architect / Consultant for pulling of wires through conduiting network. Rigid PVC boxes shall be used for the PVC conduiting and G.I. boxes of suitable size and depth shall be used for MS / GI conduiting.

7. JOINTS

Only looping system of wiring shall be used. Wires shall not be jointed/ taped. All joints shall be made at switches, sockets outlets, distribution boards and lighting points. No joints shall be made inside conduits and in junction boxes. Suitable sizes connectors to be used at light fixtures. No reduction of strands is permitted at terminations. Before connections, copper conductor wire ends shall be properly soldered (at least 20-mm length). Terminals shall have adequate cross-sectional area to take all strands. No wire smaller than 1.5 sq.mm shall be used.

8. IDENTIFICATION

Identification ferrules indicating the circuit and D.B. number shall be used for sub mains and sub-circuit wiring. The Ferrules shall be provided at both ends of each sub-main and sub-circuit.

9. CIRCUITS OF DIFFERENT PHASES & DIFFERENT DB's

Where single-phase circuits are supplied from a three phase and neutral distribution board, no conduit shall contain the wiring of different phases. Circuits fed from distinct sources of supply \ from different distribution boards or MCB's shall not be bunched in one conduit.

10. LOAD BALANCING, CONTROL & EARTH WIRE

Load Balancing of circuits in three-phase installation shall be arranged before installation is taken up.. The earth continuity green FRLS PVC insulated copper wire for individual circuits of light / power / UPS should be laid. From D.B. each circuit will have separate earth wire. Earth wire shall be run inside the conduit to earth the third pin of socket outlets, earth terminal of light fixtures & fans etc. & earth terminals of outlet box as required. Light points shall be either of single control, twin control & multiple points controlled by a single switch / MCB as per schedule of works. Insulated copper wire for earthing as specified in the item of work shall be provided with each circuit and terminated in the earth bar of DB's / Switch boxes with proper lugs, as required.

11. CONDUIT FILL

Number of wires in each conduit shall be drawn as per chart given below:

MAXIMUM PERMISSIBLE NUMBER OF 1100 V GRADE FRLS PVC INSULATED COPPER

CONDUCTOR WIRES THAT CAN BE DRAWN INTO METALLIC AND NON METALLIC CONDUITS:

Maximum number of PVC insulated 650/1100V grade aluminum /copper Conductor cable conforming to IS: 694-1990.

Nominal cross sectional area of conductor sq.mm	20mm		25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1	2	3	4	5	6	7	8	9	10	11	12	13
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6

Notes:

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit, which deflect from the straight by an angle of more than 15 degrees.
3. Conduit fill shall not exceed 40%.

12. WIRING AND EARTHING NORMS

Light Points, 6 A sockets and fans points may be wired on a common circuit. Not more than 10 light points, 6 A sockets and fan points and a load not exceeding 800 W be connected on a lighting circuit unless it is specified otherwise on the drawings/ in the scope of work. It will however, be preferred to have separate circuits of 6A sockets as may be required by the consultant. Size of the earth wire shall be of the same size as that of the live / phase conductor unless specified otherwise. It shall however, be ensured that in one switchboard, only one circuit is terminated. For different circuits, separate switch boards shall be used. Each power circuit shall be wired as specified in drawings/scope of work. Not more than two power points 6A/16A sockets shall be connected on one power circuits unless specified differently in the drawings/scope of work.

UPS circuits shall start from the UPS DB's. UPS points will have two insulated green earth wires, one for the earthing of the 3rd pin of the socket and other for the earthing of the outlet box/furniture.

The smallest copper conductor to be used for lighting circuits shall be of 1.5/2.5 sq. mm (as specified in the scope of work) and for power circuit 4 sq. mm respectively. Wiring shall be done in the looping system. Phase or live conductor shall be looped at the switch box and neutral conductor can be looped from the light, fan or socket outlet. Neutral conductor and earth continuity wire shall be brought to each switchboard situated in rooms/ halls. These shall be terminated inside the switchboards with suitable connectors.

SUB-HEAD: C. SWITCHES, SOCKETS & ACCESSORIES

1. MODULAR SWITCHES

All 6 and 16 amps switches shall be clip in switch modules. Switches shall be with positive action rockers clipped on to modular front plates and shall be suitable for 230 volts AC. Switches & plates shall be made out of Fire retardant UV stabilized Engineering thermo plastic (grade poly carbonate). All modular plates shall be fixed to the switch boxes with brass screws, leaving ample space at the back and sides for accommodating wires. All switches shall conform to IS: 3854 amended and revised to date. Switches controlling the lights shall be connected to the phase wire of the circuit.

2. MODULAR SOCKET OUTLET

Socket outlets shall be clip in modules, clipped on to modular front plates and shall be 3/5/6 pin round or flat pin or universal or international type as called for in the Scope of work. Socket outlets and plates shall be made out of Fire retardant UV stabilized Engineering thermo plastic (grade poly carbonate). GI outlet box shall have an earth terminal. The earth terminal of the socket shall be connected to the earth terminal provided inside the box.

Each socket outlet shall be controlled by a switch. The switch controlling socket outlet shall be on live side/phase wire of the circuit. All switches shall confirm to IS: 3854 and socket outlets to IS: 1293 amended and revised to date.

3. POWER OUT-LETS

Each socket outlet shall be controlled by a switch. The switch controlling socket outlet shall be on live side of the circuit. All sockets shall conform to IS: 1293 amended and revised to date.

Switches and Sockets shall have Silver Cadmium contacts for long life. Live terminals should be shrouded for finger protection.

All 3 pin / 6 pin socket outlets shall be child resistant shuttered system.

4. MODULAR FAN REGULATORS & DIMMERS

Fan regulator shall be clip in modular type suitable for 230V AC. The minimum rated power shall be 120W. The regulator shall be totally hum free. The fan regulator shall have "Off" position. The fan regulator shall be clipped on to modular front face plate.

The dimmer shall be clip in modular type suitable for 230V AC. The minimum rated power shall be 400W. The dimmer shall have "Off" position. The dimmer shall be clipped on to modular front face plates.

These shall be made of Fire retardant, UV Stabilized, and engineering thermo plastic. Dimmers and fan regulators operation should not interfere with radio & TV signal.

5. METAL OUTLET BOXES

1.2 MM thick pre-galvanized sheet outlet boxes of suitable size as per the requirement of modular front plate shall be used. The outlet box shall be of minimum depth of 50mm unless otherwise specified differently. GI outlet box shall have a brass earth terminal.

6. PLASTIC OUTLET BOXES

Plastic enclosures / outlet boxes where ever required shall be of suitable size as required for the switch / socket front face plates and shall be made of UV stabilized engineering plastics.

7. MODULAR COMMUNICATION OUTLETS

TV, Tele & Data outlets shall be modular type clipped on to suitable modular front plates on suitable outlet boxes. These are made of engineering thermo plastics. TV outlet shall be Co-axial, Silver plated for minimal signal loss.

Tele Jack, (RJ-11) shall accept minimum 2 lines, gold plated contacts for better voice clarity and with spring loaded shutter for dust protection. Data outlet (RJ 45) shall be able to accept Cat 6 cable, gold plated contacts for better data transfer efficiency and spring loaded shutter for dust protection.

8. PLATE SWITCHES AND SOCKETS

Plate switches and sockets shall be suitable for 230V AC supply and made out of Urea formaldehyde thermo setting resin. Switches shall be rocker operated. Socket shall be shuttered. All current supply contacts shall be with Silver Cadmium Oxide contact tips. All sockets shall in corporate phosphorus bronze contacts. Suitable sized 1.2 MM thick pre-galvanized sheet outlet boxes with earth studs to be used.

9. TYPE OF SOCKET OUTLETS (to be used as specified in the B.O.Q.)

6 Amps. 3 Pin Round

- a. 6 Amps. 5 Pin Round
- b. 16 Amps. 3 Pin Round
- c. 6A/16 Amp. 6 Pin Round
- d. 6 Amps. 3 Pin Universal
- e. 13 Amps. 3 Pin Flat
- f. 6 Amps. 3 Pin International (Intel Socket)

SUB-HEAD: D. LT CABLES - 1.1 KV GRADE

1. GENERAL

The cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Indian Standard and cable manufacturer's instruction.

2. MATERIAL

2A. Specification of 1.1KV grade Single / Multicore PVC insulated, PVC sheathed Aluminium / Copper conductor Armoured / Unarmoured cables shall be as per IS: 7098 Part-1:

i. Conductor:

Material	:	Aluminium / Copper	
Shape	:	Aluminium conductor	: 6 & 10 sqmm. Solid circular
			: 16 sqmm. & above stranded compacted shaped
	:	Copper conductor	: 4 & 6 sqmm. stranded non compacted circular
			: 10 sqmm. stranded compacted circular
			: 16 sqmm. & above stranded compacted shaped

Insulation Material : PVC Type-A of IS: 5831 (Red, Yellow, Blue & Black)

Inner Sheath : PVC as per IS: 1554 Part-1

Armouring : Single layer of galvanized steel round wires / flat strips

Outer sheath : PVC Type ST-1 of IS: 5831

Colour of sheath : Black

Note: Single core armoured cables shall be with “Non-magnetic” type armouring.

2B. Specification of 1.1KV grade Single / Multicore XLPE insulated, PVC sheathed Aluminium / Copper conductor Armoured / Unarmoured cables shall be as per IS: 7098 Part-1:

i. Conductor:

- Material : Aluminium / Copper
- Shape : Aluminium conductor : 6 & 10 sqmm. Solid circular
- : 16 sqmm. & above stranded compacted shaped
- : Copper conductor : 4 & 6 sqmm. stranded non compacted circular
- : 10 sqmm. stranded compacted circular
- : 16 sqmm. & above stranded compacted shaped

- ii. Insulation Material : Cross linked polyethylene XLPE (Red, Yellow, Blue & Black)
- iii. Inner Sheath : PVC Type ST-2
- iv. Armouring : Single layer of galvanized steel round wires / flat strips
- v. Outer sheath : PVC Type ST-2 of IS: 5831
- vi. Colour of sheath : Black

Note: Single core armoured cables shall be with “Non-magnetic” type armouring.

- 2C. Specification of 1.1KV grade Single / Multicore XLPE insulated, FRLS Type Aluminium / Copper conductor Armoured / Unarmoured cables shall be as per IS: 7098 Part-1:

i. Conductor:

- Material : Aluminium / Copper
- Shape : Aluminium conductor : 6 & 10 sqmm. Solid circular
: 16 sqmm. & above stranded compacted shaped
: Copper conductor : 4 & 6 sqmm. stranded non compacted circular
: 10 sqmm. stranded compacted circular
: 16 sqmm. & above stranded compacted shaped

- ii. Insulation Material : Cross linked polyethylene XLPE (Red, Yellow, Blue & Black)
- iii. Inner Sheath : PVC Type ST-2
- iv. Armouring : Single layer of galvanized steel round wires / flat strips
- v. Outer sheath : PVC Type FRLS
- vi. Colour of sheath : Black

Note: Single core armoured cables shall be with “Non-magnetic” type armouring.

3. CABLE LAYING AND HANDLING

It should be ensured that both ends of the cable are properly sealed to prevent ingress / absorption of moisture.

4. CABLE HANDLING

When cable drums have to be moved over short distance, they should be rolled in the direction of the arrow marked on the drum.

While removing cables, the drums shall be properly mounted on jacks or on a cable wheels or any other suitable means, making sure the spindle, jack etc. are strong enough to take the weight of the drum.

The cables shall not be given a sharp bend to a small radius. The minimum safe bending radius for all types of PVC/XLPE cables shall be taken as 12 times the overall diameter of the cable.

Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multicore cable shall not be less than 15 times its overall diameter.

Cable with kinks and straightened kinks or with similar apparent defects like defective armoring etc. shall not be installed / laid.

Cables of different voltages as well as power and control cables should be kept in different trenches/racks with adequate separation. Where available space is restricted, LV/MV cable shall be laid above HV cables.

Where cables cross over cannot be avoided, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

Installation of cables including jointing shall be carried out as per IS: 1255 amended and revised to date.

Power and communication cables shall, as far as possible cross at right angles. Where power cables are laid in proximity to communication cables, the horizontal and vertical clearances shall not normally be less than 60 cm.

Cables shall be laid direct in ground, in pipes / closed ducts, in open ducts or on surface depending on environmental conditions, and as required in scope of work.

During the preliminary stages of laying the cable, consideration should be given to proper location of the joint position so that when the cable is actually laid, the joints are made in the most suitable places and as approved by Consultant. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts, pipes, racks, etc. shall be avoided.

The cable shall not in any circumstances be bent so as to form an abrupt right angle but must be rounded off at the corners to a radius not less than 12 times the overall diameter of the cable.

In case, where there are chances of any damage to the wiring/cables, such wiring/cables shall be covered with a sheet metal protective covering (not less than 16 SWG), the base of the covering being flush with the plaster or brickwork as the case may be, or the wiring /cables shall be drawn through a heavy gauge metal conduit pipe by complying with all the requirements of conduit wiring system.

Such protective covering shall, in all cases, be fitted on all down drops within 1.5 m from the floor or from floor level upto the switch board, whichever is less.

While cutting and stripping of the outer sheathing of the cable, care shall be taken that the sharp edge of the cutting instrument does not touch the inner insulation of the conductors. The protective outer covering of the cable shall be stripped off near connecting terminal and this protective covering shall be maintained upto close proximity of connecting terminals. The cables laid near junction boxes shall be made moisture proof with a plastic compound.

5. CABLE JOINTING & TERMINATION

Jointing shall be as per the manufacturer's recommendations using standard kits. Cable joints shall be made in suitable, approved cable joint boxes, jointing of cables in the joint boxes and filling of compound shall be done as per manufacturer's recommendations. Heat shrinkable joints shall be made.

Cables shall be terminated onto the terminals of switchgear through crimping lugs of proper size and of heavy duty. Cable lugs shall be fitted onto the cable by crimping or compression jointing.

Continuity of cable armouring is to be maintained. Double compression glands to be used. Proper crimping tools to be used.

6. TRENCHING & CABLE LAYING

The minimum width of trench shall be 45 cm and depth shall be 75cm for laying of cable. Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the minimum gap between the cables is one diameter of the cable unless specified otherwise.

The clearance between axis of the end cables and the sides of the trench shall be minimum 1.5 D (diameter) of the end cable.

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided.

Where gradients and changes in depth are unavoidable, these shall be gradual.

The bottom of the trenches shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 9 cm in depth.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 20 cms. above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before second tier is laid. If additional tiers are formed, each of the subsequent tiers shall have a sand cushion of 30 cms as stated above. The top-most cable shall have final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 cm x 10 cm x 10 cm (nominal size) as per CPWD building specification, or protection covers placed on top of the sand, (brick to be laid breadth wise) for the full length of the cable to satisfaction of the NCCF. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm over the sides of and cables.

The trenches shall be then back filled with excavated earth free from stone or other sharp-edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth, however, should not exceed 10 cms.

Where road bends or lawns have been cut or kerb stones displaced, the same shall be repaired to the satisfaction of the architect and all surplus earth or rock removed to places as specified.

In locations such as road crossing, entry to building in paved areas etc. cables shall be laid in pipes or closed ducts.

All cable entry/exit points into the building through pipe sleeves shall be properly sealed with water and fire safe sealants in an approved manner to avoid any seepage of water into the building.

Manholes of adequate size, as decided by the Architect, shall be provided to facilitate of adequate strength feeding/drawing in of cables and to provide working space for persons. Suitable manhole covers with frame of proper design shall cover Manholes.

CABLE LOOPS: Sufficient cable loop length shall be left at both ends.

7. CABLES ON HANGERS OR RACKS / TRAYS

The contractor shall provide and install all iron hangers racks, or racks with die-cast cleat, with fixing rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides ceiling and other concrete structures, the contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good the damages as required.

The hangers or racks shall be designed to leave at least 25 mm clearance between the cables and the face to which it fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 500 mm intervals. These shall be designed to keep provision of some spare capacity for future development. Minimum spacing between the cables shall be one diameter of the cable or as specified.

8. CABLE TRAY

- a) The MS cable trays should have undergone rigorous rust proofing process, which should comprise of alkaline, degreasing, descaling in diluted sulphuric acid and a recognized phosphating process. The sheet work shall then be given two coats of oxide primer before two coats of final painting. Cable trays shall be either painted (Stove enameled) or hot dip galvanized as called for in the scope of work.
- b) Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays.
- c) Cable trays shall be either perforated or ladder type as called for in the scope of work.

9. PERFORATED CABLE TRAYS

Standard Technical details of perforated cable tray shall be as follows:

S. No.	SIZE OF TRAY	THICKNESS & COLLAR
	(Width)	(Height)
1.	150mm to 450mm width	2mm thick & 40mm collar
2.	600mm to 750mm width	2mm thick & 50mm collar
3.	900mm to 1200mm width	3mm thick & 50mm collar

Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray.

10. LADDER TYPE CABLE TRAYS

Standard technical details of ladder type cable trays shall be as follows:

S. No.	SIZE OF TRAY	SIZE OF MAIN CHANNEL OR RUNNER	SIZE OF RUNG & SPACING	CABLE TRAY SUPPORT
1.	900mm to 1500mm	25 x 100 x 25 x 2.5mm	20 x 50 x 20 x 2.5mm @ 250 C/C	50 x 50x 5mm angle @ 1000mm spacing.
2.	450mm to 750mm	20 x 75 x 20 x 2.0mm	20 x 50 x 20 x 2mm @ 250 C/C	40 x 40 x 5mm angle @ 1250mm spacing.
3.	150mm to 300mm	20 x 75 x 20 x 2.0mm	15 x 35 x 15 x 2mm @ 250 C/C	40 x 40 x 3mm angle @ 1500mm spacing.

Hangers shall be minimum 10mm dia GI Round bar.

Fixing /supporting arrangement shall be as approved by the Consultant / NCCF / PMC

Hardware to be used in cable tray system shall be galvanized or zinc passivated.

Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray. All structural steel shall be according to the latest revision of IS: 226 & 808.

a. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

b. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing, pickling in acid, cold rinsing and then galvanizing.

11. TESTING OF CABLES

The Megger value in normal dry weather shall be 50 mega ohm for 1.1 KV grade cable. Cables shall be tested at works for the following tests before being dispatched to site by the project team:

- a. Insulation Resistance Test.
- b. Continuity resistance test.
- c. Sheathing continuity test.
- d. Earth test(in armoured cables)
- e. Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the NCCF's site representative:

- a. Insulation Resistance Test(Sectional and overall)
- b. Continuity resistance test.
- c. Sheathing continuity test.
- d. Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the PMC / NCCF representative.

12. CABLE TAGS

Cable tags shall be made out of 2mm thick aluminum sheets. Each tag shall be 2" in dia or 3" x 3" square with one hole of 2.5mm dia, 6 mm below the periphery, or as approved by Consultant. Cable designations are to be punched with letters / number punches and the tags are to be tied to cables with piano wires of approve quality & size. Tags shall be tied inside the panels beyond the glanding as well as above the glands at cable entries. Along trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 meters.

Cables shall be secured to cable trays with 3mm thick x 25mm wide aluminum strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws, washers and bolts, of adequate but not excessive lengths. Cable trays for horizontal runs suspended from the ceiling will be supported with mild steel straps or brackets, at 1000 mm intervals and the overall tray arrangement shall be of a rigid construction. External cabling route marker with GI plate marked with "DANGER 1.1 kV CABLE" with 1 meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

SUB-HEAD: E. EARTHING

1. SYSTEM OF EARTHING

The system shall be TNS with 4 wires supply system (R, Y, B, N and 2 Nos. E) brought from the main LT Panel.

All non-current carrying metal parts of the electrical installation shall be earthed as per IS: 3043 – 1987 with latest amendment. All metal conduits, cable sheath, switchgear, DB's, light fixture, equipment and all other parts made of metal shall be bonded together and connected to earth electrodes. Earthing shall be in conformity with provisions of rules 32, 61, 62, 67 and 68 of Indian Electricity Rules, 1956.

All earthing conductors shall be of high conductivity copper or GI, as specified in the scope of work & shall have protection against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor.

Main earthing conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI. Wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

- a. All Lighting fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with copper wire as specified in scope of work. The earth wire ends shall be connected with solderless/bottle type copper lugs.
- b. All the earth wires in switch boxes, sockets outlets, DB's and light fixtures shall be of green Colour (PVC insulated).
- b. Main earth bus shall be taken from the L.T. switch board to earth electrodes. The electrical resistance of earthing conductors shall be low enough to permit passage of fault current necessary to operate fuse or circuit breaker, and it shall not exceed 1 ohm.

2. SIZING OF EARTHING CONDUCTORS

The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the

current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits upto 15 amps shall be earthed with PVC insulated copper wire.

All 3 phase switches and distribution panels upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper / GI wires. All 3 phase switches and distribution panels upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper / GI wires. All switches, bus bar, ducts and distribution panels of rating 200 amps and above shall be earthed with minimum of 2 nos separate and independent 25 mm x 3 mm copper / GI tape.

Earthing details given in Table - A & B shall be referred to as a general guidance. Exact sizes to be worked out by the contractor as per relevant IS Codes.

Table - a

Size of earth leads

(a) For Transformer/Generator Neutral Point Earthing:

Transformer/ DG Set	Electrolytic Bare copper Conductor Wire or strip		Galvanized Iron Conductor wire or strip
Rating 750 KVA	40mm 6.0mm	x	50mm x 6.0mm
1000 KVA	40mm 6.0mm	x	50mm x 6.0mm

NOTE: - EXACT SIZE OF EARTH LEAD TO BE DETERMINED AS PER LATEST IS CODES.

TABLE - B

(c) For Equipment Earthing (Applicable to Transformer, Generators, Switchgears, Panels, DB's, Motors etc.)

Rating of 400-V, 3ph 50 cy. Equipment In KVA	Bare Electrolytic Copper conductor Wire / Strip	Galvanised Iron Wire / Strip
upto 5	2mm dia	2mm dia
6 to 15	3mm dia	3mm dia
16 to 30	4mm dia	4mm dia
31 to 50	6mm dia	6mm dia

51 to 100	25mm x 3.0mm	25mm x 6.0mm
101 to 125	25mm x 3.0mm	32mm x 6.0mm
126 to 150	25mm x 3.0mm	32mm x 6.0mm
151 to 200	25mm x 6.0mm	40mm x 6.0mm
201 to 300	25mm x 6.0mm	50mm x 6.0mm
301 to 500	32mm x 6.0mm	50mm x 6.0mm
501 to 800	40mm x 6.0mm	50mm x 6.0mm
Above 800	50mm x 6.0mm	50mm x 6.0mm

NOTE: EXACT SIZE OF EARTH LEAD TO BE DETERMINED AS PER LATEST IS CODES.

NOTE: All three phase equipment shall be double earthed.

3. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as an earthing conductor.

4. CONNECTION/JOINTS

The earthing connections/joints should be bolted, riveted, welded, brazed type.

In case of bolted joints, GI/Passivated hardware's of adequate size/nos. should be used for firm connections. The minimum contact area should be equal to the width of the strip or cross-sectional area of earthing lead. Welded/brazed joints should be smooth and continues. All welded/brazed joints should be treated with anti-corrosive paints to protect it from corrosion/rusting.

All bolted connections/joints of Cu strip should be tinned.

Wherever, flexible earthing connection is must, it should be hydraulically crimped lugs of Copper/Aluminum.

The effective earthing connection surface should be smooth & free from paints and oxide coatings.

5. EARTHING

The following must always be ensured in earthing system:

- All earth pits should be at equi-potential. Main equi-potential bonding conductors shall be provided.
- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure shall be bonded to earth.
- The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

6. RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm.

SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING FOR ELECTRICAL INSTALLATION**7. GENERAL REQUIREMENTS****a. Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

b. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing. Jointing of earthing tape shall be by welding. All joints and cut ends shall be properly painted with aluminum paint.

8. MAINTENANCE FREE CHEMICAL EARTHING:

Maintenance Free Chemical Earthing shall be done strictly as per manufacturer's recommendations. It shall be completely maintenance free, long life close to 25 years, environmentally safe, non corrosive & electrically conductive. The earth resistance results shall be less than one ohm.

SUB-HEAD: F. FINAL DISTRIBUTION BOARDS (FDB's)

Final Distribution Boards (FDBs) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum dielectric strength of 2.5 KV for 1 Sec. All Distribution Boards shall be manufactured by a manufacturer listed in approved makes of material.

FDB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS: 13947-1993.

1. CONSTRUCTIONAL FEATURES

FDB's shall be made out of 1.6 mm thick high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of FDB shall be folded and braced as necessary to provide a rigid support for all component. FDB shall be suitable for indoor / outdoor installation as the case may be, wall mounting or free standing type as per requirement, in double door construction. The Final Distribution Boards shall be totally

enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 4.0 sqm tinned stranded copper connectors. Final Distribution Boards shall be suitable for the climatic conditions / site conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall conform to IS: 8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of FDBs.

Knockout holes of appropriate size and number shall be provided in the FDB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

2. Final Distribution Boards shall comprise of the following:

- 2.1 A Din Channel for mounting, where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.
- 2.2 Installation accessories shall be part of the DB for fixing conductor and rails/ Din Channels for mounting MCB's and RCCB's etc. phase bus bars, neutral bus bars & earthing bus bars as required. All bus bars shall be of tinned copper. MCB's / ELCB's shall be simply snapped fitted on to a Din Channel and screwed to the bus bar. The arrangement should be such that any MCB can be taken out of without disturbing the other MCB's.
- 2.3 Service cable /entry connection shall be part of the Distribution Boards.
- 2.4 The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.
- 2.5 Degree of protection shall be IP-52 for indoor application, IP-54 for kitchen, laundry, basements/garages and IP-55 for outdoor application.
- 2.6 All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.
- 2.7 Phase segregation to be maintained in all three phase distribution boards.
- 2.8 Earthing shall be provided in each FDB's.
- 2.9 Where in 3 Phase FDB's, if each phase is controlled by a DP ELCB/ DP RCCB, then a separate neutral link / bar is to be provided per phase. These will be in addition to the main neutral link / bar.
- 2.10 All internal wiring within the FDB shall be with flexible PVC insulated copper conductor wires of adequate size.

- 2.11 All bus bars including neutral bar / link shall not be less than 100 Amp, 415 V.
- 2.12 Main neutral bar / link and separate neutral link / bar per phase shall also be of 100 Amp.
- 2.13 All connections with wires shall be with adequately sized thimbles.
- 2.14 UPS DB's will have two earth buses i.e. one for body earthing and another for third pin earthing of UPS socket. Dedicated earth bus shall be fixed on the insulated supports.

3 EARTHING

Earthing shall be provided as per IS: 3043-1987.

4 PAINTING

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of FDB inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5 or as per NCCF / Architect / PMC's requirement.

5 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

6 TESTING

Testing of FDB's shall be as per following codes:

- a. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
- b. IS: 13947: 1993 for Degree of protection

7 WIRING

In wiring a FDB, it shall be ensured that total load of various circuits is divided evenly between the phases and number of ways as per Consultants approval.

8.0 Pre-commissioning Test for Final Distribution Boards

PROJECT :
 LOCATION :
 ARCHITECTS :
 PROJECT MANAGERS :
 ELECTRICAL CONSULTANTS :
 ELECTRICAL CONTRACTORS :

D.B. No.Name : Location :
 D.B. Size :
 Incomer Cable Size :
 3 Phase Incomer MCB/MCCB :
 Phase Incomer DP ELCB :

S.No.	Ckt.No.	Wire Size	MCB Rating	I.R. Value (M.Ohm)	P-E	N-E	Polarity Test	Visual Check	Remarks
				P-N					

Particular of Meggar : MegerSl.No. _____
 Range _____
 Make _____
 Voltage _____

Name & Designation of Testing Engineer _____

Signature of Testing Engineer _____

Date _____

Note: - Each Final DB to be tested and a Pre-commissioning report to be generated in the format given above.

SUB-HEAD: G. CONSTRUCTION FEATURES OF LOW VOLTAGE MAIN AND SUB DISTRIBUTION BOARDS / PANELS/SWITCH BOARDS/ METER BOARDS/ACB ISOLATOR PANELS & GENERAL NOTES FOR PANELS & SWITCH BOARDS

GENERAL SPECIFICATIONS

Main & Sub Distribution Boards shall be classified as FBA (Factory Built Assemblies) as per IS: 8623:1998/ IEC: 60439 Part-I of Cubicle type, Sheet steel clad, Totally enclosed, Dust & Vermin proof, Indoor type, Rigid, Free standing, Floor mounted compartmentalized, Single front for use on 415 volts, 3 phase, 50 cycles, AC system with a fault level withstand capacity as per B.O.Q. /as required, RMS Symmetrical. Complete with busbars interconnections, power, control/auxiliary circuits/ wiring & earthing. With powder coated paint finish, switchgear as per B.O.Q of approved makes specified.

BASE FRAME: 3MM

Normal Indoor Application: CRCA
 Outdoor Application: GI
 Sheet Type: PN02/ Equivalent as approved
 Sheet Make: TISCO/ Equivalent as approved

STRUCTURE, COVER BACK & FRONT DOOR: 2MM

Normal Indoor Application: CRCA
 Outdoor Application: GI
 Sheet Type: PN02/ Equivalent as approved
 Sheet Make: TISCO/ Equivalent as approved

PARTITIONS: 1.6MM

Normal Indoor Application: CRCA
 Outdoor Application: GI
 Sheet Type: PN02/ Equivalent as approved
 Sheet Make: TISCO/ Equivalent as approved

GLAND PLATES: 3MM

Multi Core Cables: CRCA
 Single Core Cables: Aluminum

MOUNTING PLATES: 2MM

Normal Indoor Application: CRCA
 Outdoor Application: GI
 Sheet Type: PN02/ Equivalent as approved
 Sheet Make: TISCO/ Equivalent as approved

CONSTRUCTION

Completely modular & compartmentalized, form 3B separation. Separate adequately spaced Unit Chamber, Bus bar & cable compartments.

EXTENSIBILITY

Readily extensible on both ends.

Panels should be made in easily transportable sections.

DIMENSIONS

Operating height	1800mm max. 300mm min.
Overall height	2400mm max.
Compartment size HXW	225mm x 500mm min
Cable chamber	300mm min.

DEGREE OF PROTECTION

IP: 42 for totally Indoor application.

- Panels in Substation area, Electrical Rooms, LT Panel Rooms & DG Set Room
- MDB L+P Panel
- Tower Panel
- EWS Panel

- Meter Boards (In Electrical Rooms)
- Lift Panel (In Lift Machine Room)
- AHU Panel
- Basement Ventilation Panel
- Staircase & Liftwell Pressurization Fan Panel (If Indoors)

IP: 54 for Indoor Application

- Plumbing Panel
- Fire Pump Panel
- STP Panel
- AC Panel
- DG Set Auxiliary Panel
- Laundry Panel
- Kitchen Panel

IP: 55 for Outdoor Application.

- Feeder Pillar
- Outdoor Junction boxes
- Outdoor boards / panels
- ACB Isolators (outdoors)

All outdoor IP 55 panels shall be:

- a. Double door design
- b. With canopy
- c. In GI sheet steel construction in place of CRCA sheet steels to avoid rusting.
- d. Panel shall have forced ventilation mechanism with Rital fan & filter section, to avoid temperature rise and at the same time maintaining IP 55 integrity.

DOOR HINGES

Concealed, Powder Painted

DOOR LOCKS

Zinc alloy powder painted with provision for pad locking..

GASKET

Neoprene / PE foam of suitable profile to provide desired degree of protection.

LIFTING ARRANGEMENT

Eye bolt of removable design, when removed these shall not leave any opening in the boards.

PAINTING

Pre-treatment eight tank process or on line automatic spray system with oven for drying after Pre-treatment as per IS: 101-1988 effective temperature and concentration control. Powder coating of desired shade as per requirement. Paint thickness min. 60 micron

CORROSION RESISTANCE

Withstand 500 hrs of Salt Spray as per IS: 101-1988

BUS BARS MAIN

Aluminum E-91E grade, min. 53% IACS
 Copper min 99% IACS (Tinned copper)
 Configuration: Interleaved 2000A & above

Minimum clearances shall be:

Phase to Phase	32mm
Phase to Neutral	25mm
Phase to earth	25mm
Neutral to earth	25mm

BUS BARS EARTH

As per material of main busbar of size suitable to withstand fault level specified / as required. Continues length of earth bus to be provided.

UPS Output Panels shall have two earth bars of tinned copper of suitable rating. One of the earth buses shall be dedicated i.e. mounted on insulated supports.

BUS BAR TEMP. RISE

Ambient 45°C

Maximum bus bar temperature rise 40°C over ambient

No deration of Switchgear & Panels upto 45°C

BUS BAR SIZING / CROSS-SECTION

Bus bars to be sized to carry the full rated load current without exceeding maximum temperature rise as limited above. Bus bar size calculations to be submitted with shop drawings. Busbars to withstand the maximum short circuit current as specified / as per requirement.

BUS BAR SUPPORTS

Non Hygroscopic Epoxy/SMC at suitable distance to withstand forces of short circuit as per requirement.

BUS BAR INSULATION

Black heat shrinkable, fire retardant, self extinguishing type sleeves suitable to withstand 110°C
 Colour coding to be followed as per IS codes. Phase sequences and polarity to be followed as per IS codes.

SHROUDING

All live parts should be shrouded with IP2 protection Fire Retardant, Non Inflammable, Non Hygroscopic e.g. Polycarbonate, FRP.

HARDWARE

High tensile for ACB & ACB Bus termination Joints
 Corrosion resistance, Cadmium plated for other joints
 All bolts with spring/ star washer

WIRING

1100V Fire retardant, virgin PVC color coded flexible wire

Voltage circuit	1.5 sq mm
Current circuit	2.5 sq mm
Earth circuit	2.5 sq mm
As per IS: 694	

WIRING IDENTIFICATION

Computerized ferrule on both ends as per IS: 375

TERMINAL BLOCK

Power - Melamine stud type.

Control - Polyimide color coded screw less clamp fit type.

Not more than one wire connected to one terminal block.

Plug in type terminal block at each transport section.

COMPONENT LEGEND

Computerized labels for all control component & terminal block

FEEDER DESCRIPTION PLATES

Powder coated Al. Plate with computerized printing, size:

MDB = 150 x 50 mm

S/DB = 100 x 40 mm

SPARE FEEDERS

It shall be as per B.O.Q. / SLD. If B.O.Q / SLD does not specify anything, than an average of 20% of a mix of various ratings / feeders to be provided as spare feeders in each board / panel. Spare feeders must include a minimum one biggest and a minimum of one smallest rated feeders as spares along with other spares.

CABLING

Provision for top/ bottom/ top & bottom entry of cables, as per requirement / as per site. Adequately sized cable chambers. Easy and safe termination & maintenance facility.

BUS TRUNKING TERMINATION

Wherever specified in B.O.Q power connection arrangement at top suitable for bus trunking.

SWITCHGEAR

As per specification & Makes specified. IS: 13947 I- IV, 1993

Only one make of switchgear to be used in a board/panel. The switchgear selection shall be as per manufacturer's co-ordination tables.

CONTROL COMPONENTS

As per specification & Makes specified. IS: 13947 I - IV, 1993

INDICATING INSTRUMENTS

Analog/Digital as per specifications, notes, B.O.Q. & Makes specified. IS: 13779

BMS compatible multifunction meters shall be complete with communication card, shall be networkable and shall be wired on to common RS 485 Bus and information from these meters to BMS to be released at one point.

INDICATING INSTRUMENTS ACCESSORIES

CT/PT-Cast resin as per specifications & make specified. IS: 2705, 1992

CONTROL MCB'S / MPCB'S

For control and metering circuit/wiring, these shall be of fault level as required.

SPACE HEATER

All ACB Incomer & bus couplers shall be provided with Space Heater & Thermostat & 11 watt panel illumination. Heaters shall be controlled by a 6A MCB / MPCB as per the required fault level.

SHOP DRAWINGS

Notes, General arrangement, Elevations, Single line diagram, Bill of material, Control and inter locking scheme to be submitted for approval prior to manufacturing and approval taken from PMC / Consultant / NCCF.

TESTING & PRE-DISPATCH QUALITY CONTROL

A. Fabrication, Pre-treatment, painting, assembly and wiring.

B. Tests:

- Physical, Electrical, and Operational tests of all Breakers / Switches.
- Operational check of all meters and relays.
- Dielectric strength test for insulation at 2.5kV for 1 sec.
- Insulation resistance test at 1000V megger,
- Protective measures and continuity of circuits, as per IS: 8623-I, 1993.
- Testing of protection relays by secondary injection kit before commissioning.
- Interlocking Function Test.
- Earth continuity test between various Non-current carryings parts of equipment steel work etc. & the earth bus provided in the panel.

INSPECTION

To be offered at works to PMC / NCCF.

TEST CERTIFICATE TYPE AND ROUTINE

Test results for routine tests conducted at works should be submitted. Type tests as per IS: 8623 - Part I for Short circuit, Temperature rise, Degree of protection to meet the specifications and B.O.Q must be furnished.

PACKING

Wooden Crates/ Wooden Cases/ Polythene & Water proof paper to be used.

AS MANUFACTURED DRAWINGS

To be submitted in CD format with catalogues and test certificates of switchgear, controlgear and other components used within MDB & PDB.

AFTER SALES SERVICE

Manufacturer to have an Independent department to render after sales support for Installation, commissioning & trouble shooting during and after warranty period.

OPERATING CONDITIONS:

- No De-ration of panels, Switchgear/Equipment & Busbars upto 45 Deg. C & Altitude of 1000M above MSL for indoor panels.
- No De-ration of panels, Switchgear/Equipment & Busbars upto 50 Deg. C & Altitude of 1000M above MSL for outdoor panels / feeder pillars.

CONNECTION BETWEEN BUSBARS & SWITCHGEAR

- Upto 63Amp Switch rating with 1.1 KV grade FRLS PVC insulated flexible single core copper cables. Tinned copper or silver plated copper lugs shall be used on copper wires.
- Above 63Amp Switch rating, with solid aluminium / copper busbar links, to be used.
- Neutral Bus bars for four pole feeders shall be of the same size as phase.
Neutral Bus bars for triple pole feeders shall be of 50% size of phase.
Neutral Bus bars for UPS panels shall be of 200% size of phase.

IMPORTANT NOTE: VENDORS TO SUBMIT SWITCHGEAR SELECTION/ RATINGS FOR ALL THE PANELS ALONG WITH THE BID.

SUB-HEAD: H. TESTING & COMMISSIONING

After completion of erection works before equipment is charged, the following minimum test shall be carried out. All tests shall be recorded in the format as approved by Architect/Consultant /PMC / NCCF besides the test mentioned below any other tests specified by the local authority shall also be carried out. All tools and calibrated instruments for testing, labour, materials and incidentals necessary, to conduct the tests mentioned below shall be provided by the contractor at his own cost.

L.T. Switchgear & Distribution Boards.

Insulation resistance test of all the feeders by 500 V megger.

1. Test to Earth

This is made with all fuse links in place, all switches on and all lamps in position. The result must be not less than 50 megohms divided by number of outlets i.e., points and switch positions except that it need not exceed 1 megohm for the whole installations.

Control rheostats, heating and power appliances and electric signs may, if desired be disconnected for this test but if their insulation resistance must, in each case be not less than that given in the appropriate British Standard Specifications, or where there is no such specifications, be not less than half a megohm.

2. Test between Conductors

Where practicable, a test should be made between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply.

For this test, all lamps should be removed and all switches on. The result again must be 50 megohms divided by the number of outlets i.e., points and switch positions but need not exceed 1 megohm for the whole installation.

Continuity test of all breakers, MCCB and fuse switch units.

Earth continuity test between various non current carrying parts of equipment steel work et., and the earth bus provided in panels.

Operation of all meters and relays by secondary injection.

High voltage test 3 KV for 1 minute.

3. Cables

Insulation resistance test of all LT cables with 500 V megger.

Continuity test of all the cores and the armour.

Sheathing continuity test.

Earth test.

4. WIRING

4.1 Testing of Wiring

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

Testing of Earth Continuity Path.

The earth continuity conductor, metallic envelopes of cables shall be tested for electric continuity and the electrical resistance of the same, along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation, shall not exceed one ohm.

4.2 Insulation resistance Test

The insulation resistance shall be measured by applying between earth and the whole system to conductors or any sections thereof with all fuses in place and all switches closed, and except in earthed concentric wiring all lamps in position or both poles or the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it need not exceed 500 V for medium voltage circuits. Where the supply is derived from the three wire DC or poly phase AC system, the neutral pole of which is connected to earth direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

The insulation resistance shall be measured between all conductors connected to one pole or phase conductor of all supply and all the conductors connected to the neutral or to the other pole or phase conductors of the supply with all lamps in position and switches in OFF position. The insulation resistance in mega ohm measured as above shall not be less than 50 mega ohm divided by the number of outlets or when PVC insulated cables are used for wiring 12.5 mega ohm divided by number of outlets.

4.3 Polarity test of switches

In two-wire installation, a test shall be made to verify that all switches in every circuit have been fitted in the same conductor throughout and such conductor shall be labelled or marked for connection to the phase conductor or to the non-earthed conductor.

In a three wire or a four-wire installation, test shall be made to verify that every non-linked single pole switch is fitted in a conductor, which is labelled or marked for connection to one of the phase conductor of the supply.

Sub Head I :415V, 3 PHASE, 50HZ, 3/4/5 POLES RISING MAINS : COMPACT SANDWICH TYPE

1. SCOPE

This specification covers sandwich type busbartrunking for use as feeder busbars for interconnection between separate electrical equipment / load centers, and for use as plug in busbar risers.

2. IP RATING

Following minimum IP rating for Rising Mains & Bus ducts is to be considered, even if it is not specified in the BOQ:

IP 54	:	Rising Mains with floor tap-offs	In Electrical shafts, running through electrical rooms
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Note: Above mentioned IP ratings to be considered even if not mentioned in BOQ.

3. INSULATION TYPE & CLASS

Class 'B'	:	<ul style="list-style-type: none"> Insulation shall be minimum 2 layers of Mylar on each conductor (Dupont or PET Make) This insulation shall be able to withstand a max. temperature of 130°C.
Class 'F'	:	<ul style="list-style-type: none"> Insulation shall be Epoxy coating (3M Make). This insulation shall be able to withstand a max. temperature of 155°C.
Class 'H'	:	<ul style="list-style-type: none"> Insulation shall be Epoxy coating (3M Make). This insulation shall be able to withstand a max. temperature of 180°C.

4. INSULATION VOLTAGE

The insulation's rated operational voltage shall not be less than 690 volts & rated insulation voltage shall be 1000 volts.

5. HOUSING

The housing of rising main & bus bar (IP 54, IP 55, IP 66) shall be 3mm thick extruded aluminium alloy, two piece housing.

6. BUS BARS

Bus bars shall be high purity, electrolytic grade Aluminium conductor / Copper conductor as specified in BOQ.

Bus bars shall be 3P + 50% N, 3P + 100% N, 3P + 200% N, with or without internal earth bus as specified in BOQ's.

7. STANDARDS & SHORT CIRCUIT RATINGS

Bus bars shall be designed & manufactured as per following standards:

- Short circuit withstands capacity for 1 sec. shall be as per BOQ.
- Standards applicable : IEC 60439-1&2, IEC 60947, IEC 60529 & IEC 60331 for Cast Resin bus bars.
- Certification: KEMA certified.

8. FLEXIBLE CONNECTIONS

Tinned copper flexible connections to be employed at panel, transformer & DG set / alternator ends.

9. EXPANSION JOINTS

Tinned copper flexible connections are to be provided at building expansion joints & also for liner horizontal distances 40M and above / or as per manufacturer's recommendation.

10. ELBOWS, BENDS, OFFSETS, END FEED BOXES, FLANGED ENDS

All the accessories required to make the installation complete shall have to be provided as per site conditions.

11. CONSTRUCTION FEATURES:

Bus bar joints	:	Joints shall be tinned
Straight lengths	:	The standard length shall be 3M to 4M but actual site measurement to be taken to decide on required length. A maximum of 3 plug outlet may be fixed on each side of 3M length as per the requirement.
Joint temperature Indicator	:	The busbar system shall have a colour coded temperature indicator to give an early warning when high temperature occurs at the joint.
Joint Design	:	<ul style="list-style-type: none"> • The busbar joint system shall be single bolt design, double headed "break off" joint bolt to tighten the busway with no torque wrench required. • Belle ville spring washers shall be used to ensure pressure is evenly applied across the joint.
Plug in System / Tap-off units	:	<ul style="list-style-type: none"> • Plug in system shall be push in & pull out with interlock mechanism, preventing 'ON' load connection. • Plug in pins shall be silver plated & design of pins shall

		<p>be fail safe to prevent incorrect phase installation.</p> <ul style="list-style-type: none"> • Plug in outlet shall also be grounded. • Plug in boxes shall be 3P/4P circuit breakers (MCCB's) including rotary handles. The breakers shall be with thermal magnetic releases and shall be of fault rating as per the fault at that level.
Vertical Installation	:	It shall be vertical spring hanger design. To be designed & supplied by the manufacturer, to withstand safety without fail the "Seismic Conditions" of site.

12. TEST AT WORKS

The following factory tests shall be carried out and test results to be recorded:

- a. Temperature rise (Type test with no extra cost).
- b. Insulation resistance shall be tested with 1000 V megger and shall be not less than 100 mega ohms. The testing shall be done as per IS: 8084-1976.
- c. Earth continuity test.

13. TEST AT SITE

The following tests shall be carried out at site and test results to be recorded:

- a. Insulation resistance shall be tested with 1000 V megger and shall be not less than 100 mega ohms. The testing shall be done as per IS: 8084-1976.
- b. Earth continuity test.

SUB HEAD J: SPECIFICATION OF DUAL SOURCE ENERGY METER

S. No	Features	Description
1	Connection Type	Three Phase, Four Wire
2	Accuracy	Class 1.0 as per IS 13779-99
3	Voltage	VoltageNominal : 3 x 240 V (L-N) Operating : -40% to +20%
4	Current	10-60A
5	Power Factor Range	Zero (lag) - unity - Zero (lead)
6	Frequency	50 Hz ± 5%
7	Starting Current	20mA
8	Power Consumption	Voltage Circuit : < 0.7 W and 3 VA ; Current Circuit : < 1VA
9	Temperature Range	-10°C to +60°C
10	Humidity	<=95%
11	Display	Custom built LCD with back-light 8 digit 7 segment display for parameters
12	Measured Parameters	Phase voltage, Current, Watt, Apparent current, Power factor, Frequency, Watt Hour, MD KW,MD KVA,
13	Maximum Demand (MD) Register	Integration periods 15 minutes ;Sliding / fixed block method

14	Billing registers MD,Cumulative value	Up to last 6 months bill point registers with
15	Real time clock	± 6.5min / year

SUB HEAD K: INTELLIGENT REPORTING FIRE DETECTION SYSTEM

GENERAL

DESCRIPTION:

This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

SCOPE:

A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

Basic Performance:

Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 6 (Class A) Signaling Line Circuits (SLC).

Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.

On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zones whichever is greater.

Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

Two-way telephone communication circuits shall be supervised for open and short circuit conditions.

DRAWINGS & TECHNICAL SUBMITTALS

General:

Two copies of all submittals shall be submitted to the Architect/Engineer for review.

All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

Shop Drawings:

Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

Show annunciator layout, configurations, and terminations.

Manuals:

Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.

Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.

Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

Software Modifications

Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

WARRANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

POST CONTRACT MAINTENANCE:

Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:

Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.

Each circuit in the fire alarm system shall be tested semiannually.

Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

POST CONTRACT EXPANSIONS:

The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

As part of the submittal, include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labor necessary to install this hardware.

Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent addressable device. Do not include the cost of conventional peripherals or the cost of initiating devices or notification appliances connected to the addressable monitor/control modules.

Submittals that do not include this estimate of post contract expansion cost will not be accepted.

APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

National Fire Protection Association (NFPA) - USA:

NFPA 13	Sprinkler Systems
NFPA 16	Foam/Water Deluge and Spray Systems
NFPA 17	Dry Chemical Extinguishing Systems
NFPA 17A	Wet Chemical Extinguishing Systems
NFPA 2001	Clean Agent Extinguishing Systems
NFPA 72	National Fire Alarm Code
NFPA 76	Telecommunication Facilities
NFPA 101	Life Safety Code
NFPA 90A	Air conditioning & ventilation system
EN 54	European Standards

B. Underwriters Laboratories Inc. (UL) - USA:

UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 864	Control Units for Fire Protective Signaling Systems 9th Edition Listed
UL 268	A Smoke Detectors for Duct Applications
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 464	Audible Signaling Appliances
UL 38	Manually Actuated Signaling Boxes
UL 346	Water flow Indicators for Fire Protective Signaling Systems
UL 1971	Visual Notification Appliances
UL 228	Door Holders

NATIONAL BUILDING CODES
Local Bylaws

The Video Display Terminal (VDT) shall comply with Swedish magnetic emission and X-radiation guidelines MPR 1990:10.

APPROVALS:

The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc(9th Edition) / EN 54

The fire alarm control panel shall meet UL Standard 864 9th Edition (Control Units).

The system shall be listed by the national agencies as suitable for extinguishing release applications.

The system shall support release of high and low pressure CO2.

PRODUCTS

EQUIPMENT AND MATERIAL, GENERAL:

All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

CONDUIT AND WIRE:

Conduit:

Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits

shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.

Conduit shall be 25mm minimum, 16G MS.

Wire:

All wires shall be of FRLS PVC insulated copper conductor as per BOQ

MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

The main FACP Central Console shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, panel modules including initiating circuits, control circuits, and notification appliance circuits, local and remote operator terminals, printers, annunciators, and other system controlled devices.

1. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:
 - a. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
 - b. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.
 - c. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
 - d. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.
2. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The system alarm LED shall flash.
 - b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c. The 640 -character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

- d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 - e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
3. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The system trouble LED shall flash.
 - b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c. The 640 -character backlit LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.
 - d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 - e. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.
 4. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The system trouble LED shall flash.
 - b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c. The 640 -character backlit LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.
 - d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 - e. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
 5. When a security alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The system security LED shall flash.
 - b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

- c. The 640 -character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 - d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 - e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
6. When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
- a. The system pre-alarm LED shall flash.
 - b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c. The 640-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 - d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.
 - e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

Operator Control

Acknowledge Switch:

- a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition. In addition, the FACP shall support Block Acknowledge to allow multiple trouble conditions to be acknowledged with a single depression of this switch.
- b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

Signal Silence Switch:

Depression of the Signal Silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

- 1. **Drill Switch:**

Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

2. System Reset Switch:

Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that de-activate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

3. Lamp Test:

The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

4. Scroll Display Keys:

There shall be Scroll Display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. Depression of the Scroll Display key shall display the next event in the selected queue allowing the operator to view events by type.

5. Print Screen:

Depression of the PRINT SCREEN switch shall send the information currently displayed on the 640character display to the printer.

System Capacity and General Operation:

1. The control panel shall be capable of expansion via up to 10 SLC modules. Each module shall support a maximum of 318 analog/Intelligent/addressable devices for a maximum system capacity of 3180 points. The system shall be capable of 3072 annunciation points per system regardless of the number of addressable devices.
2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either the NCCF or installing company / software programming.
3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

The FACP shall be able to provide the following software and hardware features:

- a. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.

- b. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
- c. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
- d. Action: If programmed for action, and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on alarm level.
- e. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
- f. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
- g. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the requirements of NFPA 72.
- h. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
- i. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.
- j. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.
- k. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.
- l. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.
- m. Drill: The system shall support means to activate all silence able fire output circuits in the event of a practice evacuation or "drill". If enabled for local control, the front panel switch shall be held for a minimum of 2 seconds prior to activating the drill function
- n. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

- o. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions
- p. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
- r. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.
- s. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
- t. Print Functions: The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history. Additional reports shall be available for point activation for the last Walk Test performed, detector maintenance report containing the detector maintenance status of each installed addressable detector, all network parameters, all panel settings including broad cast time, event ordering, and block acknowledge, panel timer values for Auto Silence, Silence Inhibit, AC Fail Delay time and if enabled, Proprietary Reminder, and Remote Reminder timers, supervision settings for power supply and printers, all programmed logic equations, all custom action messages, all non-fire and output activations (if pre-programmed for logging) all active points filtered by alarms only, troubles only, supervisory alarms, pre-alarms, disabled points and activated points, all installed points filtered by SLC points, panel circuits, logic zones, annunciators, releasing zones, spall zones, and trouble zones.
- u. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.
- v. Resound based on type for security or supervisory: The system shall indicate a Security alarm when a monitor module point programmed with a security Type Code activates. If silenced alarms exist, a Security alarm will resound the panel sounder. The system shall indicate a Supervisory alarm when a monitor module point programmed with a supervisory Type Code activates. If there are silenced alarms, a Supervisory alarm will resound the panel sounder.
- w. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
- x. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen. Graphic shall display when all systems are normal.

- y. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.
- z. Tracking/Latching Duct: The system shall support both tracking and latching duct detectors.
- aa. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.
- bb. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
- cc. Security Monitor Points: The system shall provide means to monitor any point as a type security.
- dd. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.
- ee. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
- ff. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
- gg. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in

its map will be active. It shall also be possible to use general zone as arguments in logic equations.

- hh. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
- ii. 10 trouble equations per device: The system shall provide support for up to 10 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
- jj. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
- kk. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone with four abort options to satisfy any local jurisdiction requirements.
- ll. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector or indicating panel module input. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

Central Processing Unit

1. The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the Central Processing Unit.
2. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
3. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
4. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

5. Consistent with UL864, the CPU and associated equipment are to be protected so that voltage surges or line transients will not affect them.
6. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.
7. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
8. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
9. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.
10. The CPU shall provide one high-speed serial connection for support of network communication modules.
11. The CPU shall provide double pole relays for FIRE ALARM, SYSTEM TROUBLE, SUPERVISORY, and SECURITY. The SUPERVISORY and SECURITY relays shall provide selection for additional FIRE ALARM contacts.

Display

1. The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.
2. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
3. The system display shall provide a 640 character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, and CPU FAILURE.
4. The system display shall provide a QWERTY style keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming / software programming.
5. The system display shall include the following operator control switches: ACKNOWLEDGE, SIGNAL SILENCE, RESET, DRILL, and LAMP TEST. Additionally, the display interface shall allow scrolling of events by event type including, FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. A PRINT SCREEN button shall be provided for printing the event currently displayed on the 640character LCD.

Loop (Signaling Line Circuit) Control Module:

1. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Photoelectric, Thermal etc.) and 159 monitor or control modules.
2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
3. The Loop Control Module shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 6 (Class B) circuit.
4. The SLC interface board shall be able to drive an NFPA Style 6 twisted shielded circuit up to 12,500 feet in length. The SLC Interface shall also be capable of driving an NFPA Style 6, no twist, no shield circuit up to 3,000/14,000 feet in length. In addition, SLC wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.
5. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine any no. whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic / by module detector testing and the automatic determination of detector maintenance requirements.

Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.
4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

Power Supply:

1. The Addressable Main Power Supply shall operate on 240 VAC, 50 Hz, and shall provide all necessary power for the FACP.

2. The Addressable Main Power Supply shall provide sufficient power to the CPU, using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Addressable Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.
4. The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Addressable Main Power Supply shall be power-limited per 1995 UL864 requirements.

System Circuit Supervision:

1. The FACP shall supervise all circuits to intelligent devices, annunciators and conventional peripherals and annunciate loss of communications with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate that device or devices are not responding and print the information in the history buffer and on a printer.
2. Sprinkler system valves, standpipe control valves, PIV and main gate valves shall be supervised for off-normal position.

Field Wiring Terminal Blocks:

All wiring terminal blocks shall be the plug-in/removable type and shall be capable of terminating up to 12 AWG wire. Terminal blocks that are permanently fixed to the PC board are not acceptable.

Printer

1. Printers shall be of the automatic type, printing code, time, date, location, category, and condition.
2. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table and UL, ULC listed. The printer shall communicate with the control using an interface complying with Electrical Industries Association standard EIA-232D. The printer power shall be 230 VAC @ 50 Hz.
3. Thermal printers are not acceptable.
4. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery backup if AC mains are lost. The strip printer shall be UL 864 listed.

Field Programming

1. The system shall be programmable, configurable and expandable in the field with / without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
2. It shall be possible to program through the standard FACP keyboard all system functions / software.
3. All field defined programs shall be stored in non-volatile memory.
4. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

Specific System Operations

1. Smoke Detector Sensitivity Adjust: Software means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.
2. Alarm Verification: Each of the intelligent addressable Smoke Detectors in the system may independently select and enable to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. System Point Operations:
 - a. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
 - b. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
4. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:
 - a. Device Status.
 - b. Device Type.
 - c. Custom Device Label.

- d. Software Zone Label.
 - e. Device Zone Assignments.
 - f. Analog Detector Sensitivity.
 - g. All Program Parameters.
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:
 6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed, one event at a time, and the actual number of activations may also be displayed and or printed. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.
 7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
 8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

Signaling Line Circuits (SLC)

Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159/125 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.

CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

Serial Interfaces

The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.

One EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL-Listed are not considered acceptable substitutes.

One EIA-232 interface shall be used to connect a UL-listed CRT terminal. This interface shall include special protocol methods that allow off-site monitoring of the FACP over standard dial-up phone lines. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset, or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.

The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.

The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

Digital Voice Command Center

The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

Function: The Voice Command Center equipment shall perform the following functions:

Operate as a supervised multi-channel emergency voice communication system.

Operate as a two-way emergency telephone system control center.

Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.

Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.

Provide all-call Emergency Paging activities through activation of a single control switch.

As required, provide vectored paging control to specific audio zones via dedicated control switches.

Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.

Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.

Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.

The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.

The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

Audio Amplifiers

The Audio Amplifiers will provide Audio Power (@70 Volts RMS) for distribution to speaker circuits.

Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).

The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:

- Earth Fault on DAP A (Digital Audio Port A)
- Earth Fault on DAP B (Digital Audio Port B)
- Audio Amplifier Failure Detected
- Trouble
- Active Alarm Bus input
- Audio Detected on Aux Input A
- Audio Detected on Aux Input B
- Audio Detected on Fire Fighter's Telephone Riser
- Receiving Audio from digital audio riser
- Short circuit on speaker circuit 1
- Short circuit on speaker circuit 2
- Short circuit on speaker circuit 3
- Short circuit on speaker circuit 4
- Data Transmitted on DAP A
- Data Received on DAP A
- Data Transmitted on DAP B
- Data Received on DAP B
- Board failure
- Active fiberoptic media connection on port A (fiberoptic media applications)
- Active fiberoptic media connection on port B (fiberoptic media applications)
- Power supply Earth Fault
- Power supply 5V present
- Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble

The audio amplifier shall provide the following built-in controls:

- Amplifier Address Selection Switches
- Signal Silence of communication loss annunciation
- Reset
- Level adjustment for background music
- Enable/Disable for Earth Fault detection on DAP A
- Enable/Disable for Earth Fault detection on DAP B
- Switch for 2-wire/4-wire FFT riser

Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.

Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).

System shall be capable of backing up digital amplifiers.

Audio Message Generator (Prerecorded Voice)/Speaker Control:

Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.

Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.

A built-in microphone shall be provided to allow paging through speaker circuits.

Speaker Switches/Indicators

The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.

The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.

Fire Fighters Telephone System

The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.

The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

Waterflow Operation

An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display; turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

Supervisory Operation

An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

Signal Silence Operation

The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.

Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

SYSTEM COMPONENTS:**Printer**

The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 230 VAC @ 50 Hz.

The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

Repeater Panel (RP)

A repeater panel shall be provided to display all system intelligent points. The RP shall be capable of displaying all information for all 10,000 possible points on the network. Network display devices, which are only capable of displaying a subset of network points, shall not be suitable substitutes.

The RP shall include a minimum of 640 characters, backlit by a long life, solid state LCD display. Additionally, the network display shall include ten soft-keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.

The network control annunciator shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of events by type.

The RP shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in a backbox designed for this use. The network shall support a minimum of 103 network control annunciators (not to exceed total node capacity) and shall connect to the network over either a wire or fiber interface.

The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in non-volatile memory. Additionally, the RP shall have a fire alarm history buffer capable of storing a minimum of 200 events in non-volatile memory. Systems that do not protect fire alarm events from being overwritten by other events are not suitable substitutes.

The RP shall include two optically isolated, 9600 baud, industry standard EIA-232 ports for UL864 listed printers and CRT's. These peripheral devices shall print or display network activity.

The network control annunciator shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A mechanical means by which the controls switches are "locked out", such as a key, shall be available.

The RP shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, Disabled Points, Other (non-fire) Events, and CPU Failure.

The network control annunciator shall include a Master password and up to nine User passwords. Each password shall be up to eight alpha-numeric characters in length. The Master password shall be authorized to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password.

The RP shall allow editing of labels for all points within the network; control on/off of outputs; enable/disable of all network points; alter detector sensitivity; clear detector verification counters for any analog addressable detector within the network; clear any history log within the network; change the Time/Date settings; initiate a Walk Test.

The network control annunciator shall support an optional Windows™ based program utility. This utility shall allow the user create an RP database, upload/download an RP database, and download an upgrade to the RP executive. To ensure program validity, this utility shall check stored databases for errors. A compare function shall be included to identify differences between databases.

For time keeping purposes the RP shall include a time of day clock.

Each RP shall support up to 32 additional 80 character remote display annunciators for displaying network activity. These "Terminal Mode" displays will mimic the activity appearing on the corresponding RP.

Speakers:

All speakers shall operate on 70 VRMS or with field selectable output taps from 0.25 to 2.0 Watts.

Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).

Frequency response shall be a minimum of 400 HZ to 4000 HZ.

The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

Graphic User Interface (GUI)

The GUI shall utilize a Microsoft(tm) operating system. Each Network Control Station shall be capable of graphically annunciating and controlling all network activity. Network display devices that are only capable of displaying a subset of network points shall not be suitable substitutes.

The GUI shall be an IBM (or compatible) personal computer with the following minimum requirements: Intel Pentium II(tm)-processor, operating at a minimum of 400 Mhz, 128Mbytes of RAM, 8 Mbytes Video RAM, 1.44 Mbyte floppy drive, 3.2 Gbyte hard disk, mouse, 32X CD-ROM, 3PCI / 1 ISA expansion slots, internal 3.2 Gbyte tape drive, sound card, 200 watt power supply, and SVGA graphics with a screen resolution of 1024 x 768. The network control station shall include a 19-inch monitor.

The GUI shall be capable of storing over 100,000 network events in a history file. Events shall be stored on hard disk and shall be capable of back-up storage to a tape drive. The history buffer allows the operator to view events in a chronological order. A filter shall be available for displaying chronological events by operator, date, time, fire alarms, troubles (including security, supervisory and system/device), disabled points/zones, system programming, operator response and operator log in/log out. The ability to print GUI history files shall also be available.

The GUI shall use a Windows(tm) dialog box technology to address, interrogate, control, and/or modify intelligent points on each fire alarm node. This shall include, and not be limited to: Activating outputs,

enabling or disabling points, adding or removing intelligent points, viewing intelligent detector sensitivity levels and modifying point information (custom messages, detector type, verification, day/night selection etc.)

The GUI shall include the ability to display system information in a graphical (floor plan) form. Each view, created using standard Windows bitmap files, shall include icons created for intelligent devices. These icons shall blink and change to the appropriate programmed icon when an event occurs. When the device has been acknowledged, the icon shall become steady. Once the point has returned to normal, the normal icon is displayed. In addition to the graphical representation of the device, the user shall be able to link pictures, documents and sound files to the device. The GUI shall also provide the ability to auto-vector to the floor plan (screen) of the device that is active. By selecting a device in the graphic presentation, the operator of the GUI shall have the ability to log onto the corresponding node and interrogate the associated intelligent point.

The GUI shall have the ability to provide the following information through a Windows(tm) pull down menu: An Event Counter that contains the number of new and total events on the network. The information that is displayed shall consist of Fire Alarms, Pre-Alarms, Security Alarms, Supervisory Alarms, and Troubles. Detailed Event windows that contain all Off-Normal events, both unacknowledged and acknowledged that are present in the system. It shall contain two views, Fire events and Non-fire events that shall be user selectable. A Current Event window that shall contain all network and local events as well as system messages with a maximum of 1,000 events displayed. A Disabled Device window that shall contain all disabled devices in the system.

The GUI shall have the option, from a Windows pull down menu, to connect to a third party paging service that allows the GUI to automatically send text-based messages regarding system status to a typical text pager.

The GUI shall include help screens, available to aid the user without leaving the selected application screen.

The GUI shall be UL-Listed for fire protection (UL864) and burglary (UL1076).

The GUI shall meet FCC regulations (Part 15, subpart J) regardless of its connection means to the network.

The GUI shall have a flexible way of assigning operator passwords. There shall be an unlimited number of possible operators, each with specific levels of control. Each operator shall have his/her own password. Operator password and control selection shall be available to a high level "administrator" who shall have complete control over levels of control. If no action has taken place on the GUI after 10 minutes, the current operator shall be logged out and require a new log-in.

The GUI shall include an industry-standard EIA-232 port for a UL864 listed printer.

The GUI shall be a table top hardware configuration.

Video Display Terminal

The Video Display Terminal shall provide a visual display and an audible alert of all changes in status of the system and shall annotate such displays with the current time-of-day and date.

The Video Display Terminal shall be enclosed in a cabinet suitable for placement on a desktop or table.

A detachable keyboard shall be provided that may be used for programming, testing, and control of the system. Individual keys shall be provided on the keyboard for the ACKNOWLEDGE, RESET, LAMP TEST, SYSTEM TEST, and SIGNAL SILENCE functions of the control panel.

The video display terminal shall include a count of all alarms and troubles in the system, as well as a count of all alarms and trouble requiring acknowledgment. These counts shall be continuously displayed during all FACP operations.

SYSTEM COMPONENTS - ADDRESSABLE DEVICES

Addressable Devices - General

Addressable devices shall use simple to install and maintain decade, decimal address switches / software adjustable. Devices shall be capable of being set to an address in a range of 001 to 159/125. Alternatively the loop controller shall electronically addresses each detector, saving valuable time during system commissioning. Each detector shall have its own unique serial number stored in its "on-board memory". The loop controller shall identify each device on the circuit and assigns a "soft" address to that device's serial number.

Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute.

Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

Addressable smoke and thermal detectors multicriteria shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both single LEDs shall be placed into steady / flash red illumination by the control panel, indicating that an alarm condition has been detected, red & green LED shall glow steady if the detector senses fine in the stand alone mode. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED. Alternatively the detector shall have Twin LEDs which shall be visible from any direction. A flashing GREEN LED shows normal system polling from the loop controller. A flashing RED LED means the detector is in alarm state. Both LEDs on steady shows alarm state - stand-alone mode.

Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7. The panel on a time-of-day basis shall automatically adjust sensitivity.

The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.

The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device.

Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

Addressable Manual Fire Alarm Box (manual station)

Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

Smoke Detector - Multi-Sensor Photo Thermal

Provide analog/addressable multisensor smoke detectors at the locations shown on the drawings. Alarm condition shall be based upon the combined input from the photoelectric and thermal detection elements. Separately mounted photoelectric detectors and heat detectors in the same location, clustered at the manufacturer's listed spacing is an acceptable alternative. The detector shall have the ability to set the sensitivity and alarm verification of each individual detector on the circuit. It shall be possible to automatically set the sensitivity of individual analog/addressable detectors for the day and night periods.

Each smoke detector shall be capable of transmitting prealarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour.

The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

Intelligent Thermal Detectors

Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

Intelligent Multi-Criteria Sensing type Photoelectric Smoke Detector

The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall be in position to work in advance multi Criteria Sensing, on command from the control panel, send data to the panel representing the analog level of smoke density.

Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

Fire Fighter Telephone

Firefighters' telephones shall be typically installed in corridors, lobbies, mechanical rooms, stairways, or other strategic locations. When lifted from its cradle, or plugged into a suitable wall jack, the handset shall activate audible and visible signals at the control panel. There, the operator needs only to lift the handset off the cradle to respond to the current call. Other firefighters' telephones may be selected at the control panel to join the conversation.

BATTERIES:

The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

If necessary to meet standby requirements, external battery and charger systems may be used.

EXECUTION

INSTALLATION:

Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

Verify activation of all waterflow switches.

Open initiating device circuits and verify that the trouble signal actuates.

Open and short signaling line circuits and verify that the trouble signal actuates.

Open and short notification appliance circuits and verify that trouble signal actuates.

Ground all circuits and verify response of trouble signals.

Check presence and audibility of tone at all alarm notification devices.

Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

FINAL INSPECTION:

At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

INSTRUCTION:

Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

The contractor and/or the systems manufacturer's representatives shall provide a typewritten

"Sequence of Operation."

SUBHEAD: L CCTV SYSTEM

The CCTV equipment shall have UL & CE Certifications.

1. Black& White Fixed CCTV Camera

The Camera shall operate on 12V DC
 The Camera shall have a 1/3" CCD
 The Camera shall work in minimum 0.5 lux illumination
 The Camera shall have a fixed 3.6mm lens for C- mount indoor cameras.

2. Color C/CS Mount Weather Proof camera.

- a. The camera shall be 1/3" CCD, 480HTV and 0.3 Lux.
- b. The camera shall have the 5mm to 50mm at F 1.8 Varifocal auto Iris lens in 1/3" format.
- c. The camera shall have the competence of Video/DC selectable, Sharpness selectable and ATW / AWB.
- d. Cameras shall be mounted in imported aluminum weather proof housings of approved finish for the outdoor applications along with suitable mounting brackets.
- e. It should be suitable to operate both in day / night mode with low lux sensitivity. Day mode shall be 2-lux and Night mode shall be 0.016 lux.

3. Color Dome fixed lens Cameras.

- a. The camera shall be 1/3" CCD, 410 K pixels, 480 HTV and 0.3 Lux.
- b. The camera shall have the competence of Video/DC selectable, Sharpness selectable and ATW / AWB.
- c. The Camera shall operate on 12V DC.
- d. The Camera shall have a fixed 3.6mm lens for C- mount indoor cameras.

4. SVGA Monitor

- a. The Monitor shall operate on 230V AC.
- b. The Monitor shall have a minimum resolution of 1024*768.
- c. The Monitor shall have controls for brightness, contrast etc. at the front of the cabinet.
- d. The Monitor shall have a screen size of 17 inches.

5. Digital Video Recorder

- a. The DVR shall be UL listed & operate on 230V AC.
- b. The DVR shall be capable of recording up to 360 hours & back-up facility also.
- c. The DVR shall have Multiplexed view (16 Cameras) Possible.
- d. It shall be possible to Control and record the data from all the cameras in real time mode and providing interface to the LAN over TCP/ IP.
- e. It shall be possible to view the recording on event basis or intelligent basis, the system shall support multi area motion detection.
- f. The software of DVR shall be capable of programming reason of interest for recording.
- g. Total 240 FPS for all 16 Cameras (480fps full live video) with provision for adjusting the recording rate from 0 to 25 FPS for each camera channel.
- h. The system will combine the function of a multiplexer, VCR, and telemetry switcher for system versatility and functional use with large system. It shall offer full triplex operation.
- i. It will have capability of VMD and activity detection.
- j. It will have telemetry control for PTZ cameras.
- k. Rack mounted option shall be provided.

SPECIAL CONDITIONS OF CONTRACT

GENERAL:

These special conditions are meant to amplify the specifications and General Conditions of Contract. If any discrepancy is noted among these Special Conditions, General Conditions of Contract, Specifications, Scope of work and Drawings, the most stringent of the above shall apply, should there be any ambiguity or inconsistency, the contractor should report the same to the Architect/ Project Manager/ NCCF and obtain clarification before submitting the tender. Contractor to collect General Conditions of Contract and Schedule of Fiscal Aspects from the NCCF/ Architect.

SCOPE OF WORK:

The work to be carried out under this contract comprises of internal and external electrical installation of the project as called in the tender documents. The Electrical Contractor shall include for the supply of the whole of the materials in accordance with the Specifications and the whole of the work of fixing necessary for the complete installation as set out in these Specifications and with the accompanying schedule and drawings, commencing from the supply authority's terminals. This also include any material, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and Customary to make the installation complete in all respects. In general the work to be performed under this contract shall comprise supply, installation, testing & commissioning of the following:-

- a. All conduit work including junction boxes, outlet boxes, wiring & earthing for lighting & power.
- b. All conduit work including junction boxes, outlet boxes & wiring for LV systems such as voice, data, fire alarm, paging, CCTV, Access control & MATV etc.
- c. Switches, plug sockets, cover plates and wiring accessories.
- d. Emergency lighting, wiring, Inverter/UPS.
- e. Substation, HT Switchgear and HT Cabling.
- f. Mains and sub-mains between various distribution boards, cables, submain wiring, cable trays, Rising Mains & Bus Ducts.
- g. Distribution Boards, Panels, meter boards & final DB's.
- h. Earthing system.
- i. Lighting Fixtures and Fans.

- j. Lightning Arrestor System
- k. External lighting, cabling, lighting fixtures and poles.
- l. LV Works including Fire alarm system & Security systems.
- m. HSD Works
- n. UPS Works
- o. Training of NCCF's staff/representative.
- p. Preparation of "As Built Drawings & Documents".

Note:-Some items may be supplied free of cost by the NCCFs for installation, testing & commissioning. The entire work is to be carried out with the direction of & to the satisfaction of the NCCF/Architect.

STANDARD OF WORK:

The work shall be carried out to the satisfaction of the Architect/Consultant/ Project Manager /NCCF and in accordance with the latest regulations of the Local Electricity Supply Authority, Local chief Electrical Inspectorate, The Fire Insurance Company, insuring the building, Indian Electricity Rules and Regulations, National Building code, National Electrical code and the enclosed Specifications.

ABBREVIATIONS:

The following abbreviations have been used in the accompanying specifications, drawings and scope of work:

RCCB stands for Residual Current Circuit Breaker

ELCB stands for Earth Leakage circuit Breaker

HRC stands for High Rupturing Capacity

G stands for gauge

GI stands for Galvanized Iron

MS stands for Mild Steel

AL stands for Aluminum

CU stands for Copper

CI stands for Cast Iron

PVC stands for Polyvinyl Chloride

A or Amp stands for Amperes.

V stands for Volts

KWH stands for Kilowatt hour

KV stands for Kilo Volts

LV stands for Low Voltage

LT stands for Low tension

HT stands for High tension

VCB stands for Vacuum Circuit Breaker

OCB stands for Oil Circuit Breaker

CSS stands for Compact Substation

VPI stands for Vacuum Pressure Impregnated

SLD stands for single line drawing/ diagram.

IEE stands for Institution of Electrical Engineers - London

IR stands for Insulation Resistance

IC stands for Iron Clad

IP stands for Ingress Protection

MCB stands for Miniature Circuit Breaker

MCCB stands for Moulded Case Circuit Breaker

MPCB stands for Motor Protection Circuit Breaker

ACB stands for Air circuit Breaker

CT stands for Current Transformer

PT stands for Potential Transformer

O/L stands for Over Load Relay

S/C stands for Short Circuit

SPP stands for Single Phasing Preventor

MV stands for Medium Voltage

SP stands for Single Pole

DP stands for Double Pole

TP stands for Triple Pole

TPN stands for Triple Pole and Neutral

FP stands for Four Pole

MDB stands for Main Distribution Board

DB stands for Distribution Board

SDB stands for Sub-Distribution Board

FDB stands for Final Distribution Board

MCC stands for Motor Control Centre

PCC stands for Power Control Centre

IS stands for Indian Standards

BIS stands for Bureau of Indian Standards

NEC stands for National Electrical Code

NBC stands for National Building Code of India

ECBC stands for Energy Conservation Building Code of India

BMS Building Management System

HVAC stands for Heating, Ventilation & Air Conditioning

NFPA stands for National Fire Protection Association of USA

PMC stands for Project Manager

SWG stands for Standard Wire Gauge

VFD stands for Variable Frequency Drive

PLC stands for Programmable Logic Controller

ATS stands for Automatic Transfer Switch

OLTC stands for On Load Tap Charger

EDO Electrically Operated Draw Out

MDO Manually Operated Draw Out

CPCB Stands for Central Pollution Control Board

BOQ Stands for Bill of Quantities (Scope of work)

FEES AND PERMITS:

The contractor shall obtain and pay for all fees and permits required for the installation and approval of the complete Electrical Installation. On completion of the work, the contractor shall obtain and deliver to the Architect/ Consultant/ Project Manager/ NCCF, certificates of final inspection and approval by the Local Chief Electrical Inspectorate. All receipted amount shall however, be payable by the NCCF on production of proof of payment.

SPECIFICATIONS AND SCOPE OF WORK:

The Specification and Scope of work shall be considered as part of this contract and any work or materials shown in schedule and not called for in the specifications or vice versa, shall be executed as if specially called for in both.

TENDER DRAWINGS:

The tender drawings if enclosed with the tender documents are only for the purpose of guidance to the contractor. The exact level, location etc. is to be governed by the Architecture/ interior layouts. The data/ information provided in the tender drawings and documents are as exact as it could be secured, but its complete accuracy cannot be guaranteed. The drawings indicate the general arrangement and broadly suggest the extent of work and route etc. Any change required to Co-ordinate this installation with other trades will have to be made without any extra cost to the NCCFs. The contractor will have to assume and include everything from supply of material to its execution, testing & commissioning to make the job safe & complete in all respects as per rules & regulations, building codes & govt. approving agencies.

GOOD FOR CONSTRUCTION DRAWINGS (GFC's):

The details and data provided in "GFC" drawings is as exact and correct as it could be possible but its complete accuracy and correctness is not guaranteed. Every effort is made to make the drawings as per site conditions and the requirement of building codes but the electrical contractor has to check the accuracy and adequacy of "GFC" drawings before start of work. The contractor must study site conditions, understand NCCF's requirement and also cross-check that the GFC drawings issued meet electrical codes, electrical safety and all govt. requirements or not. Contractor must also check the electrical earthing & lightning arrester scheme for correctness and safety. Contractor must also check electrical SLD and calculate and cross-check load balancing on the Main LT Panel's different sections, switch gear rating

and all the cable sizes. The electrical equipment layout plans must be checked for electrical safety and spacings as per electrical codes & requirement.

Any short coming noted in the design & GFC drawings and any variance from National Building codes, National Electrical code, Rules & Regulations of State Chief Electrical Inspectorate & Electrical supply company must be brought to the notice of the Architect/ Consultants/ Project Manager/ NCCF in writing before the start of the work. The very purpose of preparation of shop drawings by contractor is to eliminate any error/ shortcoming in the design and the GFC's drawings prepared by the consultant.

SHOP DRAWINGS & FINAL WORKING DRAWINGS:

The Contractor after studying the NCCF's requirement, site situation & constraints, specifications, scope of work, tender drawings and good for construction drawings (if available or otherwise) shall prepare and submit to Architects/ Project Manager/ NCCF for comments/ approval on all the shop drawings & final working drawings required for completion of full job as per National Building Code, National Electrical Code, IEEE, requirement of Local Chief Electrical Inspectorate and the local electrical supply company including NCCF's requirement. The contractor shall finally be responsible and accountable to NCCF for correctness, accuracy, adequacy and safety of the complete electrical installation. The process of completing "The shop drawings & Final Drawings" shall be completed quickly within the time frame of the project without causing any delay and before starting the actual execution work. No claims for extension of time shall be acceptable due to contractor's failure to produce right shop drawings at the right time in accordance with the approved programme of deliverables. All shop drawings to be prepared on the latest Architectural / Structural / Interior layouts, which are to be collected by the electrical contractor from the office of the Architect/Project Manager / NCCF.

Following Shop Drawings & Final Working Drawings necessarily need to be prepared and submitted by the contractor:

a) LIGHTING & POWER CONDUITING LAYOUTS & DB CHARTS:

Lighting & Power Conduiting layout showing route with details on number, run & size of conduits, number of wires/ circuits to be carried thru conduits, location of junction boxes & pull boxes, circuit numbers, phase & load balancing of circuits, wire/ circuit/ point wire size sub main size. Complete DB Chart is to be submitted for each area/ Zone.

b) LV CONDUITING LAYOUTS:

Conduiting layout of LV systems such as voice/ data/ intercom, MATV, CCTV Fire detection & alarm, Paging, public address, music and access control etc. showing route, layout, size of conduits, number of wires to be carried thru conduits, location of junction boxes & pull boxes etc. to be submitted.

c) PANEL/ DISTRIBUTION BOARDS SHOP DRAWINGS:

Shop drawings/ GA drawings of all the panels/ distribution boards/ switch boards/ cabinets with SLD's and complete control wiring, power wiring and inter locking schemes and logics to be submitted.

d) HT & LT EQUIPMENT LAYOUT:

Layout plans with dimensions, clearances for Panel rooms, Substation & DG set area, Electrical rooms and LT Panel room areas.

e) BUS DUCTING LAYOUT:

Layouts of Bus ducting, its route with details of bends, fittings, supports and its co-ordination with other services.

f) RISING MAINS LAYOUT:

Layouts of Rising Mains, route with details of bends, fittings, supports and its co-ordination with other services.

g) CABLE TRAY/ TRENCH LAYOUT

Cable tray/ trench layouts with sizes of cable trays/ trenches, details on number/ run of various cables to be Laid on trays/ in trenches. Calculations showing cable tray sizing/ spacing need to be submitted with the cable tray/ trench layouts including cable tray supporting details. Complete cable schedule is also to be submitted.

h) EARTHING LAYOUT

Earthing Layout of the complete installation showing all the earth details like size of earth tapes/ wires & materials for each equipment & routing of earth tapes/wires. Also layout of earth pits is to be submitted.

i) LIGHTNING ARRESTOR LAYOUT

Lightning Arrestor Layout showing network of horizontal & vertical conductors, down takes, test boxes & earth pits location/ layout and sizing of earth tapes etc.

j) CONTROL SCHEMES AND INTER LOCKAING

Control Schemes and Inter Lockings for linkages with other systems such as BMS, HVAC & Fire Alarm / Paging Systems.

Drawings shall not be limited to the above only. All necessary drawings/ details required for satisfactorily execution of the job need to be included.

Electrical Contractor shall also be Co-ordinating its drawings with other MEP Services & Site Plans before submitting to NCCFs/PMC.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

PRODUCT SAMPLES

Samples of the materials like conduits, accessories, switches, Sockets, wires & cables, light fixtures etc. shall be submitted to the NCCFs/ PMC prior to procurement. These will be submitted in two sets for approval and retention by NCCFs and shall be kept in their site office for reference and verification till the completion of the project.

MANUFACTURER'S CATALOGUES & DRAWINGS

Manufacturer's drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material to allow Architect/Consultant ample time for scrutiny.

TEST CERTIFICATES & TECHNICAL SUBMITTALS

Contractor shall submit to NCCFs/Project manager, test certificates & technical data sheets of all the items covered in the scope of work before supply of the item.

MANUFACTURERS INSTRUCTIONS:

Where manufacturers have furnished specific instructions, relating to the materials used in this job and covering points not specifically mentioned in specifications & scope of work, manufacturer's instructions shall be followed.

MATERIALS AND EQUIPMENT:

All materials and equipment shall be of the approved make and design. Unless otherwise called for only the best quality materials and equipment shall be used. The materials and equipment shall conform to relevant Indian standards. The contractor shall be responsible for the safe custody of all materials and shall insure them against theft, damage by fire, earthquake etc. A list of items of materials and equipment, together with a sample of each shall be submitted to the NCCF/Architect within 15 days of the award of the contract. Any item which is proposed as a substitute, shall be accompanied by all technical data giving sizes, particulars of materials and the manufacturer's name. At the time of the submission of proposed substitute the contractor shall state substitution be approved, all changes and substitutions shall be requested in writing and approvals obtained in writing from the Architect / NCCF.

TOOLS AND TACKLES

The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, all transport for labour and materials and plant necessary for the proper execution and completion of the work to the satisfaction of the NCCF/Architect.

SAFETY OF MATERIALS:

The contractor shall provide proper and adequate storage facilities to protect all the materials and equipment, including those issued by the NCCF against damage from any cause whatsoever.

CO-ORDINATION

Contractor shall fully Co-ordinate & render all necessary support and assistance to other contractors for completion of all MEP & Civil/Interior works to satisfaction & safety. This work will involve close Co-ordination with HVAC, BMS, Plumbing & Fire Fighting contractor including Civil contractor. Electrical contractor to ensure necessary safety linkages with AHU fire dampers & fire detection systems. Electrical contractor shall be fully responsible & accountable for these life safety linkages. Nothing extra can be claimed for this co-ordination support.

COMPLETION & AS BUILT DRAWINGS & DOCUMENTS:

On the completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the NCCF/Architect five sets of “**AS BUILT DRAWINGS & DOCUMENTS**” drawn at approved scale.

- Contractor to submit a complete write-up of the electrical and LV system installed along with interlocking and safety schemes.
- All the shop drawings & final working drawings need to be converted into “AS BUILT” drawings based on actual executed conditions.
- Technical documents will also have the test certificates, test reports & **IR results** for all the electrical equipment/ material used in the installation, which will need to be submitted in proper folders. All the final DB charts shall also be included in the completion documents.
- Technical catalogues, operation & maintenance manuals of the all the products & equipment used in installation also to be submitted in proper folders. List of recommended spares is also to be furnished along with schedule of preventive maintenance is to be submitted as part of completion documents.
- All the “AS BUILT” drawings, test reports, test certificates & DB Charts must be signed and stamped by the contractors Engineer-in -Charge and the supervisor, who was responsible for the execution, testing & commissioning of the installation.
- Contractor shall be responsible for the correctness of the “**AS BUILT DRAWINGS & DOCUMENTS**” and shall sign & stamp them.

GUARANTEE:

At the close of the work and before issue of final certificate of virtual completion, the contractor shall furnish written guarantee indemnifying the NCCFs against defective materials and workmanship for a period of one year after testing & commissioning of the installation. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to NCCF the following:

- a. Any defective work or material supplied by the Contractor.
- b. Any material or equipment damaged or destroyed as a result of defective workmanship by the contractor.

PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications and other documents forming part of the contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the electrical system as installed shall perform to complete satisfaction of NCCF's.

The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

CONTACTOR'S NCCF/ARCHITECT& OTHER STAFF:

- The contractor shall employ competent, fully qualified, trained & experienced full time electrical engineer to direct the work of electrical installation in accordance with drawings and specifications. The engineer shall be available at all times on the site to receive instructions from the NCCF / Architect in the day-to-day activities throughout the duration of the contract. The Engineer shall correlate the progress of the work in conjunction with all relevant requirements of the supply authorities.
- The Contractor shall employ only qualified, trained, experienced and licensed Project Engineer, Supervisor, foremen, wiremen and electricians.
- At the start of project, contractor shall furnish a list of employees i.e. Project Engineer, Supervisor, Foremen, Wiremen, and Electricians to be posted on the site, clearly specifying their qualification, experience and along with copies of qualification and trade certificates and licenses to establish / prove the furnished data.
- These details / certificates / copies of licenses of employees to be posted at site must be submitted to Architect/ NCCF.

TESTS & TEST REPORTS

On completion of complete installation, contractor shall submit to NCCF/Architect a signed copy of test report of complete installation and assume full responsibility of its soundness and safety.

Contractor shall physically inspect every material before installation and shall also carryout all necessary electrical tests such as:

- a. IR values of Panels, DB's, Boards, cabling, sub mains, circuit and point wiring.
- b. Checking and recording earth continuity, earth values of earthing pits and earthing conductor and entire earthing system and lightning arrestor system. Contractor shall be responsible for the adequacy of the earthing and lightning arrestor system and shall consider the changes in the BOQ as may be required but with the approval of the NCCFs / PMC / site in-charge before execution.
- c. Testing of all the relays and testing of transformers, HT switchgear and DG set alternator.
- d. Checking all the terminations at panels, DB's and at lighting fixtures and socket outlets for tightness.
- e. It is to be ensured by the contractor and its staff that all wire connections / cable connections / lighting and socket connections are with proper sized lugs / thimbles.
- f. Contractor and its staff must follow good engineering practices.
- g. A complete log of all the tests shall be maintained for review of NCCF / Architect.
- h. Contractor shall assume full responsibility of correctness and validation of all the tests.
- i. Any equipments / wire / cabling found faulty during testing carried out by contractor will be removed / replaced by healthy system / equipment by the contractor at its own cost.
- q. Contractor shall assume full responsibility of safety of installation and shall be liable to NCCFs for any loss / damage due to faulty equipment selection/ undersized equipment/ wrong design/ faulty installation / poor work-man-ship / poor quality.
- k. It is contractor's responsibility to cross-check all the design and drawings before execution and assumes full responsibility for the correctness and adequacy of all the designs and drawings and shall be responsible and accountable to NCCF for any deficiency and shortcomings in the system design/ product design.

COMPLETION CERTIFICATE:

On completion of the electrical installation a certificates shall be furnished by the contractor countersigned by Contractor's licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electrical inspectorate / National Building Code. The contractor shall be responsible for getting the electrical installation inspected and approved by the local authorities concerned.

LIST OF INDIAN STANDARDS (BIS)

IS: 374 - 1979	Ceiling fans and regulators (3rd revision)
IS: 694 - 1990	PVC insulated Electric cable for working voltage upto and including 1100 volts.
IS: 732 - 1989	Code of practice for electrical wiring and installation
IS: 1255 - 1983	Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)
IS: 1258 - 1987	Bayonet lamp holders (Third revision)
IS: 1293 - 1988	Three pin plugs and sockets outlets rated voltage upto and including 250 volts and rated current upto and including 160 amps.
IS: 1554 - 1988 (Part - I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS: 1646 - 1982	Electrical installation fire safety of buildings (general) Code of practice.
IS: 1885 - 1971	Glossary of items for electrical cables and conductors.
IS: 1913 - 1978	General and safety requirements for fluorescent lamps luminaries Tubular.
IS: 2026 - 1977 to 81 (Part I to IV)	Power Transformers
IS: 2071 - 1974 - 76	Methods of high voltage testing
IS: 2309 - 1989	Protection of building and allied structures against lightning
IS: 2551-1982	Danger notice plate.
IS: 3043 - 1987	Code of practice for earthing.
IS: 3480 - 1966	Flexible steel conduits for electrical wiring.
IS: 3837 - 1976	Accessories for rigid steel conduit for electrical wiring.
IS: 4146 - 1983	Application guide for voltage transformers
IS: 4615 - 1968	Switch socket outlets.

IS: 5133 - 1969 (Part -I)	Boxes for the enclosure of electrical accessories.
IS: 5216 - 1982 (Part-I)	Guide for safety procedures and practices in electrical work.
IS: 5424 - 1969	Rubber mats for electrical purposes.
IS: 5578 & 11353-1985	Marking and arrangement of bus bars
IS: 7098 - 1985 (Part - II)	Cross linked polyethylene insulated PVC sheathed cables. For working voltages from 3.3 KV upto and including 33 KV
IS: 8130 - 1984	Conductors for insulated electric cables and flexible cords
IS: 8623 -1977 (Part -I)	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200 V D C.
IS: 8623 - 1980 (Part -II)	Bus Bar trunking system
IS: 8828 - 1996	Miniature Circuit Breakers
IS: 9537 - 1981	Rigid Steel Conduits for electrical wiring (Second Revisions)
IS: 10810 - 1988	Methods of test for cables.
IS: 12640 - 1988	Earth Leakage Circuit Breakers
IS: 13947-1993 (Part-II)	Air Circuit Breakers
IS: 13947-1989	Moulded Case Circuit Breakers
IS: 13947 - 1993	Degree of protection provided by enclosures for LV switchgear and control gear.
IS: 13947 - 1993	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.
IS: 1651 & 1652-1991	Stationary cells and batteries lead acid type.
IS: 13779	Digital measuring instrument and testing accessories.
IS: 7098 (Part 1)	XLPE Insulated HR PVC Sheathed Aluminum Conductor Armoured./ Un-Armoured Cable.
IS: 3854 - 1997	Switch Modules
IS: 1293 - 1998	Socket Modules
Note: - 1.	Follow relevant (amended upto date) Indian Standards in case the listed above are found not to be latest/upto date.

2. **If codes of any/some of items are not written above, it is essential that relevant BIS Codes for these items are to be referred to.**

SECTION – D FIRE FIGHTING

1.1 Work under this sub-head consists of furnishing all Labour, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the Scope of work.

- 1.2 (A)** Without restricting the generality of the foregoing work of Fire Fighting System shall include the followings, but is not limited:
- a) Hydrant system consisting of internal hydrant risers, external hydrant ring, hydrant stations with all accessories such as hydrant hoses, first aid hose reel, branch pipe etc.
 - b) Pumping system consisting of hydrant pump, sprinkler pump, engine operated standby pump, jockey pump and equipments such as valves, strainers, piping, instrumentation and motor starting system.
 - c) Fire Fighting system for the Entire campus.
 - d) Providing M.S. black steel pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Protection for Underground pipes, Painting of pipe and Making Connection to supply system.
 - e) Black Steel Pipe, Mains, Laterals, Branches, Valves, Hangers and Appurtenances.
 - f) Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets, Sprinkler heads and Landing Valves.
 - g) Gas based fire extinguishing system for transformers, HT and LT areas located in the substation.
 - h) Supply of Portable Fire Extinguishers
 - i) Fire Fighting Pumps, diesel operated pumps, panels and all connected accessories including suction & delivery pipes.
- (B)** The Schedule of work includes the total works of Fire Fighting system for the project.

The system will be ultimately commissioned in totality and therefore all party concerned shall be responsible for successful commissioning, testing of respective package and assisting in getting approval from all concerned authorities.

2. GENERAL REQUIREMENTS

- 2.1 All materials shall be of the best quality conforming to the C.P.W.D 2006 General Specifications for Electrical works part V& applicable norm laid down in latest NBC & all relevant code of BIS and subject to the approval of the NCCF/Architect.
- 2.2 Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.
- 2.3 Pipes shall be fixed in such a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in Shaft, Passage etc.
- 2.4 Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.
- 2.5 Valves and other appurtenance shall be suitably located so that they are easily accessible for operation, repairs and maintenance.

3 PIPES

- 3.1 All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:

3.1.1 Pipe 150mm dia and below IS: 1239 heavy class.

The pipes shall be manufactured by electric resistant welded (ERW)/ High Frequency induction welding or hot finished welded process. The sulphur and phosphorus requirements in steel shall not be more than 0.05 percent each. The tubes shall be manufactured from hot rolled steel skelps/ strips conforming to IS: 10748.

The following manufacturing tolerances shall be permitted on the tubes and sockets:

Thickness: shall not be less than 10 percent

Weight: shall not vary by more than 10 percent either way.

The pipes shall satisfy the following table with regards to diameter, thickness and weight of tube.

Screwed tubes shall be supplied with threads as per IS: 554. Each tube shall be tested for hydrostatic test for leak-tightness as an in-process test at the

Manufacturer's works. The finished pipe shall be tested for tensile strength, elongation, bend test and flattening test.

3.1.2 Pipe 200 mm dia and above IS 3589 of thickness specified.

The pipes shall be manufactured by electric resistant welding (ERW)/ High Frequency induction welding or hot finished welded process. The sulphur and phosphorus requirements in steel shall not be more than 0.05 percent each. The tubes shall be manufactured from hot

rolled steel skelps/ strips conforming to IS: 10748.

The pipes shall conform to the tensile test, hydraulic pressure test and mechanical tests as per IS: 3589. The pipe shall also conform to the requirements of as per IS: 3589. The tolerance shall as per IS: 3589. All pipes shall be of minimum 6 mm wall thickness. Pipes shall be supplied with bevel edging.

4 PIPE FITTINGS

- 4.1 Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are need to complete the piping work in its totality.
- 4.2 Fabricated fittings shall not be permitted for MS pipe diameters 50 mm and below only screwed jointing shall be adopted, while for pipes above 50 mm dia welded or flanged connection shall be used. Only electro galvanized nuts/ bolts shall be used.
- 4.3 When used, they shall be fabricated, welded and inspected in workshops under supervision of Project Managers whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.
- 4.4 M.S Pipe upto 150 mm dia shall have all fittings as per IS: 1239, part II, (heavy grade) while pipes above 150 mm dia shall be as per IS: 3589 inclusive of IS marking.

5 PIPE JOINTING

- 5.1 **Screwed**
Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed M.S. forged fittings)
- 5.2 **Welded**
Joints between M.S. pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to x- ray test from an approved agency as per the TAC norms at the cost of contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase of required current and capacity.
- 5.3 All welding shall be carried out by a certified welder only. The contractor must produce the welder's certificate.
- 5.4 All pipe edges shall be bevel finished to a clean edge by a electric grinder. A requisite gap determined by the thickness of the weld electrode shall be given between the joints before start of welding.

Weld electrodes shall be of approved make of grade and type as suitable for the job. This shall be satisfied by the Project Manager before start of work.

- 5.5 Joints shall be given a first weld in the full width on the full dia of the pipe. Welding shall be carried out vertically from the surface.

After application of first coat the weld shall be cleaned by electric grinder and then another layer of welding shall take place. The weld shall also be cleaned by grinding. Similarly, a third weld shall also be applied.

- 5.6 All pipe cutting shall be by oxy-acetylene gas flam cutter only. The cut surface shall be cleaned by electric grinder before further welding.

5.7 Flanges.

Flanged joints shall be provided on:

- a) Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- b) Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- c) For jointing all types of flanged valves, vessels appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- d) Flanges shall be as per I.S.6392-1971, Table 17/18 with appropriate number of G.I., Washers, Nuts and Bolts, half threaded of GKW make or equivalent with 3 mm insertion neoprene gasket complete.
- e) For connection of C.I pipes, fittings shall also be of C.I heavy grade conforming to IS: 1538. The flanges shall be smooth faced and neoprene gasket shall be provided. Where unavoidable and to connect underground pipe with riser M.S. pipe may be used in the form of distant pieces. The joint between C.I and M.S pipe shall be flanged type. M.S pipe shall be flanged type. M.S. pipe laid at such location shall be provided anti -corrosive treatment as per Para 7.12.
- f) Mild steel flanges shall be in accordance with table -17 of IS: 6392 i.e. "Plate Flanges for Welding" and flange thickness shall be as under. Gasket thickness shall not be less than 3 mm.

Pipe dia.	Flange Thickness
200mm.	24 mm.
150 mm and 125 mm.	22 mm.
100 mm and 80 mm.	20 mm.
65 mm.	18 mm.
40 mm .	16 mm.

All hardware items such as Nuts, Bolts, and Washers shall be of appropriate size. Washers shall be used on both sides of the bolt.

5.8 Unions

Provide approved type of dismountable unions on pipes lines 65 mm and below in similar

places as specified for flanges.

6.0 PIPE PROTECTION

- 6.1 All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer after dumping the pipes at site immediately and shall be painted with one coat of red oxide primer after erection of pipes and proper hydraulic testing and two or more coats of Synthetic Enamel Paint of approved shade.
- 6.2 All black steel pipes under floors or below ground shall be provided with protection against corrosion after proper hydrantic testing by application of 100mm wide and 4mm thick layer of PYPKOTE/MAKPOLYKOTE over the pipe, with overlap of 25mm minimum as per manufacturers specifications.

7. PIPE SUPPORTS

- 7.1 All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.
- 7.2(i) Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners. Load bearing capacity of Anchor Fastener will be checked at site and then approved for implementation.
- (ii) Hangers/ supports for all the piping shall be approved by the Project Manger before installation. Anchoring fasteners shall be rated to take minimum 0.4 ton load and shall be as per approved make. Hangers shall be at 3.0m intervals. Additional supports shall be provided at bends etc. Angles for pipe supports shall not be less than 50x50x6mm size. Cutting shall be by gas cutter. All cut edges and weld surfaces shall be ground to a smooth finish.
- (iii) Split pipe support clamps with rubber lining for vertical, horizontal and roof handing.
- (iv) Clevis Hangers for horizontal supports to adjust varying heights.
- (v) Sprinkler Hangers for horizontal supports for pipes from 15 mm dia. to 150 mm dia.
- Fasteners and fully threaded rods shall be used for installing the pipe supports. The sizes of pipe supports and installation shall be in accordance with manufacturer's recommendations. Some of the typical supports are shown in the figure-9 in General speciation 2006 of CPWD for electrical work, part V (Wet Riser & sprinkler system).
- (vi) For pipes of size 100 mm and above ,with the prior approval of Engineer -in -charge 'U' clamp with dash fastener may be used for supporting horizontal pipe from ceiling.

- 7.3 The supports/ angle pieces shall be cut by oxy-acetylene gas and cleaned by electric grinder. All cutting for bolt inserts shall be by electric drill.

8. TESTING

- 8.1 All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure including water hammer effects and test pressure upto 15kg/ cm² without drop in the pressure for at least an hours.
- 8.2 Rectify all leakages, make adjustment and retest as required.

9. ANCHOR BLOCK

Contractor shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

10. VALVES

- 10.1.1 Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves upto 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 Kg./cm² class-II as per I.S: 778-1971. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.
- 10.1.2 Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type. An arrow mark in the direction of flow shall be earmarked on the body of the valve.
- 10.1.3 Valves bellow 50mm size shall have screwed ends while those of 50mm and higher sizes shall have flanged connections.
- 10.1.4 The landing valve shall be fitted to a T connection of the riser at the landing in such a way that the valve is in the centre of the internal hydrant opening and at a height of 1 m. from floor level.
- 10.1.5 The valve base shall be vertical and the valve facing outside. There should be no hindrance in operation of the handle.

11. EXTERNAL YARD HYDRANTS

- 11.1 The Contractor shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications as specified in Scope of work and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

- 11.2 Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S or fiber glass, as specified in Scope of work of size 75 x 60 x 25 cms, as approved by the Architect to equip 2 nos. of 63 mm dia non percolating reinforced rubber line (RRL) hose and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the NCCF/Architect. The fire hose cabinet shall have with glass fronted double door with lock and keys and break glass recess for keys all complete. The glass shall be of minimum 8mm thickness.

The FHC shall be red painted. The words “yard hydrant”, “hydrant” etc. shall be painted in white (or red on the glass) in 75mm high letters. The hose box shall be lockable with socket spanner. Top surfaces shall be slopped for water discharge. Vents shall also be located on sides of the Hose Box.

A brick pedestal with brick wall complex with plaster shall also be constructed for supporting the hose box. All surfaces shall be plastered with 1:4 ratio (1 cement: 4 fine sand) mortar.

Yard hydrant valve shall comprise “single headed single outlet gun metal landing valve” conforming to type ‘A’ of IS:5290-1977. The valve shall be complete with hand wheel, quick coupling connection spring and gun metal blank cap as per IS: 5290. The hydrant shall be fixed on hydrant riser through a 80mm dia tool piece pipe at approx. 1.2 mtr from finished floor level. The hydrant shall be IS marked. The hydrant shall be tested to 25 kg/cm² test pressure. All threaded joint shall be sealed with “holytide”. The lug shall be wing type. Sample shall be approved by NCCF/Architect.

12. INTERNAL HYDRANTS

- 12.1 The Internal Hydrant outlet shall comprise “Single Headed Single Outlet Gunmetal Landing Valve” conforming to type ‘A’ of IS: 5290-1977. Separate valve on the head shall form part of the landing valve construction.
- 12.2 A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.
- 12.3 The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

13. FIRST-AID HOSE REEL EQUIPMENT

- 13.1 First aid hose reel equipment shall comprise reel, drum which can swing upto 170 degs with hose guide fixing wall bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS: 884 - 1969. The hose tubing shall confirm to IS: 444-1980. The drum shall be fabricated from GI sheet of minimum 18 gauge thickness. Normally MS construction is used. Other material may be used in areas having corrosive atmosphere.
- 13.2 The hose tubing shall be of 20 mm dia and 36.5m long. The G.M nozzle 5mm and globe valve shall be of 20 mm size to shut off the water supply to the Hose Reel.
- 13.3 The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 -

1969. The first-aid hose reel shall be connected directly to the M.S. pipe riser through a 25mm dia pipe...

13.4 A MS bracket shall be fixed on the wall to which the first aid hose reel shall be bolted. The bracket shall be of 40x40x5mm thick MS angle to form a square of 400x400 approx. This shall be fixed on the wall. After approval of sample by Project Manager further units shall be fabricated in factory and all joints shall be finished with grinder and shall be spray painted after single coat of primer.

13.5 The water flow rate shall be not less than 24 lpm and the range of jet shall be not less than 6m.

14. HOSE PIPES, BRANCH PIPES AND NOZZLES

14.1 Hose pipes

14.1.1 Two numbers Hose Pipes shall be rubber lined woven jacketed (RRL) and 63mm in dia. 15m long. They shall conform to type A (Reinforced rubber lined) of IS: 636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

14.1.2 Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

14.1.3 The length of hose tube shall be such that the nozzle of the hose can be taken into every room and within a range of 6m from any part of the room.

14.1.4 There shall be no obstruction in swinging the hose reel and should be installed above landing valve where provided.

14.1.5 The inlet valve shall be at 900 mm above floor level.

14.1.6 Hose reel bracket should be firmly grouted on the wall with the help of rawl Bolts.

15. BRANCH PIPE

15.1 Branch pipes

Standard short sized Branch pipe shall be of Copper, Gunmetal or Aluminum alloy 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle. The branch pipe shall be tested to 20kg/ cm² pressure.

15.2 Nozzle

The nozzle shall be of Copper or Gunmetal, 20 mm internal diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

15.3 End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

- 15.4 Two RRL hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

16. HOSE CABINET (INTERNAL)

- 16.1 The internal hose cabinet shall accommodate the Hose Pipes, Branch Pipe, Nozzle and Hydrant Outlets and shall be fabricated from 16 gauge M.S sheet as specified in scope of work. The overall size shall be 2100x1000x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with. Sample of the fire door shall be approved by NCCF/Architect.
- 16.2 The hose cabinet shall be painted red and stove enameled.

17. FIRE BRIGADE INLET CONNECTIONS

- 17.1 Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified and as described in the scope of work, for the following purposes:
- i) Fire Brigade suction draw out connection for fire static tank with provision of foot valve.
 - ii) Fire brigade inlet connection to fire static tank.
 - iii) Fire brigade inlet connection to the wet riser system. Each connection shall be in accordance with similar dia of Sluice valve and Non return valve.
- 17.2 The locations of the Fire brigade connection shall be suitably decided with the approval of Consultant/ NCCF/Architect and with a view that these are easily accessible to the fire brigade, without any possible hindrance.

18. VALVE CHAMBERS

- 18.1 Contractor shall provide suitable Brick Masonry Chamber in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.
- 18.2 **Valve chambers shall be of following size:**
- For depths 100 cm and beyond 90x90x100 cm

19. PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per scope of work and shall conform to IS: 2190-1979.

20. SPRINKLER HEADS

- 20.1 Sprinkler heads shall be provided at approximate spacing to cover 12 m² per Sprinkler head. The spacing shall however, be in conformity with the drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling.
- 20.2 Sprinkler heads shall be Chrome finished Brass/Gunmetal with quartz bulb with a temperature rating of 68°C. Sprinkler heads shall be of type and quality approved by the local fire brigade authority. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special application side wall Sprinkler types as shown in drawings. All Sprinklers should have the Specifications, as far as maximum possible as per NFPA requirements and shall be UL/FM approved.
- 20.3 Contractor shall supply spare Sprinkler Heads of each type as per requirement and one Spanner neatly installed in a steel box with glass shutters as specified in scope of work and installed at locations approved by the NCCF/Architect.
- 20.4 The nominal bore shall be 15 mm dia and colour of liquid shall be red. The below false ceiling shall also be provided with a double plate captive rosette assembly to seal the junction between the pipe and the false ceiling. The sprinkler head shall be of approved make.
- 20.5 Components of sprinkler system: - Following types of valves are used in the installations.
- (a) Stop valve.
 - (b) Test valve.
 - (c) Drain valve.
 - (d) Flushing valve.
 - (e) Check valve.
 - (f) Installation valve and Alarm valve.
 - (g) Pre action valve.
 - (h) Subsidiary valves.
 - (i) Alarm Device.
 - (j) Pressure Gauges.

The location of above valves shall be as under.

21. (A) ALARM VALVE & AUTOMATIC WATER MOTOR GONG VALVE

The alarm valve & water motor gong valve is to be provided on all the Sprinkler main delivery pipes or Installation Control Valves.

- 21.1.1 Main Stop valve: - Only one main stop valve shall be provided immediately after main alarm valve at a location which is readily accessible.

- 21.1.2 Test valve:-For testing hydraulic alarm or electric alarm by drawing water from downstream side, test valve shall be connected with downstream of the water flow alarm.
- 21.1.3 Drain valve: - For drainage of system, drain valve 50mm. dia shall be provided down steam of installation valve /stop valve or any subsidiary stop valve. A common valve can perform the function of test and drain. The outlet shall be connected with a 50mm dia G.I drain pipe along with rise pipes as shown in figure no 3 and 4 in general specifications for electrical work of CPWD 2006 for electrical work, part-V(Wet Riser & sprinkler system).
- 21.1.4 Flushing valve: - If the water used for sprinkler is not portable, flushing valve shall be provided at the end of the distribution pipe. The valve size shall be same as distribution pipe. Valve outlet shall be fitted with a brass plug and extended to not more than 3 m. above floor.
- 21.1.5 Check valve: - check valve shall be provided where more than one water supply is available and shall be fitted on each water supply pipe.
- 21.1.6 Subsidiary stop Valve: - Subsidiary stop valve which shall be of the same dia as the pipe line in which they are fitted shall be provided to control water supply to sprinklers of highly sensitive areas like computer room.
- 21.1.7 Installation and Alarm valve: - Sprinkler installation shall be fitted with suitable main installation valve to control water supply to the installation. The valve set shall comprise of following:
- (a) a main stop valve .
 - (b) an alarm valve .
 - (c) a water monitor alarm gong .

The main stop valve shall be placed in the vicinity of the main entrance of the protected area at an easily accessible place. The valve shall be secured upon by a pad lock & protected against damage. A location plate shall be fixed near the valve bearing the following words in raised letters:

SPRINKLER STOP VALVE

Alarm valve shall be fitted on the main supply pipe immediately after the main control valve and before any connection is taken off to supply any part of the installation.

- 21.1.8 Alarm Device: - Water monitor alarm suitable for sprinkler service shall be provided very closed to the installation and alarm valve. This alarm shall be provided on the outside of the external wall. Strainer shall be fitted between the motor nozzle and the alarm valve connection. The water outlet shall be positioned so that any flow of water can be seen. The alarm device shall provide audibility level of 85 dB above the back ground noise level.
- 21.1.9 Pressure Gauges: - pressure gauges shall be provided at each of the following points.
- (a) Immediately down steam of the alarm valve.
 - (b) Immediately up stream of the main stop valve.

Stop cock shall be provided before pressure gauges for removal without interruption of water supply of the installation. Pressure gauges shall be as per IS: 3624.

21. (B) SELECTION OF TEMPERATURE RATING

21.1 Temperature rating of a sprinkler should not be less than 30o C more than the highest anticipated temperature of the location of installation .Under glazed roof or where there are roof sheets of PVC or similar plastic martial, sprinkler shall be rated 79o C to 100o C.

21.2 **SELECTION OF ORIFICE SIZE**

In moderate hazard application, sprinkler of orifice size 15 mm. shall be used.

21.3 **SIZE OF INSTALLATION**

The number of sprinkler in an installation (excluding sprinkler provided in concealed spaces) shall not exceed 1000 nos .As far as possible one area shall be controlled by one installation and alarm valve .If the area is quite larger, more than one installation and alarm valves should be planned. Details of area controlled by installation valves shall be exhibited near the installation valves.

If there is more than one block in a campus, each block shall be provided with different installation and alarm valve.

21.4 **PROTECTION OF SPRINKLER**

Any sprinkler installed in a position of risk or accidental damage shall be fitted with a metal guard suitable for sprinkler service.

22.0 **FIRE FIGHTING PUMPS**

22.1 **Fire. Sprinkler and Jockey Pumps**

22.1.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers.

Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

22.1.2 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.

22.1.3 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.

22.1.4 Pumps shall be provided with approved type of mechanical seals.

22.1.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

22.1.6 The pump shall meet the requirements of the Tariff Advisory Committee (TAC) and unit shall be design proven in fire protection services.

22.1.7 **WATER SUPPLY ARRANGEMENT FOR SPRINKLER**

Pump -Detail of pumps to be installed for sprinkler installation are given in Appendix 'A' in general CPWD speciation for electrical work part -V. For large installation s, separate jockey pump shall be provided for sprinkler system .All pumps shall have common discharge header.

If two electrical pumps are to be provided one non -return valve be provided in the header such that sprinkler pump will not feed other system.

Separate electrical panel with independent power supply from sub-station shall be provided. The system controller shall be suitably modified to include operation of second electrical pump. In Para.

- (a) Sprinkler pumps will start on pressure loss (about 1kg /cm²) in the sprinkler header.
- (b) If sprinkler pumps does not start in pre set time or fails during operation, the main electric fire pump shall start and feed to sprinkler system.
- (c) Diesel pump will start and feed water only in case supply to main electrical pump is not available or within a pre set time the main electrical pump fails to starts or fails during operation. No other pump will be working when diesel pump is in operation. Audio -visual alarm shall be available to indicate failure of both sprinkler and main electric pump.

22.1.8 SPRINKLER ANNUNCIATION PANEL AND ALARM

Electrically operated alarm shall be provided for indication of operation of sprinkler in an area. Water flow switches shall be installed in main distribution pipes which shall be wired to sprinkler annunciation panel .In the event of operation of a sprinkler, the flow switch will operate and give signal to the annunciation panel to indicate operation of sprinkler in the area. This will initiate an electrically operated alarm. The system shall be independent of fire alarm system.

22.2 Motors for Electric Driven Pumps

22.2.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.

22.2.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

22.2.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.

22.2.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.

22.2.5 Motors shall be designed for two start system.

22.2.6 Motors shall be capable of handling the required starting torque of the pumps.

22.2.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

22.3 Air Pressure Vessel for Fire Pumps

22.3.1 Provide an air pressure vessel fabricated from 10mm M.S. sheet with dished ends and suitable supporting legs, air pressure vessel shall be provided with a 100mm dia flanged connection from pump, one 50mm dia drain with valve, one gunmetal water level gauge and

25mm sockets for pressure switches. the vessel shall be 450mm dia x 2000 mm high and tested to 1.5 times of the working pressure or 20 Kg/Cm², whichever is greater.

22.3.2 The fire pumps shall operate on drop pressure in the mains automatically or manually as specified below:-

22.4 Operating Conditions for the Service Pumps

22.4.1

Fire Service Pump	Nos.	Cut in Pressure	Cut Out Pressure	Remarks
Jockey pump	One	9.0 Kg/cm ²	10.0 Kg/cm ²	To auto start and auto stop on pressure switch on air vessel to stop.
Main pump (Hydrant)	One	8.0 Kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
Diesel Fire Pump	One	6.0 Kg/Cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
Sprinkler Pump	One	7.0 Kg/Cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.

(The above ratings will be adjusted finally at the time of commissioning as per site requirement and final setting shall be kept as per approval of NCCF/Architect/Project Consultant).

22.5 Diesel Fire Pump

22.5.1 Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

22.5.2 General

The diesel pump set shall be suitable for automatic and manual operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

22.5.3 Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500/2900 RPM as specified in bill of quantities.

22.5.4 Fire pump

- a) The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2850 lpm as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg. /cm² at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 12 Kg. /cm² in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

- b) The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal.
- c) The pump casing shall be designed to withstand 1.5 times the working pressure.
- d) Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

22.6 **Diesel Engine**

22.6.1 **Environmental conditions** - The engine shall be required to operate under the conditions of environment as specified.

22.6.2 **Engine Rating**- The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycles, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended upto date.

22.6.3 **Engine Accessories** - The engine shall be complete with the following accessories:-

- (i) Flywheel dynamically balanced.
- (ii) Direct coupling for pump and coupling guard.
- (iii) Radiator with hoses, fan, water pump, drive arrangement and guard.
- (iv) Corrosion Resister
- (v) Air cleaner, oil bath type/dry type
- (vi) Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- (vii) Pump for lubricating oil and Lubricant oil filter
- (viii) Elect. starting battery (24/12 v)
- (ix) Exhaust silencer with necessary pipe work
- (x) Governor
- (xi) Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).
- (xii) Necessary safety controls

- (xiii) Winterization arrangement, where specified.
- (xiv) Fuel System: The fuel shall be gravity fed from the engine fuel storage tank to the engine driven fuel pump. The engine fuel storage tank shall be mounted either over or adjacent to the engine itself suitably wall / floor mounted with proper support.

All fuel tubing in the engine shall be with copper and fuel piping from day oil tank to engine shall be MS / Reinforced flexible hose connection. Plastic tubing shall not be permitted.

The fuel tank shall be welded Steel Construction (4mm Thick) and of 200 Ltrs. capacity or of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary supports, level indicator (Protected against mechanical injury) inlet, outlet, overflow connection and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediment into the fuel line to the engine.

Tank shall be provided with epoxy coat from inside and outside with one coat of Red oxide primer and two or more Coats of Synthetic enamel paint of approved shade. A semi rotary hand pump for filling the daily service tank together with hose pipe of 5 m long with a foot valve etc shall also form part of scope of supply.

- 22.6.4 **Starting system**- The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the flywheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The battery capacity shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

- 22.6.5 **Exhaust system**-The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed to be taken out of the building as per statutory requirement. The Contractors are advised to see the drawing and site to assess the length and size of exhaust pipe required and its cost & installation included with price of pump. The total back pressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

- 22.6.6 **Engine shut down mechanism**- This shall be manually operated and shall return automatically to the starting position after use.

- 22.6.7 **Governing System**- The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

- 22.6.8 **Engine Instrumentation**- Engine instrumentation shall include the following:-

- (i) Lubricant oil pressure gauge.
- (ii) Lubricant oil temperature gauge
- (iii) Water pressure gauge
- (iv) Water temperature gauge
- (v) Tachometer
- (vi) Hour meter.

The instrumentation panel shall be suitably mounted on the engine.

22.6.9 **Engine Protection Devices-** The following engine protection and automatic shut down facilities shall be provided:-

- (i) Low Lubricant oil pressure
- (ii) High cooling water temp.
- (iii) High Lubricant oil temperature
- (iv) Over speed shut down.

22.6.10 **Pipe work-** All pipe lines with fittings and accessories required shall be provided for fuel oil, Lubricant oil and exhaust systems, copper piping of adequate sizes shall be used for Lubricant oil and fuel oil. M.S. piping will be permitted for exhaust.

22.6.11 **Anti Vibration Mounting-** Suitable anti-vibration mounting duly approved by NCCF/Architect shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

22.6.12 **Battery Charger-** Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

23.0 CABLES

23.1 Contractor shall provide all power control cables from the motor control centre to various motors, level controllers and other control devices.

23.2 Cables shall conform to IS: 1554 and carry ISI mark.

23.3 Wiring cables shall conform to IS 694.

23.4 All power and wiring cables shall be aluminum conductor PVC insulated armored and PVC sheathed of 1100 volts grade.

23.5 All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

23.6 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

23.7 All cables joints shall be made in approved manner as per standard practice.

23.8 The cable jointing shall be Crimping type.

23.9 The cable shall satisfy the following tests as per relevant IS codes:

- (i) Insulation Resistance test sectional and overall.
- (ii) Continuity Resistance test.
- (iii) Earth continuity test.

All tests shall be carried out in accordance with relevant standard code of practice and Indian electricity rules. The contractor shall provide necessary instruments, equipments and labour for conducting the above tests and shall bear all expenses of conducting such tests.

24.0 CABLE TRAYS

24.1 Contractor shall provide G.I. perforated cable trays at locations as shown on the drawings and of sizes as given in the bill of quantities, with G.I. sheet thickness of 2.0mm.

24.2 Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by welding support rods with insert plates OR Anchor fasteners.

24.3 Cost of clips, bolts, nuts, support rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

24.4 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8 mm dia round headed bolts, nuts and washers.

24.5 Factory fabricated bends, reducers, tee/ cross junctions etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending the largest size of cable to be carried by the cable tray.

25.0 EARTHING

25.1 There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armour clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.

25.2 Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bars shall be made by means of three 10mm brass studs and fixed at 100mm centres. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe

of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.

- 25.3** A brick masonry manhole 30x30x30xcm size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated, in this manhole for testing.
- 25.4** All equipments installed shall be properly earthed to the main earthing station.

26.0 MOTOR CONTROL CENTRES

26.1 MCC shall be cubical type i.e. one motor feeder completely in one cubicle, and shall be fabricated from 14 gauge CRC sheet with dust & vermin proof construction. It shall have Powder Coated finish and shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following: -

- a) Incoming main MCCB of required capacity.
- b) One MPCB for each motor.
- c) Fully automatic as specified D.O.L/ Star delta starters suitable for motor H.P. with push buttons one for each motor and ON/OFF indicating LED type lamps.
- d) Single phasing preventor of appropriate rating for each motor.
- e) Rotary duty selector switch.
- f) Panel type ampere meters one for each motor.
- g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.
- h) LED type-indicating lamps for in incoming main and ON/OFF indicating lamps for each motor.
- i) Rotary switch for manual or auto operation for each pump (manual/auto/off).
- j) Fully taped separate aluminium bus bars of required capacity.
- k) Space for liquid level controllers as specified.
- l) The panel shall be prewired with colour-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
- m) Power wiring and Control wiring in MCC to be of Copper only and minimum size 4 & 1.5 Sqr.mm respectively.
- n) Provided with a degree of protection of IP-52 and of uniform height of not more than 2450mm

26.2 All switchgears and accessories shall be of approved make such as “Siemens, English Electric, Larsen & Toubro” or equivalent.

26.3 Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers.

27.0 VIBRATION ELIMINATORS

All suction and delivery lines shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer's details. Flexible connectors shall be as manufactured by Relay Corp., New Delhi / Resistoflex.

28.0 PIPING

28.1 Pipes for suction and delivery shall be galvanised/M.S tube (heavy duty) conforming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in bill of quantities. The flanges shall be G.I. / M.S as per I.S 6392 – 1971 Table 17/18.

28.2 Full way and check valves 50mm dia and below shall be gunmetal tested to 20Kg/Sq.cm pressure certified and conforming to I.S:778.

28.3 Suction strainer or foot valves shall be C.I., conforming to I.S:4038 - 1979, as specified in bill of quantities.

28.4 Joints

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 3mm thick Neoprene gasket complete with nuts, bolts and washers etc.

28.5 Testing

All G.I. pipes shall be tested to hydrostatically for a period of 30 minutes to a pressure of 6 Kg/cm² without drop in pressure.

29. COMMISSIONING

29.1 After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary piping, labor, tools and equipments etc. for carrying out testing and commissioning of the entire fire fighting system complete as per requirement in the presence of Client's representative and during the visit of the Fire Officer whenever and as may be required. Generally, the following test/inspection has to be carried out:-

- (a) For the automatic operation of the Jockey/main fire pump and diesel pump as per the sequences required.
- (b) For checking the pressure available at the farthest and highest point in the fire ring and for the wet riser system.
- (c) For the automatic operation of the Sprinkler System either by a dummy fire below a sprinkler head or by using the Inspection Test Valves. In this case, the annunciation panel indicating the particular zone and mechanical Gong valve should work.

30.0 GUARANTEE

- 30.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.
- 30.2 The form of warranty shall be as approved by the NCCF/Architect.
- 30.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.
- 30.4 The warranty shall expressly include replacement of all defective or under capacity equipment. NCCF/Architect may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.
- 30.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the NCCF/Architect.
- 30.6 The contractor shall include in his rates the operation of all mechanical equipment for a period of six months from the date of commissioning. No separate payment will be made on this account.

A P P E N D I X – III

SCHEDULE OF TECHNICAL DATA

1. FIRE PROTECTION SYSTEM

1.1. FIRE PUMPS & MOTOR

1.1.1 Electrical Driven Main Fire & Sprinkler Pumps

Make / Manufacturer	:
Quantity	:
Liquid Handed	:
Liquid Temp degree C	:
Special Gravity of Liquid	:
Suction	:
Rated Discharge	:

Actual Discharge	:
Model	:
Horizontal / Design	:
Speed / No. of Stages	:
Impeller Dia (Maximum)	:
Suction / Delivery Size	:
Efficiency at Rated Capacity & Head	:
KW required at rated capacity & head	:
Shut Off Head	:
<u>Material of Construction</u>	
Pump Casing	:
Impeller	:
Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
<u>Mechanical Seal</u>	:
Make of Mechanical Seal	:
Whether pumps are capable of discharging 150% of rated capacity at a head not less than 65% of rated head.	:
Whether automatic priming arrangement included	:
<u>Description of Motors</u>	
Make	:
Model No.	:

Type	:
Frame size	:
Speed (RPM)	:
Rated Capacity (Power)	:
Full load current	:
Enclosure	:
Coupling / Pulley	:
Class of Insulation	:
<u>Size of Foundation</u>	:
For complete coupled set mounted over MS base frame	:

1.1.2 Diesel Engine Driven Pump

Make / Manufacturer	:
Quantity	:
Liquid Handed	:
Liquid Temp deg.C	:
Special Gravity of Liquid	:
Suction	:
Rated Discharge	:
Actual Discharge	:
Model	:
Horizontal / Design	:
Speed / No. of Stages	:
Impeller Dia (Maximum)	:
Suction / Delivery Size	:

Efficiency at Rated Capacity & Head	:
KW required at rated capacity & head	:
Shut Off Head	:
<u>Material of Construction</u>	
Pump Casing	:
Impeller	:
Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
Mechanical Seal	:
Make of Mechanical Seal	:
Whether pumps is capable of discharging 150% of rated capacity at a head not less than 65% of rated head.	:
Whether automatic priming arrangement included	:
<u>Description of Engine</u>	
Make	:
Model No.	:
Type	:
Frame size	:
Speed (RPM)	:
Rated Capacity (Power)	:
Full load current	:
Enclosure	:
Coupling / Pulley	:

No of Cylinder	:
Fuel Pump & Water pump detail	:
Engine Cooling & Oil System	:
Diesel Oil tank capacity	:
Fuel Oil storage shall ensure working of pump for number of hours	:
<u>Size of Foundation</u>	
For complete coupled set mounted over MS base frame	:

1.1.3 **Jockey Pump**
(Please submit separate data sheet for each type of pump)

Liquid Handed	:
Liquid Temp deg.C	:
Special Gravity of Liquid	:
Suction	:
Rated Discharge	:
Actual Discharge	:
Model	:
Horizontal / Vertical Design	:
Speed / No. of Stages	:
Impeller Dia (Maximum)	:
Suction / Delivery Size	:
Efficiency at Rated Capacity & Head	:
KW required at rated capacity & head	:
Shut Off Head	:
<u>Material of Construction</u>	
Pump Casing	:
Impeller	:

Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
Mechanical Seal	:
Make of Mechanical Seal	:
<u>Description of Motor</u>	
Make	:
Model No.	:
Type	:
Frame size	:
Speed (RPM)	:
Rated Capacity (Power)	:
Full load current	:
Enclosure	:
Coupling / Pulley	:
<u>Size of Foundation</u>	
For complete coupled set mounted over MS base frame	:

1.2 **PIPING**

15 NB TO 50 NB	:
15 TO 50 NB Fittings	:
65 NB TO 150 NB Pipes	
65 NB TO 150 NB Fittings	
200 NB ONWARDS Pipes	

200 NB ONWARDS Fittings

Flanges

Gaskets

1.3 HYDRANT VALVES

1.3.1 Technical Specifications :

Item :

Working Pressure :

Code for Design :

1.3.2 Construction Features

Type of Stem

Type of Inlet

Type of Outlet

Flange Drilling

1.3.3 Material of Construction

Body and Bonnet :

Stop Valve, Valve Seat :

Check nut & gland nut :

1.4. PRESSURE GAUGE

1.4.1 Technical Specifications :

Working Pressure :

Code for Design :

Scale range :

1.4.2 Construction Features

Case :

Pointer :

Dial Size	:
Dial Lettering	:
Process Connection	:
1.4.3 Material of Construction	
Case	:
Movement	:
Block	:
1.5 PRESSURE SWITCHES	
1.5.1 Technical Specifications :	
Item	:
Working Pressure	:
Scale range	:
1.5.2 Construction Features	
Protection	:
Cable Entry	:
Process Connection	:
Repeatability	:
Switch Type	
No. of contacts	:
Contact Rating	:
1.5.3 Material of Construction	
Enclosure	:
Pressure element	:
Wetted Parts	:

SPECIAL TECHNICAL CONDITIONS

SECTION - I

1. GENERAL INSTRUCTIONS

- 1.1 Fire fighting works specified in the tender have to be executed in accordance with:
 - 1.1.1 The rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation/No objection certificate from the Local Fire Authority.
 - 1.1.2 The specification applicable shall be C.P.W.D 2006 General Specification for work "Part V" (Wet Riser & Sprinkler System).
 - 1.1.2 Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.), shall be followed as applicable.
 - 1.1.3 The codes of the National Fire Protection Association of USA (N.F.P.A.) shall be used as a general guide for good engineering practice, design and workmanship norms. No certificate of compliance to NFPA codes will be required.
- 1.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.
- 1.3 It is the contractor's responsibility to ensure the compliance of design to meet the above requirements.
- 1.4 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on the basis of Architectural and Interior design drawings issued by the NCCF/Architect. Work will be executed only as per approved shop drawings.
- 1.5 Quantities in the tender document are approximate worked out on the tender drawing.
- 1.6 Contractors are invited to highlight any aspects of the contract document that may need revision or reconsideration before the work is started. He must furnish details of any variations in the specifications or the quantities that may be necessary for him to comply with the Code and statutory requirements. These may be identified and approval of the Project managers

taken before the start of the work.

1.7 Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for submission and approval of the Local Fire Authority and for Insurance Companies as may be required by the Client.

1.8 The Scope of work includes:

- a) Internal wet riser system
- b) External hydrant system
- c) Sprinklers in basements and floors
- d) Portable Fire Extinguishers
- e) Fire Fighting Pumps, pipe network and its accessories

1.9 **SAFETY CODES AND LABOUR REGULATION**

(i) In respect of all labour employed directly or indirectly on the work for the performance of the fire fighting contractor's part of works, the contractor at his own expense, will arrange for the safety provision as per the statutory provisions, B.I.S recommendations, factory act, workman's compensations act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty of Rs 200/- for each violation. In addition the Engineer-in-charge shall be at liberty to make arrangements and provide facilities as afore said and recover the cost incurred thereon from the contractor.

(ii) The contractor shall provide necessary barriers, warning signals and other safety measures while laying pipelines, cables etc. or wherever necessary so as to avoid accidents. He shall also indemnify DSIIDC against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there from during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

1.10 **WORKS TO BE ARRANGED BY THE DEPARTMENT**

Unless otherwise specified in the tender document, the following works shall be arranged by the Department.

- (i) Space for accommodating all the equipment and components involved in the work,
- (ii) Masonry ducts within and outside the building for carrying pipe lines and cables wherever specified.

1.11 **MACHINERY FOR ERECTION**

All tools and tackles required for unloading / handling of equipments and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.

1.12 COMPLETENESS OF THE TENDER, SUBMISSION OF PROGRAM APPROVAL OF DRAWING AND COMMENCEMENT OF WORK

(i) Completeness of the tender:-

All sundry equipments, fittings, assemblies, accessories hardware items, foundation bolts, supports, termination lugs for electrical connection, cable glands, junction boxes and all other item which are useful and necessary for proper assembly and efficient working of the various equipments and components of the work shall be deemed to have been included in the tender, irrespective of the fact whether such items are specially mentioned in the tender or not.

(ii) Submission of the Program:-

Within fifteen days from the date of receipt the letter of award, the successful Tenderer shall submit his program for submission of drawings, supply of equipment, installation, testing, commissioning and handing over of the installation to the Engineer-in-charge. This program shall be framed keeping in view the building progress and the Milestones fixed in schedule 'F' clause-5 of General Conditions of contract. Item like piping etc. that directly affect the building progress shall be given priority. Hose pipes, branch pipes, first aid hose reel pipes shall be supplied just before commissioning the system.

1.13 DISPATCH OF MATERIALS TO SITE AND THEIR SAFE CUSTODY

The contractor shall dispatch materials to site in consultation with the Engineer-in-charge. Suitable lockable storage accommodation shall be made available free of charge temporarily, watch and ward however shall be the responsibility of contractor.

Program for dispatch of material shall be framed keeping in view the building progress. Safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the contractor till final taking over by the department.

1.14 CO-ORDINATION WITH OTHER AGENCIES

The contractor shall co-ordinate with all other agencies involved at the site of the work, so that the work of other agencies is not hampered due to delay in his work. Piping, Cabling or any other work, which directly will affect the progress of work of other agencies, shall be given priority.

1.15 QUALITY OF MATERIALS AND WORKMANSHIP

- (i) The components of the installation shall be of such design so as to satisfactorily function under all conditions of operation.
- (ii) The entire work of manufacture / fabrication, assembly and installation shall conform to sound engineering practice.
- (iii) All equipments and materials to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after-sales service.

1.16 CARE OF THE BUILDING

Care shall be taken by the contractor during execution of the work to avoid damage to the building. He shall be responsible for repairing all such damages and resting the same to the original finish at his cost. He shall also remove all unwanted and wasted materials arising out of the installation from the site of work from time to time.

1.17 INSPECTION AND TESTING

1.17.1 Initial inspection and testing

- (i) Initial inspection of materials and equipments and manufacturer's works may be done by the Engineer-in-Charge or his representative. For item /equipment requiring initial inspection at manufacturer's work, the contractor will intimate the date of testing of equipments at the manufacturer's works before dispatch. The contractor shall give sufficient advance notice regarding the dates proposed for such tests to the department's representative(s) to facilitate his presence during testing. The Engineer-in-charge at his discretion may witness such testing. Equipments will be inspected at the manufacturer/authorized dealer's premises, before dispatch to the site by the contractor.
- (ii) The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangement for the same.
- (iii) The material duly inspected by Engineer-in-Charge or his authorized representative shall be dispatched to site by the contractor.
- (iv) No additional payment shall be made to the contractor for initial inspection/testing at the manufacturer's works by the representative of the Engineer-in-charge. However, the department will bear the expenses of its representative deputed for carrying out initial inspection/testing.

1.18 Final inspection and testing

Final inspection and testing will be done by the Engineer-in-Charge or his representative. The installation will be offered for inspection by local bodies (Chief Fire Officer). The contractor or his representative shall attend such inspection of the chief fire officer, extend all test facilities as are considered necessary, rectify and comply with all observations of the chief fire officer which are part of the agreement. In case the contractor fails to attend the inspection and make desired facilities available during inspection, the department reserves the right to provide the same at the risk and cost of the contractor and impose penalty for the same. The installation will be accepted by the department only after receiving clearance from Chief Fire Officer for the work executed by the contractor under the agreement.

1.19 Safety Measures

All equipment shall incorporate suitable safety provision to ensure safety of the operating personal at all the times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment.

1.20 GUARANTEE

- (i) The contractor shall guarantee the complete system to provide the specified flow and pressure under all conditions and outlets.
- (ii) All equipments shall be guaranteed for a period of 12 month from the date of acceptance

and taking over of the installation by the Department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of Engineer -in-Charge in this regard shall be final.

1.21 TENDER DRAWINGS

The drawing appended with the tender document is intended to show the areas allotted for various equipments, tentative pipe routes. The equipment offered shall be suitable for installation in the spaces shown in these drawings. The details of the drawing are given as under.

- (a) Lay out drawing of the equipments to be installed in pump room and terrace.
- (b) Drawing showing the details of erection of entire equipment including their foundations.
- (c) Plumbing drawing showing the layout of entire piping, dia and length of pipes, hydrant, air vessel, valves and isometric drawing showing connection to various equipment.
- (d) Sprinkler drawing indicating layout and size of pipe, Location of valves, sprinklers etc.
- (e) Electrical wiring diagrams for all electrical equipment and controls including the sizes and capacities of the various cables and equipments.
- (f) Dimensioned drawings of all electrical and control panels.
- (g) Drawing showing details of supports for pipes, cable trays etc.
- (h) Any other drawing relevant to the work.

2.1 Water Storage & Pump House

- 2.1.1 A static underground RCC water storage tank as shown in the drawing having gross water storage of required capacity will be provided. The tank will be provided with manholes, inserts, puddle flanges, ladders inside and outside, cat ladder to the tanks by the civil contractor.
- 2.1.2 Overhead water storage tank of required capacity on each Block as a secondary water source for the sprinkler system will be provided on the terrace.
- 2.1.3 Configuration and operating conditions of pumps are given in the Specifications.

2.2 Wet Riser Hydrant System

- 2.2.1 The building will be provided with a wet riser system. Hydrants are fed from a 150 mm dia M.S. pipe endless ring main. The ring main will be provided with three isolation valves to enable

atleast a part of the main to provide water in case a section is under repairs.

- 2.2.2 External fire hydrants will be provided on the ring main. Hydrants shall be located at least 2 m away from the building. Internal wet risers for the building shall be connected to the ring main with an non return valve and a fire brigade inlet connection with isolation butterfly valve for each wet riser connection.
- 2.2.3 Hydrant stations and cabinets shall be provided at all designated locations inside and along with the external hydrants. The hydrant stations shall be located in fire cabinets as per drawings and will contain all items described in the Schedule of work and specifications.

2.3. Sprinkler System

- 2.3.1 The building is also protected with automatic sprinkler system as per requirement with permitted exceptions e.g. electrical switch rooms, power transformers and D.G. rooms, Panel rooms, Electrical rooms as identified.
- 2.3.2 Types of sprinklers to be used shall be as given in specifications, Schedule of work to be got approved by the Engineer -in -charge.

2.4. Pumping System

- 2.4.1 The pumping system shall provide the water supply and pressure to the wet riser fire and sprinkler mains. Diesel Engine will be a common stand by.
- 2.4.2 Provide a full bore test valve on the bypass line with rate of flow meter on the common pump header to discharge in the water tank. Also provide an isolation valve on headers outlet to each circuit to enable pressure setting and testing of pumps.

3. INSPECTION AND TESTING OF MATERIALS

- 3.1 All material before allowing to bring at the store, will be preliminary / visually inspected at the entry gate of the project site.

This inspection will be conducted with the help of the quality approval format as prepared by the clients.

- 3.2 For examination and testing of materials at the working site, the Contractor shall provide all Testing and Gauging Equipment as necessary.
- 3.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the NCCF/Architect.
- 3.4 All Testing Equipment shall be preferably installed in special room meant for the purpose.

4. METRIC CONVERSION

- 4.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

- 4.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

5. REFERENCE POINTS

- 5.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 5.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Fire fighting drawings.

6. REFERENCE DRAWINGS

- 6.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the NCCF/Architect.

7. SHOP DRAWINGS

- 7.1 The Contractor shall submit two copies of Shop Drawings as an advance copy to the NCCF/Architect for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit six copies of shop drawings for execution to the NCCF/Architect.
- 7.2 The Contractor shall submit four copies catalogues, manufacturer's drawings, equipment characteristic data or performance charts as required by the NCCF/Architect.

8. COMPLETION DRAWINGS

- 8.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the NCCF/Architect. These drawings shall have the following information:
- (a) Run of all piping with diameters on all floors and vertical stacks.
 - (b) Ground and invert levels of all fire fighting pipes.
 - (c) Location of Control Valves.
 - (d) Location of all Mechanical equipment with layout and piping connections.

- 8.2 Contractor shall provide four sets of catalogues, manuals, performance data and list of spare parts together with the name and address of the manufacturer for all Electrical and Mechanical equipment provided by him in the form of a book of manuals.
- 8.3 All “Warranty cards” given by the manufacturers shall be handed over to the Project Manager also in the form of a comprehensive record book / documents.

9. CONTRACTORS RATES

- 9.1 Rates quoted in this tender shall be inclusive of cost, unless specified of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract service tax, labourcessand all such expenses as may be necessary and required to completely to do all the items of work and put them in a working condition.
- 9.2 Rates quoted are for all heights, lifts and depths required for this work.
- 9.3 Unless specified, all rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete of appropriate mix and strength as directed by NCCF/Architect. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.
- 9.4 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

10. TESTING

- 10.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.
- 10.2 Tests shall be performed in the presence of the NCCF/Architect.
- 10.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.
- 10.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.
- 10.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

11. SITE CLEARANCE AND CLEANUP

- 11.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

- 11.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.
- 11.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.
- 11.4 All aforesaid expenditure involved in the site clearance and cleanup are included in the contract price.

12. LICENSE AND PERMITS

- 12.1 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to fire fighting system. He shall also be responsible for co-ordination for getting the approval, with other agencies working on the project relating to their scope of work.
- 12.2 Contractor shall obtain, from the local authorities all related sanction and completion certificates with respect to his work as required for occupation of the building.
- 12.3 All inspection fees or submission fees paid by the Contractor shall be reimbursed by the Employer on production of valid official receipts.

13. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

- 13.1 If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to NCCF which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. or the actual cost given by the Employer shall be final and binding on the Contractor.

14. CUTTING & MAKING GOOD

No structural member shall be chased or cut without the written permission of the NCCF/Architect.

15. MATERIALS

- 15.1 All materials used in the works shall conform to the tender specifications.
- 15.2 As far as possible materials bearing I.S. certification marks shall be used with the approval of the NCCF/Architect.
- 15.3 Unless otherwise specified and expressly approved in writing by the NCCF/Architect, materials of makes and specifications mentioned with tender shall be used.

16. MOCK UP

The Contractor shall install all pipes, clamps and accessories and fixing devices in mock-up shaft and room so constructed as directed by NCCF/Architect without any extra cost. The materials used in the mock-up may be reused in the works if found undamaged.

Any tiles or finished surfaces or floors damaged by the Contractor while doing his work shall be made good with new tiles or other finishing material. No payment shall be admissible for such repairs. The NCCF/Architect may, at his discretion get the damaged work repaired by other agencies and debit the cost of such repairs to the Contractor.

SECTION – E ELEVATOR

SUPPLY, INSTALLATION AND COMMISSIONING OF PASSENGER LIFTS (CAPACITY OF 13 PERSONS EACH) LUMP SUM CONTRACT

1.0 The tender drawings exhibited / enclosed are preliminary drawings intended for the guidance of the contractor only. They may be subject to revision and alteration without vitiating any of the terms of the contract and the contractor shall be bound to execute the works as shown in the final drawings without claiming any extra payment.

ALL PARTS AND COMPONENTS USED IN THE LIFT & SUPPORTING SERVICES SHOULD BE OF THE LATEST MAKE/MODEL AND TECHNOLOGY. ALL PARTS AND ITEMS USED IN THE LIFT SHOULD BE MADE AVAILABLE BY THE COMPANY FOR 15 YEARS FROM THE DATE OF INSTALLATION. ANY UP GRADATION REQUIRED FOR NON AVAILABILITY OF SPARE PARTS WILL BE UNDERTAKEN BY THE COMPANY ON THEIR OWN COST DURING 15 YEARS SERVICE LIFE OF LIFT. AN UNDERTAKING TO THIS EFFECT IS TO BE OBTAINED FROM THE COMPANY AND WILL BE SUBMITTED TO THE BOARD.

2.1 ELECTRICITY

Contractor shall make his own arrangement of electricity required for execution of job and for Testing and Commissioning of Lifts. Main supply for normal running of lifts after testing & commissioning shall be NCCF responsibility.

2.6 INSPECTION OF SITE

The Contractors shall before submitting the tender, inspect the site and acquaint himself with all aspects affecting the work to be the carried out including the site conditions, availability of site, availability of labour and materials, Working conditions. No claim whatsoever from the contractor shall be entertained, arising out of the prior knowledge or otherwise in respect of these.

2.7 INSPECTION AND TESTING

NCCF Project Manager and his staff, Architect and his staff or the authorized representative shall have full power to inspect drawings of any portion of the work or examine the material and workmanship of the system at the Contractor's works or at any place from which the materials or equipment is obtained. Acceptance of any material or equipment shall in no way relieve the contractor of his responsibility for meeting the requirements of the specifications. The cost of any special tests and/or analysis not called for in this specification shall be borne by the contractor. The delay if any, due to rejection of material will be attributed to contractor and no extra time shall be granted towards such delay.

2.8 PROGRAMME OF WORK AND PROGRESS REPORTS

The contractor shall submit within Ten days from the date of Issue of Letter of Intent, detailed schedule showing the programme and order in which the contractor propose to carry out the work with dates

and estimated completion times for various parts of the work in the form of bar charts based on Critical Path Method.

2.9 TESTING

Tests for the various items of equipment shall be performed at the contractor's cost and test certificate to be furnished by the contractor. The Contractor shall inform the equipment test schedule to the Project Manager & Architect, if they desire. If required by the Engineer, the Contractor shall permit the NCCF authorised representative to be present during any of the tests. After notification to the NCCF that the installation has been completed the contractor shall make under the direction and in the presence of the Engineer such tests and inspections as have been specified and addition as the engineer shall consider necessary to determine whether or not the full intent of the requirements of the plans and specifications have been fulfilled. In case the work does not meet the full intent of the specification and further tests shall be considered necessary the contractor shall bear all the expenses thereof.

2.10 MAKE OF MATERIALS

No specification or make of material described in the tender document/Contract Agreement shall be changed without prior approval of CEO NCCF through Project Manager.

2.11 GODOWN/WORKER ACCOMMODATION

No storage space shall be given by NCCF at site. Contractor shall make his own arrangement for storage of materials/Godown facilities etc. The accommodation for workers shall also be arranged by the contractor at his own risk and cost. No labour hutment shall be allowed within the site premises.

2.12 FIRE OFFICER'S APPROVAL

It shall be the responsibility of the contractor to meet all mandatory requirements of Greater Noida Local Fire Service concerning operation of lifts& electrical safety office, provision of firemen's switch, indicative marking etc. All Statutory Approval from start to Execution, completion and handing over shall be in the scope of Tenderer. The tenderer shall also be responsible for coordination, getting all approvals, licenses or any other Statutory Approvals required for successful Completion of Elevators in the lump sum quoted cost. All expenses for the same shall be borne by the Tenderer.

2.13 LICENCE

Inspection fee for the inspection of the elevator by the Lift Inspector shall be payable by the Contractor. The contractor shall provide all necessary arrangements for inspection of the lift by the Lift Inspector. All necessary assistance and follow up for obtaining license will be responsibility of the contractor.

2.14 PARTICULAR SPECIFICATION

As enclosed.

2.15 DRAWINGS

As enclosed

- 2.19 The children of laborers shall stay in crèche otherwise penalty shall be initiated against the contractor.

2.16 APPROVAL

It is to be unequivocally understood that on commencement of work, during execution of work or at the completion of work, all approvals of the local authorities such as **GNIDA/Local Electricity Board**, Fire Department, Lift Inspector or any other statutory body, where approval has a bearing on the execution and completion of work being done by the contractor shall be obtained by the contractor at his own cost. No claim shall be entertained whatsoever on this account.

2.17 WORK ON SUNDAYS AND HOLIDAYS

For carrying out work on Sundays and Holidays, the CONTRACTOR will approach the Project Manager or his representative at least two days in advance and obtain permission in writing. The CONTRACTOR shall observe all labour laws and other statutory rules and regulations in force. In case of any violation of such laws, rules and regulations, consequence if any including the cost thereto shall exclusively be borne by the Contractor and the NCCF shall have no liability whatsoever on this account.

2.18 RULES FOR SAFETY AND LABOUR WELFARE

2.18.1 FIRST AID POST

The CONTRACTOR shall provide and maintain in a readily accessible place FIRST AID appliances including adequate supply of sterilized dressings, gauge, cotton wool and requisite medicines, as prescribed in the Construction Rules of the place in which work is carried on. In case of a large work place the FIRST AID POST shall be run by a trained compounder. In case of accident, the contractor shall provide suitable transport to facilitate removal of urgent cases to Hospitals etc.

2.18.2 SAFETY EQUIPMENT

All necessary personal safety equipment such as helmets protective footwear, protective goggles/eye shields, Life jacket, Gas masks etc., as considered adequate by the Architect shall be available for use of persons employed on the site by the Contractor and maintained in a conditions suitable for immediate use and the contractor shall take adequate steps to ensure proper use of equipment by those concerned.

- a) Workers employed on mixing asphaltic materials, cement and lime mortars/concrete shall be provided with protective footwear and protective goggles.
- b) Those engaged in handling any material which is injurious to eyes shall be provided with protective goggles.
- c) Those engaged in welding work shall be provided with welder's protective eye-shields.

- d) When workers are employed in sewers and manholes, which are in use, the contractor shall ensure that manholes covers are opened and manholes are ventilated at least for an hour before workers are allowed to get into them. Manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to public.
- e) The contractor shall not employ men below the age of 18 and women on the work of painting with products containing lead in any form. Whenever men above the age of 18 are employed on the work of lead painting, the following precautions shall be taken:
 - i) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.
 - ii) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
 - iii) Overalls shall be supplied by the contractor to workmen & adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

2.18.3 SAFETY PRECAUTIONS

Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect public from accidents and shall be bound to bear expenses of defense 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.

2.18.4 SCAFFOLDINGS

Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and hand-holes shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1/4 to 1 (1/2 horizontal and 1 vertical).

2.18.5 GUARD RAILS

Scaffolding or staging more than 3.25 meters above the ground or floor, swung or suspended from an overhead support or erected with stationery support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 meter high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

2.18.6 RIGID DESIGN

Working platform gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if height of a platform or gangway or stairway is more than 3.25 meters above ground level floor level, it shall be closely boarded, have adequate width and be suitably fenced.

2.18.7 OPENING GUARDED

Every opening in floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of 1 meter.

2.18.8 HOISTING MACHINES

Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

- a)
 - i) These shall be of good mechanical construction sound materials and adequate strength and free from patent defects and shall be kept in good repair and in good working order.
 - ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.
- b) Every crane driver of hoisting appliance operator shall be properly qualified and no person under the age 21 years shall be in charge of any hoisting machine including any scaffold winch or give signals to operator.
- c) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No Part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.
- d) In case a departmental machine, safe working load shall be notified by the Project Manager. As regards Contractor's machines the Contractor shall notify safe working load of each machine to the Project Manager /Architect whenever he brings it to Site of work and get it verified by the Project Manager/Architect.

2.18.9 SAFE GUARDS FOR MOVING AND DANGEROUS PARTS:

Motors gearing, transmission, electric wiring and other dangerous parts of hoisting appliance shall be provided with efficient safe guards; hoisting appliance shall be provided with such means as will reduce to the minimum risk of accidental descend of load. Adequate precautions shall be taken to reduce to the minimum risk of any part of suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energised, insulating mats,

working apparel such as gloves, sleeves and boots, may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys other materials which are good conductors of electricity.

Note: All scaffolds, ladders first Aid Equipments/Medicines and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places or work. Necessary warning sign boards in Red/White paint, with proper lighting arrangements for nights are to be provided at prominent locations.

3.0 COMMERCIAL TERMS AND CONDITIONS

- 3.1** The Contractor shall at their own cost enclose and barricade the site along its entire periphery with barbed wire fencing of sufficient height erected as per the design of the Architect, maintain in proper condition for the entire duration of the Contract. The Contractor shall be permitted to provide only one entry point where directed by NCCF, provided with a secure gate for admission into the site of work. The Contractor shall employ at their own cost sufficient security personnel as decided by the NCCF on duty at all times at the gate and elsewhere within the site to prevent trespass, pilferage and damage, etc. The Contractor shall at his own cost install and maintain night lighting of sufficient illumination all around and within the site to adequately illuminate it at night. Additional illumination shall be provided around stores, offices, machinery installations, stockyards etc., and the Contractor shall maintain all the illumination in proper and workable order during the entire period of the contract. Nothing extra shall be payable to the Contractor on the above account. If the contractor fails to enclose and barricade the site or employ insufficient security staff or provide in sufficient illumination as above, the same will be provided by the NCCF at the risk and cost of the Contractor and amount so spent will be recovered from the contractor.
- 3.2** The Contractor shall, at their own cost, make their own arrangements to protect and store the materials, tools, and plants until such time as the site is handed over to the NCCF. Neither NCCF nor Architect will be responsible for the loss or damage to any of their materials.
- 3.3** The drawing and specifications are to be considered complementary to each other but should anything appear in the one that is not described in the other, no advantage can be taken of any such omission. Should any discrepancy appear or any misunderstanding arise, as to the meaning or interpretation of anything contained in either the drawings or the specifications, the condition of the specifications will rule for any decision required. However, if both the specifications and drawings do not derive the proper interpretation of items under question, the decision of the Architect with prior approval of NCCF in such matter shall be deemed to be final and binding upon the Contractor. Direction and explanations required to complete the provisions of such specifications, and give them due effect shall be given by the Architect. The drawings and specifications are intended to require and include all labour and material and equipment necessary for the complete and proper execution of the work contemplated, and the contractor is nevertheless to provide the same in spite of any inconsistencies occurring in the drawings and/or specifications.
- 3.4** Should the NCCF and/or Architect so require, the contractor shall furnish all the details, duly substantiated by books of accounts, vouchers, invoices and necessary records of expenditure, of all the expenses incurred by him in connection with the carrying out of the work, Testing

of any items of work, for which the NCCF or Architect may desire verification. Such statement of expenditure may form the basis of any action that the NCCF & Architect may take in connection with the work.

- 3.5** The Contractors shall clean up and remove at their own cost all rubbish, excess earth, debris, constructional loose materials, bushes, weeds, trees, or vegetation, which in the opinion of the NCCF and Architects are unwanted and surplus to requirement and clear the site by carting away such debris from the Project Site at no extra cost by transporting to the reclamation filling ground. Without any additional cost, all holes or hollows whether originally existing or created during construction shall be leveled of and made good as directed.

On completion of the work, the Contractor shall clear off the premises, and ground up to a point 30 Meters. beyond project site on all sides, leaving it dry and clean neat and in a tidy condition and remove all surplus unwanted material, tools, and equipment within 7 days after receipt of written notice of the NCCF or the Architect requiring him to remove the same, and on his default to comply with such notice, the NCCF will forthwith remove all such rubbish, surplus materials or plants or tools lying at or around/outside the site at the risk and cost of the Contractor and make such recoveries from the Contractor as necessary.

- 3.6** The Contractor shall make their own arrangement for supply of water and electricity as required for the successful and efficient execution of the work. it will be the Contractor's responsibility to ensure the safe and satisfactory custody and use of water and electricity without wastage and contamination. The expenditure of all water and electricity connected with construction shall be entirely borne by the contractor.

The contractors at their own cost should provide necessary precautions against breeding of mosquitoes. The Contractor shall indemnify the NCCF against any breach of rules in respect of anti-malaria stipulation, and shall pay any charges, fees, fines, etc., to the authorities concerned if required. Water fit for Construction shall only be allowed to be used and the Contractor shall furnish, install and maintain the necessary water and electricity connections for the complete duration of work, and bear all expenditure thereof, and remove them only after obtaining the written approval of the Architect.

- 3.7** The Contractor shall be co-operative and give full facility to all other Contractors Working at site for storage of their material and execution of their work. The NCCF through their Architect reserves the right to execute any work not included in this contract which he may desire to get carried out by other person/s, representatives and/or Contractors, and the Contractor shall allow all reasonable facilities and use of their scaffolding for the execution of such work. The Contractors shall arrange their programme of work so as not to hinder the progress of other works. The decision of the Architect on any points of dispute between the various Contractors shall be final and binding on all Contractors.

- 3.8** The Contractor shall carry out and complete the work in conformity to the law, regulation, rules, stipulation or requisition of any local or state Administration or Municipal authority, Government of India, Service Undertaking, etc., and shall give all notice, pay all fees, and shall also be responsible for receiving any notices from such authorities concerned and shall keep the Architect and NCCF informed of his compliance of such notice and pay cost of any dues to them for the successful completion of the construction work.

3.9 During the execution of the work, it shall be incumbent on the Contractor to extend all facilities to the NCCF, Architect and or their representatives, the consulting Engineers, to inspect check measure the work, and the Contractor shall provide vertical transport for the purpose by means of approved mechanical or electrical lift. He shall be available at all times and shall provide the NCCF, Architect and/or their representatives with whatever facilities, measurements, documents, samples, tests etc., that they may require.

3.11 CONSTRUCTION DRAWINGS

3.11.1 LAYOUT DRAWINGS

Before commencing the work, the Contractor shall prepare and submit to Architect, at his cost layout drawings for the work, illustrating, dimensioning, and specifying the intended routes and layout for all concealed and exposed horizontal and vertical runs of electrical conduits, schematic diagrams etc., to be followed.

3.11.2 COMPLETION DRAWINGS

On completion of the work and before applying for Certificate of virtual completion, the contractor shall prepare at his cost, and submit to NCCF through the Architect, 3 sets of completion drawings illustrating, dimensioning and specifying the work actually carried out.

The drawings shall also indicate all horizontal, vertical and concealed, exposed electrical lines, and contain schematic diagrams satisfactorily explaining electrical installations, wiring diagrams, etc., as considered necessary by the Architect.

4.0 TECHNICAL SPECIFICATION

This specification is intended to cover the complete installation of the Lift Plant in a first class workman like manner and to include all work and materials in accordance with the drawings as specified. The work shall be carried out in accordance with the "C.P.W.D." General Specification for Electrical work (Part-III) lift 1981, along with I.S.I; National electric code, Indian Electricity Act & Rules which govern the requirements of the lift installation including amendments upto date of the following standards and regulations.

i)	IS:1860:1980	Code of practice for Installation / erection and maintenance of Electric Passenger & Goods Lifts.
ii)	IS: 3534:1976	Outline Dimensions of Electric Lifts.
iii)	IS: 4722	Rotating electrical machines.
iv)	IS: 325	Three phase induction motors.
v)	IS: 900	Installation and maintenance of induction motors.
vi)	IS: 4029	Guide for testing of three phase induction motors.
vii)	IS:8623 & 4237	Switchgear and control gears.
viii)	IS: 4064	Air break switches
ix)	IS:2208 & 9224	HRC cartridge fuses.
x)	IS:10118	Selection, installation and maintenance of Switchgear and control gear.

xi)	IS: 2959	Contractors.
xii)	IS: 1354 & 1554Part-I,II	PVC insulated cables
xiii)	IS: 10810	Test procedures for cables.
xiv)	IS: 6875	Control switches & push buttons.
xv)	IS: 732	Wiring installation.
xvi)	IS: 6121	Cable glands.
xvii)	IS:9537	Rigid steel conduit.
xviii)	IS : 3043	Earthing
xix)	IS: 2365-1977	Specification for steel wire suspension rotor for lifts, elevators hoists.
xx)	IS: 1030 -1982	Specification for carbon steel castings for general engineering purpose.
xxi)	IS: 7759-1975	Specification for lift door locking.
xxii)	USA standard institute (Code No.AI.7.1)	Safety code elevators, dumb waiters & moving walks.
xxiii)	Material specifications	BIS or approved equal.
xxiv)	IS: 4202	Lift code & national electric code for lifts.
xxv)	IS:4666:1980	Specification for Electric Passenger and good lifts.
xxvi)	As per Bombay lift Act, 1939 amended upto date.	

1. Drawings

Before the commencement of work, the lift contractor on receipt of building drawings, shall prepare and submit all drawings necessary shop drawings showing the general arrangement of the lift equipments, to their approval but before the installation of the lift's and these drawings will become part of the contract. The contractor should submit the shop drawings within 30 days from the date of award of LOI for approval from Architect/NCCF before executing the job and the Drawing should be got approved within 45 days from date of issue of LOI. Only those drawings are to be executed which are signed by four authorities namely, the Architect/his representative, the Project Manager, the Contractor/his representative, and NCCF HQ representative.

2. Painting

All exposed metal work furnished under these specifications, except as otherwise specified shall be properly spray painted over an anti-corrosive primer coat and another two coats after installation.

3. Civil work to be done by contractor: (included in contract)

- a) To provide scaffolding in the hoist way required for erection of lift.
- b) To carry out minor civil work, such as modification and making good the pocket/cutout in wall/ceiling for car, counter weight, rail bracket, hall buttons, indicators and laying of sills in positions or any other work required for smooth operation commissioning of lifts.
- c) To Provide and fix the steel item such as machine beams, hoisting hook, arch beam, bearing plate in the machine room, separators wherever required and buffer support channels and vertical iron ladder in lift well.
- d) The contractor will provide required electric panel with cable feed at one place in the machine room. From panel to lift controller and machine etc., all electrical work will be done by lift supplier.

- e) Providing and fixing of necessary sill supporting projection sheet steel facia plates on all landings as per requirements.
- f) To provide suitable M.S. trap door (double panel) with angle iron frame work not less than 50 mm x 50 mm x 6 mm and MS chequered plate, locking arrangement etc., duly painted for trap door opening in each machine room.

4. **Work also included**

The contractor shall provide the following:

- a) A hoist-way properly framed and finished including pit of required depth with drain including waterproofing, as per approved lift supplier drawing. The hoist way wall shall be neat plastered to avoid dust accumulation.
- b) Properly lighted and ventilated machine room and hoist way shall also have light on alternate floor including access doors, ladder and guards as required walls & ceiling shall be properly finished to avoid accumulation of dust.

The machine room secondary slab, floor slab shall have trap door to permit passage for heavy parts to be replaced for repairs. The machine room floor shall be finally finished after the lift machine and equipments have been installed in position by the lift contractor. M.S. Trap doors for trap door opening shall be provided by the Contractor within the quoted price.

5. **Power Supply**

The apparatus shall be suitable to operate on 415 volts 3 phase 4 wire, 50 Hz, Alternating current with a variation of + 6% in volts and + 3% in frequency respectively. The supply for illumination and signal equipment shall be 230 V A.C.

6. **Control Panel**

Each lift shall be provided with one control panel. Control lift panel shall have MCCBs or MCB of adequate rating to receive NCCF's 415V, 3 ph., 4 wire A.C. power supply and if required 240 V AC single phase supply also.

- 6.1 Control Panel shall be provided with ammeter, voltmeter and selector switches on incoming side.
- 6.2 The panel shall be complete with thyristors, techno-generators, transducers, with fuses, overload relays, single phasing preventor, phase reversal protection relay, timer, relay, auxiliary relay, push button, pilot lamp control components etc.
- 6.3 Power contractors for A.C. circuit shall be triple pole electromagnetic A.C. 4 duty with minimum 2 NO+2NC auxiliary contracts and for DC circuit these shall be of double pole electric type DC-3 duty with 2 NO+2 NC auxiliary contacts.
- 6.4 Electronic components contact system shall be free from false operation due to vibration and mechanical shocks. All electrical contacts shall be of silver or other similar cadmium metallic alloy, and shall be capable of withstanding 10,000 operations.

- 6.5 Electronic circuits shall be of modular design using electronic printed circuit boards to facilitate easy replacement of faulty circuit with spare cards.
- 6.6 Electronic components and cards shall be compatible and suitable for conditioned environment for satisfactory operation. All components shall be clearly and unambiguously marked for proper identification to facilitate maintenance. The wire shall be colour coded sloper and shall be provided with latching facility for holding the PCBs in position.
- 6.7 Ready accessible and clearly marked test points shall be provided in all important modules and circuits.
- 6.8 The printed circuit board shall be glass epoxy and of Bakelite sheets.
- 6.9 Heat dissipation components shall not be mounted on PCBs to avoid damage to PCBs and loosening of soldered connections due to heat.
- 6.10 Reverse Phase Relay. A reverse phase relay shall be provided on the controller which is designed to protect the lift equipment against phase reversal, failure.

7. TESTS

The following tests shall be carried out to the satisfaction of the NCCF/Architect Engineers.

- a) Insulation and earth test for all electrical apparatus.
- b) Continuous operation of the lift under full load conditions for one hour at the end of which time the temperature of the motor and the operating coils will be tested. This shall be as per I.S.I specification.

The car is to be loaded until the weight on the rope is twice the combined weight of the car and the specified load. This load must be carried on for about 30 minutes without any sign of weakness, temporary or permanent elongation of the suspension ropes strands.

8. TESTING

Testing at manufactures works of the various equipments and components as required by Indian Standards shall be done by the successful tenderer before dispatching the material to site. The tenderer shall furnish a certificate to this effect. The lift equipment shall be inspected by our authorized representative of NCCF/Architect wishes to participate in the well in advance before carrying out such tests. Various tests required to be done as per Indian Standards at site of the installation shall be done in the presence of the purchaser's representative.

Electrical Power required for testing and commissioning of lifts shall be Contractor's responsibility and nothing extra shall be paid on this account. Main supply for normal running of lifts (after testing and commissioning) shall be NCCFs responsibility.

9. Warranty

The bidder shall provide for Two years warranty after commissioning against all manufacturing defects and shall provide for free replacement of all materials having manufacturing defects.

10. Permission to install the lifts and license to run the lifts from relevant authorities

It shall be the responsibility of the successful tenderer to obtain the necessary permission, if required, to install the lifts from the relevant local authorities and subsequently to have the installation inspected by the relevant local authorities and arrange to obtain the license to run the lifts. All relevant papers connected to obtaining the permission and final inspection will be signed by the NCCF. The requisite fees for this purpose shall be included in the quoted rate and no extra will be paid on this account.

11. Erection

The lift Contractor shall commence the erection of the lift equipment immediately after receipt of the complete equipment from makers and complete the work to the satisfaction of the Engineer concerned within the stipulated time. The lift installation shall be handed over in perfect working order on completion of the work.

12. Data

The Contractor shall furnish technical particulars of the equipment devices type make and catalogue number for the approval by the NCCF through Architect/Consultant.

- a) Motor sizing calculation.
- b) Brake selection calculation.
- c) Single line/Schematic diagram of electronic control panel.
- d) Layout of lift machine room showing electric control panel, elevator equipment etc.
- e) Cable size calculation alongwith cable and equipment layout.
- f) Rope size calculation.
- g) Earthing layout.
- h) Inspection manuals for equipment and accessories covered in the scope of supply.
- i) Technical literature of operation & control.

13. Machine

The lift machine shall be placed directly above the hoist-way upon machine room slab and steel beams. Suitable material like anti-vibration pads of approved make and required thickness shall be used below the lift machine to reduce wear and tear. It shall include a motor, electro-mechanical brake, worm gear, sheave shaft and sheave, all completely mounted on a common bed-plate. Double thrust bearings shall be used to take care of the thrust of the worm shaft. The hard alloy cast iron or steel sheave shall have rope grooves to ensure proper traction and minimize rope wear. Suitable means of lubrications shall be provided for all the bearing and the worm gear. Means for manual operation of the lift car shall be made by providing winding wheel suitably marked to indicate the direction of the movement of car to be brought to the nearest landing manually in the event of stoppage of lift due to any reason with a warning display for switching of the Electrical supply before operating manually.

14. Motor

The motor shall be squirrel cage type, particularly designed for elevator service with high starting torque and low running current. The A.C. lift motor output voltage will be electronically monitored / varied during acceleration and deceleration to make a smooth and accurate stop.

15. Braking System

Braking of the lift will be done by electronically varying the voltage and the frequency of the motor feeding current (Variable Voltage and Variable Frequency control: i.e. V.V.V.F.(Control). The electromagnetic holding brake will be applied only after the lift has come to complete standstill.

16. Control

The control shall be microprocessor controlled electronically regulated A.C. Variable Voltage & Variable Frequency drive using pulse width modulation (PWM). The Control should have closed loop system to archive accurate leveling at stoppages and better performance. The Controller with be within built voltage stabilizer / CVT.

17. Controller with Drive System

Controller with Duplex Full Selective/Collective control, drive control with digital technology having thruster controller acceleration and deceleration and digital tachometer on worm shaft for two lifts side by side are being installed in each building.

18. Car Frame Safety Gear and Governor

The car frame which supports the car platform and enclosure shall be made of structural steel and equipped with suitable guides and car safety device mounted under car platform. The safety gear shall be of instantaneous type. Car safety, to stop the car whenever excessive descending speed is attained, shall be operated by a speed governor through a continuous steel rope. Suitable device shall be provided to cut off power from the motor and apply the brake on application of safety.

19. Thermal Overload Protection

Auto Thermal overload protection to be provided to protect the driving motor against overloads. If the car is overloaded, it will not start. The overload indicator and the sounding buzzer shall signal the overload condition.

20. Priority Control

Switching on the key contact and at the same time pressing the required floor buttons will allow a direct travel to the selected floor while the already registered car commands will be cancelled.

21. Full Load Control

Full loaded cars should respond only to car commands. Floor calls remains registered and are served by the next available not fully loaded cars.

22. Counter Weight

All counter weights shall be cast iron and shall travel between rigid guides of steel frame capable of withstanding buffer impacts. Suitable metallic counter weights guard of required length shall be provided at the bottom of the hoist way.

23. Car Safety and Governor

The car safety is to be provided to stop the car whenever excessive descending speed is attained and runs more than 10 seconds in the same directions. The safety shall be operated by a centrifugal speed governor located at the top of the machine or hoist way and connected to the governor through a continuous steel rope, Suitable means shall be applied to cut off power from the motor and apply brake to stop the elevator immediately after that the elevator shall restart automatically in normal speed.

24. Sound Reducing

The lift contractor shall provide necessary sound reduction materials, preferably anti-vibration pads of proper density to effectively isolate the machine from the machine beams or flooring.

25. Terminal and Final Limits

Terminal switches shall be provided to stop the car at the terminal landings. These terminal switches shall act independently of the operating device or final limits switches, Ultimate or final limit switches shall also be provided to automatically cut off the power and apply brake in case the car travel beyond terminal landings.

26. Terminal Buffer

Suitable spring buffers shall be installed to stop the car and counter weight at the extreme limits or travels. Buffer must be suitable for installation in the space available.

27. Guides

Car and counter weight guides shall be of rigid steel, machined `T` section only the size being in accordance with relevant Indian standards. It shall be capable of withstanding the forces resulting from the application of car or counter weights safety devices.

28. Hoist Ropes

Round stranded steel wire ropes shall be used for lift suspension. The number and sizes of the hoisting rope shall be so selected to ensure proper factor of safety and proper operation of elevator. The suspension ropes shall correspond to relevant Indian Standard. Governor ropes shall also be of steel. The rope dia shall be minimum 1/2", construction 8/19, with safety factor 8 minimum.

29. Car Platform

The car platform shall be framed construction and designed on the basis of rated load evenly distributed. The flooring shall be sound proof and of anti-skid surface. The PVC flooring shall be of approved shade.

30. Car Enclosures of Body

The car body shall be of SS 304 (16 gauge) sheet hair line finished and scratch proof. The car have suspended ceiling with arrangement for air through a silent pressure fan mounted on the roof of the car. In directed lighting shall be done with fluorescent fitting evenly distributed in the cabin. Fan and light should automatically be put on when lift is in operation. Each lift car shall have switch for the alarm with hooter in Control Room also. The lift supplier must get approval of car enclosure, doors etc., prior to manufacture of the same.

31. Car Door

- a) The car entrance shall be protected by two MS sheet steel panel centre opening horizontal sliding doors.

32. Landing Door

- a) Each landing shall be provided with two stainless steel panel central opening horizontal sliding doors.

33. Architraves: - As per drawing.**34. Car and Landing Door Operators**

An electric door operator for opening and closing the car door and the landing door shall be provided. It shall consist of a machine on the elevator car is stopping at a landing. The car door and the landing door shall be mechanically connected and shall move simultaneously in opening and closing. Every landing door shall be provided with a locking device which shall comply with the following requirements:

- a) It shall not be possible to open the landing door from the landing side until the lift car is within that particular landing zone.

However, provision shall be made for opening the door by means of special key for use in case of an emergency.

- b) It shall not be possible for the car to be started or kept in motion unless all the landing doors and car door are closed and locked except when the car is coming to a stop at that landing within the leveling.
- c) The electrical and mechanical parts of all locking devices shall be of suitable design and construction.
- d) An electric contact for each car door shall be provided which shall prevent car movement away from the landing unless the door is in closed position.

The car door and landing door shall open automatically as the car is stopping at a landing. The closing of car door and landing door must occur before the car is sent in motion a device shall be provided to stop and reverse the doors during their closing motion.

35. Door Hangers and Tracks

The car and the landing door shall be provided with two point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be of steel with moulded nylon collar and shall include shielded ball bearing. Tracks shall be suitable steel section with smooth surface. The landing doors shall also consist of headers, sills, frames etc. as required.

36. Car Door Safety System

Infrared safety system provided in car doors comprising multiple beam arrangement together with the high scanning frequency should be sensitive and alert enough to detect even the minutest of the obstacles. In the event of a person interrupting the beam the closing operation of the doors (the car and landing doors) shall return to the open position. The closing operation of the doors shall also be reversible by pressing a button (DO button) in the lift car operating panel.

37. Car Operating Panel in the Car

The car operating panel shall be stainless steel sheet flush mounted and contain the following:-

- a) A series of push buttons numbered to correspond to the landing served which will light up while in service.
- b) An emergency stop button'.
- c) An emergency call button connected to a bell to serve as an emergency signal.
- d) An alarm buzzer.
- e) Digital car position indicator and direction arrows.

- f) A nonstop priority control button.
- g) A door open button.
- h) A door close button.
- i) A fan switch which shall operate only when lift is in operation.
- j) Overload indicator with buzzer.
- k) Ventilation slots at top and bottom of panel as per requirements.
- l) Name plate of manufacturer with load and capacity data.
- m) Intercom system. Instrument to be handed to the NCCF after commissioning of lift.
- n) Auto- Emergency light.
- o) Recorded voice for floor indication.
- p) Instructions for lift operations & emergencies on metal plate.
- q) Illumination with sufficient back up (2-3 lights).

38. Car Direction Indicator.

Digital signal indicator in the car shall be provided by the appropriate arrow being illuminated to indicate the car travel direction.

39. Emergency Light in Car

A trickle charged battery operated emergency light lamp shall be provided in the car which shall operate automatically in case of power failure for minimum 90 minutes.

40. Alarm Bell

An emergency alarm bell shall be provided. The alarm bell shall be located in the ground floor landing and push button for the same shall be in the car-operating panel. The system shall be operated by batteries with trickle charger and the bell/siren should work the moment the alarm button in the car is pressed.

41. Intercom System

Intercom station in car operating panel powered by line charge battery. In case of blackout, the intercom system and alarm device will remain operative for 90 minutes at least. Intercom system of each lift should give indications / be operative from security gate along with ground floor lift lobby.

42. Call Button in Landings

An 'up' push button and a 'down' push button at each intermediate landing and a single push button at each terminal landing shall be provided to call the lift car in a particular landing for

traveling in a direction desired. The push buttons shall have call registration lights and shall illuminate when a button is momentarily pressed to indicate that the call is registered and the direction of the call is registered. The button shall remain illuminated until the call is answered. The top covers of landing push button boards shall be of stainless steel.

43. Floor Position Indicator & Direction Arrows.

Digital signal indication at all landing shall be provided by the appropriate numeral and direction arrow being indicated when the car is passing the corresponding floor. The indicator shall remain illuminated when the car is stopped at a floor. The top cover of the floor position and direction arrow indicator units shall be stainless steel.

44. Emergency Key

Emergency Key or equivalent device shall be provided as required by the elevator supplier.

45. Detailed Instructions

Inside the lift car suitable instruction for passenger on car operating panel will be displayed. Such instructions in lift car shall indicate capacity, Nos. of persons; 'No Smoking' and such other instructions as are suitable for proper and safe operation of the lifts. Lifts supplier shall also supply laminated chart giving "Dos" and "Don't" for smooth performance of lift duly framed with glass cover in each lift.

46. Fireman Switch

Each lift will have fireman switch for access of fireman. The operation of this switch shall cancel all calls to this lift and lift will stop at the next nearest landing if traveling upward. The doors will not open at this landing and the lift will start traveling to ground floor. In case of its travel in the downward direction when the fireman's switch is operated, it will go straight to ground floor direct without stopping enroute. The emergency stop button inside the car will become in operative during the journey. Once the car has reached the ground floor, it shall be safely under the command of fireman by car buttons, landing calls being isolated. The lift can be put in normal use by putting the fireman switch in its original position.

47. Operation

The operation shall be duplex full collective-selective with or without attendant. It shall generally function in the manner described below:

On every intermediate landing is a Up/Down button with 'Call Registered' lights. The extreme positions have one call button with a "Call Registered" even. Inside the car is the complete set of buttons and a key operated change over switch to facilitate operation with or without attendant. However, in this case the car attends to all calls registered inside the car and at the landings, in the ascending or the descending order. If it is landing, the last stop is the top-most

registered call. After this, it automatically reverses the direction of travel and attends to all calls registered "Down" on this downward trip, irrespective of the sequence in which the calls are registered, the car will answer all calls in a sequenced order depending upon the direction in which it is traveling. If the key is turned to 'Attendant' operation, the lift operation can select the direction of travel by pushing the right buttons in the car.

48. Emergency Stop Switch

On top of the lift car an emergency stop switch shall be provided for use by maintenance personnel. Similar switches shall also be provided in the car. Operation of these switches shall render the car and landing buttons in operative and cancel all registered calls.

49. Emergency Battery

A trickle charged battery of ninety minutes capacity will be supplied to feed emergency light, intercom system and alarm in case of power failure.

50. Electrical Wiring

Power wiring between the controller and main board and controller to various landings shall be done in heavy gauge conduits conforming to European rules and specification for electrical works. All cables shall be flame retardant or PVC insulated of appropriate size and voltage grading. Complete copper wiring for the entire lift installation will be used.

All multi-core trailing cables employed for the car shall satisfy the requirement of relevant European Standard. There shall be separate trailing cables for the controls, for the lighting and fan and for signal circuits. The length of the cable shall be adequate to prevent any strain due to movement of the car. All cables shall be so tagged for easy identification. Trailing cables shall be so suspended, anchored and run that the strain on individual cable conductor shall be reduced to a minimum and the cable are free from contact with the car counter weight, shaft sides etc. No intermediate jointing shall be permissible in the trailing cable.

51. Note

These are General Specification. The supplier can quote as per his design with reason explaining better working and functioning of the equipment's in support (write up) along with bid. Tenderers must strictly comply with the above specifications and if there are any variations these shall be separately listed.

A. CONTRACTOR'S BARRICADES:

Contractor shall erect and maintain barricades required in connection with his operation to guard or protect.

- a) Excavation work
- b) Area adjudged hazardous by Contractor or NCCF's inspectors.

c) NCCF's existing property subject to damage by Contractor's operations.

Contractor's employees and those of its sub-contractors shall become acquainted with NCCF's barricading practice and shall respect the provisions thereof.

Barricaded and hazardous areas adjacent to but not located, in normal routes of travel shall be marked by red flashed lanterns at nights.

B. SCAFFOLDING:

- (i) Suitable double stage scaffolding should be provided for workmen for all work that cannot safely be done from the ground or from solid construction except short period work as can be done safely from ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical). Lights to protect the workers and staff from accidents to be provided . Contractor shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of laid down precautions and pay any damages and costs which may be awarded in any such suit or 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.
- (ii) Scaffolding or staging more than 4 metre above the ground or floor swing suspended from an over-head support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 3 ft. high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.
- (iii) Working platform gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform, of the gangway or the stairway is more than 4 meters above ground level or floor level they should be closely boarded, should have adequate width and should be suitably fastened as described in (ii) above.
- (iv) Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 meter.
- (v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length while the width between the said rails in rung ladder shall in no case be less than 30 cms. for ladder upto and including 3 meters in length. For longer ladder this width should be increased atleast 5 cm for each additional foot of length. Uniform steps spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any sites of work shall be so stacked or placed to cause danger or inconvenience to any person or public. The contractor shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be bought by any person for injury sustained owing to neglect of the above precautions and pay any

damages and costs which may be awarded in any such suit or 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.

C. EXCAVATION AND TRENCHING

All trenches 1.2 meters or more in depth shall at all times be supplied with at least one ladder for each 50 meter length or fraction thereof.

Ladder shall be extended from bottom of the trench to at least 1 meter above the surface of the ground. The sides of the trenches which are 1.5 meters in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of side collapsing. The excavated materials shall not be placed within 1.5 meters of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

D. DEMOLITION

Before any demolition work is commenced and also during the progress of the work.

- a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- b) No electric cable or apparatus which is liable to be source of danger shall remain electrically charged.
- c) All practical steps shall be taken to prevent danger to persons employed from risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
- d) Stone breakers shall be provided with protective clothing and seated at sufficiently safe intervals.
- e) When workers are employed in sewers and manholes, which are in use, the contractor shall ensure that the manhole covers are opened and are ventilated at least for an hour before the workers are allowed to get into the manholes and the manholes so opened shall be cordoned off with suitable tailing and provided with warning signals or board to prevent accident to the public. Proper Safety Belts shall be used by the workers going in the sewers & manholes. Further before entry presence of TOXIC gases shall be tested and presence of Oxygen verified.
- f) The Contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken.
 - i) No paint containing lead or lead product shall be used except in the form of paste or readymade paint.
 - ii) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

- iii) Overalls shall be supplied by the contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash them during and on cessation of work.

E. All necessary personal safety equipment as considered adequate by the NCCF should be kept available for the use of persons employed on the site and maintained in condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

Those engaged in mixing or stacking of cement bags or any materials which are injurious to the eyes shall be provided with protective goggles.

F. Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to laid down standard precautions.

a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.

b) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.

c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to the operator.

d) In case hoisting machine and of every chain ring hook shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load of the conditions under which it is applicable which shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(e) In case of hired machine, the safe working load shall be notified to the NCCF. As regards Contractor's machines, the Contractor shall notify the safe working load of the machine to the NCCF/ Architect whenever he brings any machinery to site of work and get it verified by the Project Manager or its authorized representative.

G. Motors gearing transmission electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards Housing appliances should be provided with such means as to reduce to the minimum the accidental descent of the load, adequate pre-cautions should be taken to reduce to the minimum the risk of any part or any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energised, insulation mats, wearing apparel, such as gloves, sleeves, and boots, as may be necessary should be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

H. All scaffolds ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use either by the Contractor or any other external agencies/ sub

contractors/associate contractors. Adequate washing facilities should be provided at or near places of work.

- I. These safety provisions should be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work-spot. The person responsible for compliance of the safety code shall be named therein by the Contractor.
- J. To ensure effective enforcement of the rules and regulations relating to the safety precautions, the arrangements made by the Contractor shall be open to inspection by NCCF or its representatives.
- K. Notwithstanding the above clause there is nothing in these to exempt the Contractor from the operations of any other Act or rules in force in the Republic of India. The works throughout including any temporary works shall be carried out in such a manner as not to interfere or destroy in any way whatsoever the property of the Administration or of a third party.

In addition to the above, the Contractor shall abide by the Safety code provision as per Indian Standard Safety Code framed from time to time and any additional requirement as per local safety bye laws and as required by the NCCF from time to time within his quoted rates.

SECTION – F EXTERNAL DEVELOPMENT WORK

ROAD, PATHWAYS, KERBS AND EARTH FILLING OVER AREAS

1. SCOPE OF WORK

The road work in this contract comprises of previous of road with sub base course 75 mm thick consolidated base course 75 mm thick consolidated 90 mm thick the cement concrete in pathways kerb stones, and earth filling as described in schedule items and as specified in succeeding paragraph.

MATERIAL

2. SUB BASE AND BASE COURSE

This shall be water bound macadam with stone aggregates. Stone aggregate shall be quartzite. This shall be crushed/ broken stone as per grading requirement given in the table shown below:-

a) GRADING REQUIRMENT OF STONE AGGREGATE

Grading No.	Size Range	Sieve Designation	Percent by weight Passing the sieve	Test Requirement
1.	90 mm to 40mm	100mm	100	one test per 100 cum
		80 mm	65-85	
		63 mm	25-60	
		40 mm	0-15	
2.	63 mm to 40 mm	80 mm	100	- do –
		63 mm	97-100	
		50 mm	35-70	
		40 mm	0-15	
		20 mm	0-5	

b) The stone shall be hard, durable and free from excess of flat elongates soft elongates soft and disintegrated particles dirt and other objectionable manner

3. (A) STONE SCREENINGS FOR SUB BASE AND BASE COURSE

Screening to fill voids in the stone aggregate shall consist of the same material as the stone aggregate.

(i) The screening shall have grading shown in the following table:-

GRADING FOR SCREENING

Grading Classification	Size of Screenings	Sieve Designation	Percent by weight passing the sieve	quality Recd. for 10 Sq
Sub base course 0.63	12.5		12.5 mm	100
	2		10.0 mm	90-100
Base Course	10.00mm	10.00 mm	100	0.40cum
		4.75 mm	85-100	
		150 micron	10-30	

(ii) The screening shall be clean, durable, free from disintegrated pieces and other objectionable material.

(b) STONE CHIPPIINGS FOR PREMIX CARPET

Stone chippings shall consist of fairly cubical ferment of clean hard tough and durable rock of uniform quality throughout. This shall be crushed stone and shall be free of elongated or flaky pieces soft or disintegrated stone salt alkali vegetable matter and dust. These shall conform to the quality requirement if given in para_below

S. No	Type of Construction	Test	Test Method	Requirement	Frequency Test
i)	Sub Base Course	Loss Angeles abrasion value	IS:2386 (Part IV)	60% Max.	one test per 200 cum aggregates.
		Agg. Impact value	IS:5640***	*50% Max.	
ii)	Base Course	a) Loss Angles Abrasion Value Or agg. Impact Value	IS:2386 (Part IV) IS: 2386 (Part IV) IS: 5640***	50% Max *40% Max	--do--
		b) Flakiness Index	IS: 2386 (Part I)	**15%	--do--
iii)	Screening Stone Chipping	a) Loss Angles Abrasion value of agg. Impact value	IS:2386 (Part IV)		one test per 20-100 cum
		b) Flakiness Index	IS: 2386 (Part I)		one test per 50-100cum

Of aggregate

c) Striping Value IS: 6241

--do--

* Aggregate may satisfy requirements of either of the tow tests

** The requirements of flakiness index shall be enforced only in case of crushed Broken stone and crushed slag.

=====

4. BINDING MATERIAL

The binding material shall consist of fine grained material possessing plasticity index value 4-6 which shall be determined in accordance with IS: 2720 (Part V). The quantity of binding material required shall be as under:-

- | | | |
|----|-------------|-------------------------|
| a) | Sub Base | Per 10 Sqm.
0.15 cum |
| b) | Base Course | 0.15 cum |

WORKMANSHIP

5. PREPARATION FORMATION

- a) Preparing Formation
The ground shall be formed to proper gradient, camber, super elevation, etc. corresponding to the required surface, by trimming the surface soil (if any) shall be thrown clear of the road formation. The formation shall be watered and rolled.
- b) Preservation of Property
Road side trees shrubs poles fences monuments buildings pipe lines sewers etc. within or adjacent to the road which are not to be disturbed shall be protected from injury or damage.

6. PREPARATION OF SUB-GRADE

The surface of the formation for a width equal to that of base course shall first be cut to the depth below the proposed finished level equal to the combined depth of base course and wearing course (due allowance being made of consolidation). It shall then be cleared off all foreign substances and sub-grade dressed of parallel to the finished profile.

7. CONSOLIDATION OF SUB-GRADE

The sub-grade shall then be sprinkled with water and rolled with minimum of 5 numbers of passes of 8-10 tonne smooth wheeled roller, till the soil is evenly and densely consolidated.

- 8. **All undulations** in the surface that might develop due to rolling shall be made good with earth or quarry soils as the case may be and sub-grade re-rolled.

9. SUB-BASE

The sub-base shall be water bound macadam with stone aggregate of size 90 mm to 40 mm. This shall be laid on prepared sub-grade in conformity with line, grades and thickness. The consolidated thickness of the sub-base shall be 100 mm. Loose quantity of the aggregate shall be 2.02 cum per 10 sqm. The stone aggregate shall be mechanically inter-locked by rolling and voids thereof filled with screening and binding material with the assistance of water laid on a prepared sub-grade. The coarse aggregate shall be spread uniformly and evenly up on the prepared sub-grade in required quantities with a twisting motion to avoid segregation. In no case shall these be dumped in heaps directly on the area where these are to be laid. This shall be laid on proper profile grades by using templates. The surface of the aggregate spread shall be carefully trued up and all high or low spots corrected by removing/adding aggregate as required.

10. ROLLING

Immediately after spreading of the coarse aggregate is shall be compacted to the full width by rolling with a power roller of 8-10 ton capacity. Initially light rolling is to be done which shall be discontinued when the aggregate is partially compacted with sufficient voids to permit application of screening. The rolling shall begin from the edges with roller runner forward and backward and adding the screenings simultaneously until the edges have been firmly compacted. The roller shall then progress gradually from the edges to the center parallel to center line of the road and overlapping uniformly each proceeding rear wheel tract by $\frac{1}{2}$ width and shall continue until the entire area of the sub base has been rolled by the rear wheel. Slight sprinkling of water may be done during roller.

On super elevated curves the rolling shall proceed from the lower edge and progress gradually continuing toward the upper edge of the road.

11. APPLICATION OF SCREENING

After the coarse aggregate has been lightly rolled to the required surface, screening shall be applied gradually over the surface to completely fill the inter-stices. Dry rolling shall be continued while screening is being spread so that the jarring effect of the roller causes them to settle in the voids of the aggregate. The screening shall be spread uniformly in successively thin layers, which shall be applied at a slow rate. To ensure filling of all voids rolling and brooming shall continue with the spreading of screening. Damp and wet screening shall not be used under any circumstances.

12. SPRINKLING AND GROUTING

After spreading the screening and rolling, the surface shall be copiously sprinkled swept in brooms and rolled to distribute the screening evenly additional screening be applied wherever necessary until the stone aggregate is well bonded and firmly set for the entire depth and until a grout has been formed of screening and water and from a wave of grout ahead of the wheels of the roller.

13. APPLICATION OF BINDING MATERIAL

After the application of screening and rolling, the binding material shall be applied at a uniform and slow rate into two or more successive thin layers. After each application, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand broom to fill the voids. The surface shall then be rolled by an 8-10 tonne roller, water being applied to the wheels. This process shall be continued till the slurry forms a wave ahead of the wheels of the roller.

14. SETTING AND DRYING

After final compaction of the sub base course, the road shall be allowed to cure over night. Next morning, the defective spots shall be filled with screening or binding material lightly sprinkled with water if necessary and rolled. No traffic shall be allowed till the macadam sets.

15. SURFACE EVENNESS

The surface evenness of the complete W.B.M. sub base course in the longitudinal and transverse direction shall be as under:-

Longitudinal profile - undulation when measured with a 3 meter straight edge shall not be more than 15 mm. cross profile – undulation when measured with a camber template shall not be more than 12 mm.

16. RECTIFICATION OF DEFETS

When the surface irregularity of the WBM sub base course exceeds the tolerance specified above or where the base course is otherwise defective due to sub-grade soil mixing with the aggregate the layer of its full thickness shall be scarified over the affected area re-shaped with added material and re-compacted. The depressions shall not be filled with screening and binding material.

17. BASE COURSE

Base course of water bound macadam shall be with stone aggregate of size 63 to 40 mm in 75 mm consolidated thickness. The base course shall be laid over the prepared sub-base course with operations as described in the succeeding paragraphs. The quantities of the loose aggregate required for base course should not less than 1.33 cum per 10 sqm of road surface for 75 mm consolidated thickness of base course.

a) **Spreading of Stone Aggregate**

This shall be as specified above for sub base course Para 28 except that the base course shall be constructed with a consolidated thickness of 75 mm thick.

b) **Rolling**

This shall be as per Para 29 of the sub base course

- c) **Sprinkling and Grouting**
This shall be as per Para 31 of the sub base course
- d) **Application of Screening**
This shall be as per Para 30 of the sub base course
- e) **Application of Binding Material**
This shall be as per Para 32 of the sub base course
- f) **Setting and Drying**
This shall be as per Para 33 of the sub base course
- g) **Surface Evenness**
This surface evenness of the completed base course in the longitudinal and transverse direction shall be as under:-
 - i) **Longitudinal Profile**
Maximum permissible undulation when measured with a 3 m long straight edge 12 mm
 - ii) **Cross Profile**
Maximum permissible undulation when measured with a camber template 8 mm.
- h) The longitudinal profile shall be checked with 3 meter long straight edge of the middle of each traffic line.
- i) The transfer profile shall be checked with a series of 3 chamber boards at intervals of 10 meters
- j) Rectification of defective construction same as for sub base course.

18. PLAIN CEMENT CONCRETE (ROAD)

- (a) **Preparation of Surface**
The surface area shall be well compacted by 8-10 tonne road roller provide to required camber all as per required level.
- (b) **Under Layer**
Lean concrete bed 1:5:10 (1 cement: 5 Coarse Sand: 10 Graded stone aggregate of 40 mm nominal size) over 100 mm consolidated thickness irrespective of what is shown on drawing shall be laid in required slope and thoroughly rammed by heavy iron rammer of 4.5 or 5.5 kg. Ramming shall be continued till a skin of mortar covers the surface completely and surface cured properly.
- (c) **Topping**
100 mm thick vacuum dewatered concrete of mix 1:2:4 (1 Cement: 2 Coarse Sand: 4 stone aggregate 20 mm nominal size) shall be laid in pattern as shown on the drawings as directed. Panel size shall not be more than 2m X 3m and cement concrete shall be laid in alternate panel. Excessive trawling shall be avoided. Surface vibrators shall be used to vibrate the concrete. Use of dry cement or cement and sand mixture sprinkled

on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted. The top surface shall be patta/ broom finished. Surface shall be finished rough and grooves be provided as per the required patten and as directed by the NCCF/ Architect. The grooves shall be 12 mm wide and 90 mm deep clear gap between panels and these gaps shall be filled with 55% coarse sand mixed with 45% bitumen S – 90 after the concrete has been fully cured. To get absolute straight joints, angle iron/ steel side shuttering shall be used.

- (d) The concrete surface shall be well cured by the ponding method for seven days.

PATHWAYS

Under Layer

Lean concrete bed of 150 mm consolidated thickness PCC of mix 1:5:10 (1 Cement: 5 Coarse Sand: 10 graded stone aggregate of 40 mm nominal size) over 100 mm thick fine sand shall be laid in required slope and roughly rammed by heavy iron hammers of 4.5 or 5.5. kg. Ramming shall be continued till a skin of mortar covers the surface completely.

Topping

50 mm thick concrete of mix 1:2:4 (1 Cement: 2 Coarse Sand: 4 graded stone aggregate of 20 mm nominal size shall be laid in panel of 1.0 X 1.2 m by using 50 X 6 mm asbestor cement strips and concreting shall be trowel finished.

After the concreting starts setting weld mesh of size 50 Mm X 50 MM X 75 MM shall be kept on surface and pressed by wooden hammers so as to get an impression of weld need on concrete.

Curing

The surface shall be cured for 7 days by ponding and care should be taken that nobody walks over it for seven days.

19. PCC PAVEMENT (PRE CAST)

Preparation

The surface shall be well dressed and vegetation and grass removed. The surface shall be rolled by hand rollers.

Under Layer

Same as P.C.C. for road to thickness for 100 mm.

Topping

Pre case cement concrete 1:2:4 (1 Cement: 2 Coarse Sand:4 Graded Stone aggregate 20 mm down gauge) to a thickness of 75 mm with similar anti skid surface of panels of patterns as shown in drawings.

20. PCC KERB STONE

These shall be factory made pre-cast/ cement concrete as per drawings and as approved by Architect and NCCF finished even and concrete cured well.

21. EARTH FILLING OVER AREA

Earth filling over areas shall be by bringing earth from outside NCCF land by the contractor. The entire plot levels shall be taken in a grid of 3m X 3m and jointly signed before fillings. Earth shall be spread in layers of 20 cm in the entire width of the road. Each layer shall be rolled with a roller of minimum ½ tone weight by providing 5 passes. Every 3rd layer and top most layers shall be consolidated with a powder roller of minimum 8 tone weight by giving 5 passes. Light watering shall also be done for each layer while consolidation. Final level shall be attained as indicated by NCCF/ Architect.

Computing the gross filling volume shall be by prismatic formulae, Simpson's Rule or trapezoidal formula as the case may be. Area covered by buildings shall be deleted. Any excess excavation in foundation after plinth filling etc shall also be deducted. The net payable volume shall be arrived after deducting 10% from the gross volume arrived after above procedure. Rate quoted shall be deemed to include all operations and above provisions for net volume only and the volume of earth is also included in the lump sum quoted rate.

BOUNDARY WALL

22. MATERIAL AND WORKMANSHIP

Specification of materials and workmanship in respect of all items shall be same as of identical item for the buildings works as described herein before except with the changes described in succeeding paragraph.

23. LAYOUT

After setting out of work as per stage of Para 47 below the layout of boundary wall shall be got approved from the Project Manager/ Architect after getting the layout of the plot approved from the local authorities.

24. EXCAVATION IN TRENCHES

Earthwork in excavation in any type of soil for foundation of wall shall be carried out as per details shown in drawings nos.

The details specifications for earth filling, plinth filling, brick work, DPC, steel and iron work; cement base paint shall be as specified herein before.

25. M.S. RAILING OVER BOUNDARY WALL

M.S. railing on boundary wall shall be fabricated out of M.S. angle 40 X 40 X 6 mm M.S. square bars. M.S. flat iron and spikes fabricated out of M.S. square bars as per details shown on drawing furnished by the Architect.

The railing shall be erected truly vertical and fixed properly. Painting of railing of required shade shall be with two coats of oil paint over one coat of approved primer. M.S. angles near the ends of and M.S. square bars at the centre of each grill panel shall be embedded in PC.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm size) as per details shown in drawings furnished by the Architect.

26. MAIN GATE

Steel gate shall be of ornamental pattern and shall be fabricated and welded out of S.S. flat S.S. sq. bars, flower leaves cut and fabricated out of S.S. sheets, S.S. tubes, S.S. Plates and steel roller wheels. The pattern of gates shall be as per details shown on drawings. Before fabrication the Architect may order minor variation in Design/Pattern.

The rates quoted against item GATES shall be deemed to be inclusive of provisioning, fabrication, welding, erection at site, embedding of gate pillars, making it functional and painting with two coats of synthetic enamel paint of approved shade over one coat of approved steel primer. Excavation for foundation of gate pillars and M.S. guides and provisioning of concrete shall be measured and paid separately. Provisioning of gate lights is not included in the scope of the item.

27. WELDING

This shall be done by electric arc process as specified herein before.

28. WEEP HOLES

Weep holes to drain off surface rainwater out of the premises shall be provided at location as shown in drawings along the boundary wall. Opening of suitable size as approved by the Project Manager/ Architect shall be provided in the boundary wall to serve as weep holes.

29. HORTICULTURE WORK

The horticulture operations shall be started on ground previously leveled and dressed to required formation levels and slopes. The planning of grass, shrubs ornamental hedging and trees will be executed as per the overall landscaping plan of the area.

MATERIAL**DUMP MANURE**

Dump manure shall be of well decayed organic or vegetable matter obtained in dry state from the municipal dump or similar source approved by the Architect/NCCF. It will be free from earth, stone, brick bats or other extraneous stuff and shall pass through sieve of I.S. designation 16.

SLUDGE

It shall be obtained from approved sewage disposal works. It will be transported to site in lorries with efficient arrangement to prevent spilling.

GOOD EARTH

It shall be agricultural soil of loamy texture free from kankar, mooram, shingle, rock, stone, brick bats and building rubbish and any other foreign matter.

CALCUTTA GRASS

Grass shall be fresh Calcutta Grass from weed, rank vegetation but having 'Rhizomes' with sufficient nodes and shall be approved by the Architect/ NCCF.

TRENCHING IN ORDINARY SOIL

- a. The trenching of soil is done in order to loosen and turn over and bury the top layer containing weed etc. in base and to bring up the lower layers of good earth to form proper medium for grassing, hedging and shrubbery.
- b. The whole plot shall be divided into narrow rectangular panels of 1.25 x 1m these sectional shall excavated soil deposited in adjacent section preceding it. The trenched ground shall after rough dressing be flooded with water to enable the solid to settle down. Weeds or other unwanted vegetation that appear on ground are uprooted and removed and area fine dressed.

c. SPREADING GOOD EARTH/ SLUDGE MANURE

Good earth sludge/ manure will be removed from the stacks in head load and spread evenly over fine dressed surface to required thickness with a twisting motion to avoid segregation in proportions of 2:1. These will be broken down to particle size of 6 mm

d. EXCAVATION AND TRENCHING FOR HEDGE/ SHRUBBERY

Beds for badge and shrubbery are to be prepared to widths and lengths of 60 cm and 2 to 4 meters respectively or as shown on the landscape plan.

The beds shall be excavated to a depth of 60 cm and excavated earth stacked on the sides of the beds. The surface of the excavated bed shall then be trenched for further depth of 30 cm. The top surface shall be rough dressed the excavated earth from the top 60 cm. will be then thoroughly mixed with sludge/ manure in proportions of 8:1 by volume and flooded with water. The surface after subsidence will be again filled with earth and manure and finally dressed to.

e. DIGGING HOLES FOR PLANTING TREES

Holes of circular shape 60 cmdia and 60 – 75 cm. depth shall be excavated and excavated earth broken to clods not more than 75 mm in any direction and stacked on the sides of the holes. Stones, brick bats and all other unsuitable materials will be removed from the excavated soil. This mixture of soil and good earth is then thoroughly mixed with dump manure and sludge in given proportion and filled in the excavated hole to required levels

and watered. The saplings of approved trees with roots encased in gunny bags brought from the nursery will then be planted in these holes and watered continuously from time to time till the sapling have taken firm root in the prepared holes.



JAMIA MILLIA ISLAMIA

VOLUME III

PRICE BID

TENDER DOCUMENT FOR CIVIL, PLUMBING &
SANITATION, INTERNAL ELECTRICAL, FIRE FIGHTING,
ELEVATORS AND EXTERNAL DEVELOPMENT WORKS

EXPRESSION OF INTEREST

FOR

CONSTRUCTION OF:-

- 1) Multi-Storey Administrative Block**
- 2) Academic Block for Health & Allied Science**
- 3) Teaching & Training Block**
- 4) Class Rooms (24 Nos.)**

AT

JAMIA MILLIA ISLAMIA, NEW DELHI-110025

- Nodal Agency
NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA
LIMITED,
LUCKNOW

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NATIONAL COOPERATIVE CONSUMER FEDERATION INIDA LIMITED**SCHEDULE 'C'****SUMMARY OF COST FOR PHASE-II**

Sr. No.	Description of Sub head	COST	NO.	TOTAL AMOUNT
1	Lump Sum Price worked out by contractor for Blocks for Foundations as per attached Tender, Drawings and Specifications for:			
	Total			
2	Lump Sum price worked out by contractor for Under Ground Water Tank & Pump Room as per attached Tender, Drawings and Specifications		1	
3	Lump Sum price worked out by contractor for Road Work as per attached Tender, Drawings and Specifications		1	
4	Lump Sum price worked out by contractor for External Fire Fighting Works as per attached Tender, Drawings and Specifications		1	
5	Lump Sum price worked out by contractor for External Water Supply Works as per attached Tender, Drawings and Specifications		1	
6	Lump Sum price worked out by contractor for External Drainage Works as per attached Tender, Drawings and Specifications		1	
7	Lump Sum price worked out by contractor for External Sewer System as per attached Tender, Drawings and Specifications		1	
8	Lump Sum price worked out by contractor for Electric Sub Station as per attached Tender, Drawings and Specifications		1	
9	Lump Sum price worked out by contractor for Tube well as per attached Tender, Drawings and Specifications		1	
10	Lump Sum price worked out by contractor for Landscaping & Horticulture Works as per attached Tender, Drawings and Specifications		1	
11	Lump Sum price worked out by contractor for Rain Water Harvesting as per attached Tender, Drawings and Specifications		4	

	Summary	
	TOTAL COST (IN FIGURES) (S. No. 1 to 11)	
	TOTAL COST (IN WORDS)	
	Discount/Addition if any (In Figures)	
	Discount/Addition if any (In Words)	
	NET TOTAL COST OF Project (IN FIGURES)	

SCHEDULE OF PAYMENT C-1

This Yard stick is to be applied for the Respective Types For The Separate BUILDING BLOCK As Per The Percentage Noted In Schedule 'C'

PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF FOUNDATIONS

Sr. No.	Stage of Work	%	Total %
1	On completion of excavation, dewatering, piling work including boring, providing & installing cast in situ straight bore piles below pile cap including RCC and steel reinforcement complete	55.0%	55.0%
2	On completion of testing of piling work	2.0%	57.0%
3	On completion of Pile cap/Raft/Stich slab/Foundation work including RCC and steel reinforcement work complete	40.0%	97.0%
4	On completion of water proofing work in foundation including Pre-construction and Post-construction work complete	3.0%	100.0%
	Total %		100.0%

SCHEDULE OF PAYMENT C-2

This Yard stick is to be applied for the Respective Types For The Separate BUILDING BLOCK As Per The Percentage Noted In Schedule 'C'

PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF BUILDING BLOCK (Excluding Foundations)

Sr. No.	Stage of Work	Common	8 Floors	Total %
		% of each Block	per Floor %	
1	RCC works above foundation including Column, pedestals, Beams, Slabs, Sand filling/ refilling, water proofing , Brickwork upto Slab level , filling, consolidation, roof slabs & beams for the basement slab etc including form work	2.25%		2.25%
2	RCC works including Columns, Beams, Slabs, Staircases, Shafts etc. complete with shuttering and reinforcement for stilt floor and for Each floor (8 floors)		3.28%	26.24 %
3	RCC works above Terrace level including Columns, Beams, Slabs, Staircases, Shafts, , etc. complete with shuttering and reinforcement for mumty, machine room and overhead tanks	1.75%		1.75%
4	Brick/ Conc. Block Masonry works including lintels, Chajjas, Lofts, Counter Slabs , Shelves , RCC lintels, etc. incl. Rain Water Pipes.(8 floors)		0.47%	3.76%
5	Brickwork/Concreting for Staircase Head Room , Parapets, Lift Machine Room, etc.	0.15%		0.15%
6	Doors, Frames and shutters		0.10%	1.50%
7	Aluminium Doors, Window frames & Shutters, Hinges, etc.		0.60%	9.00%
8	Building Hardware, glazing, Railings in Staircases, Balconies , ETC		0.15%	2.25%
9	Electrical Conduits including boxes and wiring,.		0.10%	1.50%
10	Electrical Switches & Sockets, Distribution Boards, MCBs, Meter Board, Tag BUILDING BLOCK, Earthing, , Testing, etc.		0.10%	1.50%
11	Lifts: Mobilization advance, Approval of drawings, Delivery of material, Installation, testing & commissioning and Handing over including NOC of competent	2.00%		2.00%

	authority			
12	Internal Plaster and water proofing works in sunken areas of Toilets, Kitchens, etc and including Punning and POP Cornice Work	0.50%	1.00%	15.50 %
13	External Finishing Works including Painting, making Grooves, Shaft Plaster and Painting and painting of pipes, Etc.	4.50%		4.50%
14	Dado & Counter Tops including polishing, etc.		0.10%	1.50%
15	Flooring & Skirting Works including Stone wall cladding	0.50%	0.30%	5.00%
16	Roof Terracing and Water Proofing and copings,	0.10%		0.10%
17	Primer and Painting of Entire Works		0.12%	1.80%
18	Final Painting Internal	0.10%	0.15%	2.35%
19	Sanitation Works including Plumbing Pipes including fittings and testing		0.50%	7.50%
20	C.P. Fittings and testing		0.40%	6.00%
21	Sanitary wares and Testing		0.10%	1.50%
22	Electrical Fittings in Common Areas	0.10%		0.10%
23	Misc. balance Items, solar water heating system etc.	1.00%		1.00%
24	Testing and commissioning and handing over of NOC/completion certificate of all works	1.25%		1.25%
	Total %			100.00%

SCHEDULE C-4

PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST CONSTRUCTION OF UNDER GROUNG WATER TANK & PUMP ROOM (Refer S. No. 14 of Schedule C-3)

UNDER GROUNG WATER TANK & PUMP ROOM

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Completion of RCC walls upto slab top with all fittings (sleeve, puddle flang) and foot rest complete with haunches	20	20
2	Construction of slab with manhole cover and other services	10	30
3	Completion of water proofing	5	35
4	Internal glazed tiles in walls & flooring etc.	5	40
5	Supplying & commissioning of pumps and panels etc.	15	55
6	Hydro testing of U.G. Tank	5	60
7	Providing & fixing electrical fittings with all respects	10	70
8	Supplying & commissioning of VV, WTP etc. complete	15	85
9	Obtain water connection, outlet connection permissions from GNIDA	3	88
10	Water & electric connections, testing & commissioning	10	98
11	Misc. works	0.5	98.5
12	On final handing over	1.5	100
	Total %		100

SCHEDULE C-5**PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF ROAD WORKS****Road Works**

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Removing of grass root, debris stamps and cutting of trees/plants upto 500 mm below and preparation of subgrade with 95% compaction on test of OMC.	5	5
2	Providing and laying of 90-45 mm size stone aggregate complete with rolling etc. (1st Layer)	7	12
3	Providing and laying of second laying 63-45 mm complete with rolling. (2nd Layer)	7	19
4	Providing and laying of third layer (63-65 mm)	7	26
5	Providing and laying of Kerb stone as per drawing.	9	35
6	Providing and laying of top surface	20	55
7	Painting & marking of road works.	10	65
8	Road reflector and overhead signage	10	75
9	Providing and laying of CC paver and D I grating.	10	85
10	Miscellaneous Work	5	90
11	On final handing over	10	100
	Total %		100

SCHEDULE C-6			
PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF EXTERNAL FIRE FIGHTING			
External Fire Fighting			
S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Excavation for pipe line for all kinds of soil.	5	5
2	Supplying, laying, jointing of ISI pipe complete with all fittings.	15	20
3	Supply & fixing in position IS marked cast iron double flanged butterfly valves with nickel plated disk, nut bolt with 3 mm rubber gasket including testing complete as per drawing.	7	27
4	Connection with distribution line complete with all fittings as per requirement.	12	39
5	Providing & fixing of fire hydrant with all accessories.	7	46
6	Providing, fixing and commissioning of three phase pumps and machines with all accessories complete as per required with all respect.	37	83
7	Hydro test / pressure testing of line	2	85
8	Miscellaneous Work	5	90
9	submitting NOC from Fire Department to NCCF	5	95
10	On final handing over	5	100
	Total %		100

SCHEDULE C-7**PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF EXTERNAL WATER SUPPLY****External Water Supply**

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Excavation of trench for all kinds of soil.	5	5
2	Supplying, laying, jointing of ISI marked pipes and valves complete with all fittings.	8	13
3	Supply & fixing in position ISI marked cast iron double franged butterfly valves with nickel plated disk, nut bolt with 3 mm rubber gasket including testing complete as per drawing.	7	20
4	Connection with distribution line complete with all fittings as per requirement.	12	32
5	Making of thrust BUILDING BLOCK at bond and support at different location as required.	3	35
6	Providing & fixing of garden hydrant with all accessories.	10	45
7	Construction of valve chamber with finish.	5	50
8	Providing & fixing of precast / SFRC / heavy duty cover with frame.	5	55
9	Providing, fixing and commissioning of three phase variable cum fixed speed hydro pneumatic sets complete with borewell.	25	80
10	Hydrotest / pressure testing of line	5	85
11	Miscellaneous Work	5	90
12	On completion of water supply connection to local authority main line and Internal main line	5	95
13	On final handing over	5	100
	Total %		100

SCHEDULE C-8

PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF EXTERNAL DRAINAGE WORK

External Drainage Work

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Excavation work (as required) as per BOQ and detailed drawings	5	5
2	Laying of RCC NP-2 pipe in correct line / level complete with joint and haunching including bed concrete.	20	25
3	Back filling with excavated soil in each layer not more than 20 cm compacted layer	10	35
4	Construction of manhole complete with internal / external plaster neat finish including footrest, if required.	15	50
5	Providing & fixing of SFRC cover with grout complete as required in detailed drawings / BOQ.	10	60
6	Testing and commissioning of drainage work.	5	65
7	Supply, testing and commissioning of pump suitable automatic operation, float valve including all accessories etc.	20	85
8	Miscellaneous Work	5	90
9	On completion of water supply connection to local authority main line and Internal main line	5	95
10	On final handing over	5	100
	Total %		100

SCHEDULE C-9**PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF EXTERNAL SEWERAGE LINE NETWORK****Sewer Line Network**

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Excavation work (as required) as per BOQ and detailed drawings	5	5
2	Laying of RCC pipe in correct line / level complete with joint and haunching including bed concrete.	20	25
3	Back filling with excavated soil in each layer not more than 20 cm compacted layer	10	35
4	Construction of manhole complete with internal / external plaster neat finish including footrest where ever required.	15	50
5	Providing & fixing of SFRC cover with grout complete as required in detailed drawings / BOQ.	10	60
6	Testing and commissioning of drainage work.	5	65
7	Supply, testing and commissioning of pump suitable automatic operation, float valve including all accessories etc.	20	85
8	Miscellaneous Work	5	90
9	On completion of water supply connection to local authority main line and Internal main line	5	95
10	On final handing over	5	100
	Total %		100

SCHEDULE C-10**PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE
CONSTRUCTION OF ELECTRIC SUB- STATION****Electric Sub – Station**

S.No.	Stage of Work	Percentage Payable	% age Cumulative
1	PCC and RCC work in foundations	25	25
2	Brick work in super structure	25	50
3	Door/ window, Rolling shutters frames	5	55
4	Internal plastering	5	60
5	Flooring, plinth protection and ramps	6	66
6	Cable ducts channels including duct cover	8	74
7	Door/window shutters and rolling shutters including painting and finishing	4	78
8	Glazing, Hardware and painting	2.5	80.5
9	Internal Electrification / Sanitary/ Plumbing work	6	86.5
10	External Finish	7	93.5
11	Miscellaneous works like water proofing, finishing, signages etc	5	98.5
12	Handing Over of building	1	99.5
13	Site clearance	0.5	100
	Total %		100

SCHEDULE C-11			
PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF TUBE WELL			
Tube well			
S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Obtain permission from Central Ground Water Board or any other authority for boring tubewell	10	10
2	After completion of Drilling / Boring for Pipe	24	34
3	After completion of laying Pipe for Casing	15	49
4	After completion of Fixing/ laying of submersible pump with Electrical work.	30	79
5	After completion of Laying of G.I. Pipe from Tube well point to under ground water tank	20	99
6	Testing and Handing over.	1	100
	Total %		100

SCHEDULE C-12

PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF LANDSCAPING AND HORTICULTURE

Landscaping & Horticulture

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Cleaning of area and removal of all kind of debris and levelling work.	2	2
2	Trenching in ordinary soil and filling of good earth with sludge as required.	5	7
3	Supplying and fixing of drain boards and geo textile fabrics	5	12
4	Civil work, finishing, stone cladding and Development for landscaping / horticulture in line & level as required including planters, pergolas, moulds, amphitheatre, feature walls, signages, benches etc complete	20	32
5	Supplying and laying good earth for plantation, road, jogging track and pathways etc	10	42
6	Uprooting and fine dressing for plantation complete with mixing of sludge.	3	45
7	Grassing with doob including watering and maintenance upto 30 days	5	50
8	Providing and laying of kerb stone all around	5	55
9	Providing and laying of plant, shrubs and trees, vertical plantation on feature walls etc in holes including spreading of manure sludge & pesticides etc. complete.	5	60
10	Supplying and laying Grass pavers and other granite/ Rcc pavers and pathways in landscape area, parking and driveways etc complete	10	70
11	Construction and commisioning of water bodies including finsihing of civil works, stone cladding and providing, testing and commisioning mechanical pump and fountains etc.	5	75
12	Construction and finishing of Play courts and Kids play area including all play ground equipments and chain link fence etc complete.	5	80
13	Miscellaneous Items like dustbins, drip irrigation, hoses etc	10	90
14	Maintenance of the landscaped area including Plants, Green area upto 12 months from date of completion.	10	100
	Total %		100

SCHEDULE C-13

PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST THE CONSTRUCTION OF RAIN WATER HARVESTING

Rain water Harvesting

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	After completion of Excavation work.	10	10
2	After completion of Brick work and provision of over flow pipe etc. complete.	15	25
3	After completion of Drilling / Boring & laying of slotted & plane pipe with fixing of cap etc. complete.	25	50
4	After laying of stone gravels, sand, stone ballast etc. complete.	24	74
5	After laying of RCC slab for covering of well & fixing of SFRC frame and cover etc. complete.	15	89
6	After Miscellaneous work and testing	5	94
7	On connections to main line and NOC from local authority	5	99
8	Handing over.	1	100
	Total %		100

SCHEDULE C-14**PAYMENT SCHEDULE YARD STICK FOR INTERIM PAYMENT AGAINST
SUPPLY AND INSTALLATION OF LIFTS (Refer S. No. 11 of Schedule C-2)****LIFTS**

S.No.	Stage of Work	Percentage Payable	%age Cumulative
1	Advance against Purchase Order	10	10
2	After approval of drawings	10	20
3	After delivery of material at site and inspection / verification by Architect and NCCF	50	70
4	After installation, testing and commissioning of lift equipment	15	85
5	After handing over of lift to NCCF and after getting No objection certificate from the competent authority (Electrical Department/Lift Inspector) for operation of lifts	10	95
5	On completion of minimum two months working of lift after handing over	5	100
	Total %		100

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCHEDULE D1 & D1.1	
SCOPE OF WORK	
FOR CIVIL WORKS FOR FOUNDATIONS	
Sr. No.	DESCRIPTION
	FOUNDATION WORK
1.0	STEEL REINFORCEMENT
1.1	Steel Reinforcement for RCC work including straightening, cutting, bending, placing in position and binding all complete upto plinth level
11.1	Thermo-Mechanically Treated Bars (fe 500)
2.0	DESIGN MIX CONCRETE
2.1	Providing and laying in position READY MIXED M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixers for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of RMC from transit mixer to site of laying, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per the direction NCCF/Architect.
2.2	All works upto plinth level including Raft foundation, Stitch Slab and Pile cap
2.3	Providing M-30 grade concrete instead of M-25 grade BMC/RMC
3.0	INTEGRAL CRYSTALLINE WATER PROOFING
	Providing and laying Integral crystalline water proofing material for horizontal surface and entire depth of Raft/Pile Cap in specified proportions (minimum 2 % of weight of cement or as specified by the manufacturer). Properly Mixing in RMC/BMC/RCC in specified proportions as per the approved brand of crystalline waterproofing material like Xypex 2000 NF/ Panetron/Kryotone etc with RMC/BMC. Thoroughly mixing to workable consistency and pouring and casting in position within 20 minutes, Vibrating with mechanical vibrators and compaction etc. complete as per direction of Engineer In-charge.
	The water proofing compound used in integral crystalline water proofing treatment shall satisfy all the requirements indicated in relevant BIS standards and shall be got tested before and after its use. Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the NCCF/Architect in writing. Materials shall be kept under double lock and key and proper account of water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements. Contractor shall associate himself with anyone of the specialist firms mentioned in approved list of specialized agencies for the work relating to the Water Proofing Treatment. In case the contractor intends to get the water proofing work executed from an agency other than as specified, he shall apply to the NCCF/Architect in writing along with the credentials and relevant details including name of owner/company, its location, capacity technical establishment, past experience etc. NCCF/Architect shall give approval in writing and the work shall not be started without said written approval of the NCCF/Architect. The entire responsibility for the quality of this treatment and its efficiency shall however, rest with the main contractor only.
4.0	FORM WORK

4.1	Centering and shuttering including strutting propping etc and removal of formwork for:
4.1.1	Foundations, footing, bases of columns, etc for mass concrete
5.0	MISCELLANEOUS WORKS
5.1	Any other works required to complete the foundation work as per design and drawing
6.0	EARTHWORK
6.1	Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth and removal of rubbish upto any distance outside the periphery of the area cleared.
6.2	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means to depth as per drawings including disposal of excavated earth upto all leads and lift, disposed soil to be levelled and neatly dressed.
a	All Kinds of Soil
6.3	Filling available excavated earth in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth: consolidating each deposited layer by ramming and watering in all leads and lifts.
6.4	Supplying the good earth from outside including the cost of filling the same within the site in layer not exceeding 20 cm in depth & consolidating each deposited layer by ramming, watering in all lead & lifts etc. complete.
6.5	Supplying, diluting and injecting chemical emulsion for POST-CONSTRUCTIONAL anti-termite treatment and creating a continuous chemical barrier under and around the column pits, wall trenches, retaining wall, basement excavation, top surface of plinth filling, junction of wall and floor, along the external perimeter of building, expansion joints, over the top surface of consolidated earth, surroundings of pipes and conduits etc. complete as per specifications.
a	Chloropyriphos emulsi-fiable concentrate 20% with 1.0% concentration.
6.6	The tenderer shall deposit all required royalties and take permission from the concerned department for excavation and submit the same to NCCF before starting of excavation work.
7.0	CONCRETE WORK
7.1	Providing and laying in position cement concrete of specified grade, including the cost of centering and shuttering. All work upto all heights and levels.
8.0	DE-WATERING
8.1	Work for excavation shall include bailing or pumping out water which may accumulate in the excavation during the progress of work either from subsoil, seepage, springs, flooding, rain or any other cause and diverting surface flow if any by bunds or other means, pumping out water shall be done in such approved manner as to preclude the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structure.
	The excavation shall be kept free from water:-
8.1.1	When concreting /reinforcement work/water proofing work are in progress.
8.1.2	Till the NCCF/Architect consider that concrete/mortar is sufficiently set.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCHEDULE D2A	
SCOPE OF WORK	
FOR CIVIL WORKS FOR BUILDING BLOCK	
SR. NO.	DESCRIPTION
1.0	CONCRETE WORK
1.1	Providing and laying in position cement concrete of specified grade, including the cost of centering and shuttering. All work upto plinth level.
a	1:4:8 (1 cement : 4 coarse sand :8 graded stone aggregate 40 mm nominal size).
1.2	Providing and laying cement concrete in string or lacing courses, parapets, copings, bed BUILDING BLOCK, anchor BUILDING BLOCK, plain window sills, fillets etc. at all floors, including the cost of centering, shuttering and finishing.
a	1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 12.5 mm nominal size)
1.3	Providing and laying damp-proof course 40 mm thick with cement concrete 1:2:4 (1 cement :2 coarse sand : 4 graded stone aggregate 12.5 mm nominal size) including providing and mixing water proofing material in cement concrete work @ 1 Kg per 50 kg of cement with Bitumen coating.
2.0	REINFORCED CEMENT CONCRETE WORK
2.1	Providing and laying in position machine batched, machine mixed and machine vibrated Design mix cement concrete of M-25 grade for reinforced cement concrete structural elements including the cost of centering, shuttering, finishing and admixtures in recommended proportions (as per IS: 9103) to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per directions of NCCF/Architect.
a	All work in plinth and superstructure (any thickness) above raft level in all shapes and sizes
i	Walls, columns, pillars, posts and struts
ii	Beams, plinth beams, girders, bressumers, cantilevers, suspended floors, lintels, roofs and folded steps & risers, staircases including spiral staircases, shelves, fins and pergola beams and planters etc.
2.2	Add for providing richer mixes at all floor levels.
a	Providing M-30 grade R.C.C. instead of M-25 grade R.C.C.
2.3	Providing, hoisting and fixing at all levels precast reinforced cement concrete in lintels exceeding 0.75 m clear span at all floors including the cost of required centring and shuttering with 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size).
2.4	Reinforcement steel (Fe 500) for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete at all levels and in all R.C.C. items with 18 gauge binding wire and cover BUILDING BLOCK of specified thickness in CM (1:3) complete, as per drawings and specifications at all heights and levels.
a	Thermo mechanically treated bars confirming to Fe-500 grade
2.5	Providing, hoisting and fixing up to floor at all levels, precast reinforced cement concrete in small lintels not exceeding 1.5m clear span, up to floor at all levels including cost of centering, shuttering, finishing and reinforcement steel with 1:2:4 (cement: coarse sand: graded stone aggregate 20 mm nominal size)
2.6	Extra for additional height in centering,shuttering wherever required with adequate bracing, propping etc including cost of de-shuttering and de-centering at all levels, over a height of 3.5m for every additional height of 1 metre or part thereof.
a	Suspended floors, roofs, landings, beams and balconies.

3.0	BRICK WORK
3.1	Brick work with FPS bricks of class designation 10.0 (10.0 N/SQMM) in foundation and plinth in cement mortar 1:6 (1 cement:6 coarse sand).
3.2	Brick work with FPS bricks of class designation 10.0 (10.0 N/SQMM) in cement mortar 1:6 (1 cement : 6 coarse sand) in superstructure above plinth level, upto any floor in all shapes and sizes.
3.3	Half brick masonry of FPS bricks of class designation 10.0 (10.0 N/SQMM) in cement mortar 1:4 (1 cement: 4 coarse sand) in superstructure above plinth level upto all floors and level including providing and placing 2 nos. 6 mm dia M.S. bars at every fourth course.
4.0	WOOD WORK
4.1	Providing and fixing factory made door/window frames in Hard wood/ Red Mirandi wood in Single rebate frames of doors and other frames of 100 mm x 65 mm size including 35x12mm wooden moulding of Red Mirandi wood all around the frame, one side flush with brick work/ column and fixed in position with M.S. hold fasts 40 x 5 mm and 300 mm long 3 nos. on each side or 100 mm long gun metal dash fastner in case of RCC column, including grooves and making arrangement as shown on drawing, applying anti-termite paint on surfaces touching masonry or concrete etc. complete
a	115 mm x 65 mm for external door frames
b	100 mm x 65 mm for internal door frames/Toilets
4.2	Teak wood frame
	Providing wood work in frames of Main doors, windows, and other frames in Double Rebate frames including 35x12mm wooden moulding in second class Teak wood all around the frame, one side flush with brick work/ column and fixed in position with M.S. hold fasts 40 x 5 mm and 300 mm long 3 nos. on each side or 100 mm long gun metal dash fastner in case of RCC column, including grooves and making arrangement as shown on drawing, applying anti-termite paint on surfaces touching masonry or concrete etc. complete and fixed in position with hold fast lugs or with dash fasteners of required dia & length complete in all respects.
4.2.1	Second class Teak wood of size 150 mm x 65 mm for entrance doors frames
4.3	Providing and fixing skin moulded door shutter , made in approved factory with High Density Fiberboard (HDF) conforming to IS:15380:2003. These will have HDF skin (Boiling water proof as per IS 15380-2003) which will be boiling water resistant, termite resistant and with embossed authentic wood grain texture and paintable/polishable. The core shall be imported Flex Board Core (with min 7 years warranty). The adhesive used shall be confirming to BWP grade of IS 848. The Stile and Rail and Lock Block shall be made of 1st class hard Wood . The Stile & Rail shall be min of 50-60mm wide, 26-28mm thick and Lock Block shall be 101 x 380mm. The door shutter shall be of 1 Panel/2Panel type painting with 2 or more coats with spray synthetic enamel paint over a coat of wood primer to give an even shade as directed by NCCF/Architect complete in all respects.
a	35 mm thick (internal doors of DU)
4.4	Providing and fixing 35 mm thick both side laminated flush door shutter , decorative type, core of block board construction with frame of 1st class hard wood and well matched 3 mm thick commercial ply on both faces of shutters using phenol formal-dehide synthetic resin (conforming to B.W.P. Type specified in IS:848 1974) including 6 mm thick external lipping of 2nd class teak wood glued & nailed all around complete, painting with 2 or more coats with spray synthetic enamel paint over a coat of wood primer to give an even shade.
4.5	Providing and fixing of double leaf/single leaf Panelled door shutters including SS butt hinges with necessary SS screws in 40 mm thick 2nd class teak (2P) panelled shutters for Main doors with all fixtures and fittings like mortise lock and chain, magic eye, door stopper, tower bolts, sliding aldrops etc complete.
a	40 mm thick Second class teak wood 2 panel door (double leaf) MAIN DOOR

b	40 mm thick Second class teak wood 2 panel door (double leaf) with SS Round Bars in upper panel and solid wood panel in the lower panel. MAIN DOOR
4.6	Providing 40x5 mm flat iron hold fast 40 cm long including fixing to frame with 10 mm diameter bolts, nuts and wooden plugs and embeddings in cement concrete block 30x10x15cm 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size)
4.7	Providing and fixing Stainless steel (304 grade) fitting of approved make with necessary screws etc. complete.
a)	Sliding aldrops
	250 x 16 mm or as required
b)	Tower Bolt
i)	250 x 10mm or as required
ii)	150 x 10mm or as required
c)	Handles
i)	125mm with plate 175 X32 mm
d)	Hanging floor door stopper 150 mm or as required
e)	40mm dia rubber buffer of required length with necessary stainless steel screws etc. complete
f)	Stainless steel butt hinges with necessary screws etc. complete
i)	125 x 70 x 4 mm hinges or as required
g)	Cylindrical locks at room door
h)	Mortise lock and chain link
i)	Magic eye
4.8	Providing and fixing steel finished 100mm Mortice latch & lock with six levers and pair of lever handles with necessary screws etc. complete in MAIN DOOR complete
4.9	Supply and Fixing of 46mm thick Wood Fire Check door of 120 minutes fire rating fabricated with 1.2mm thick galvanised sheet with infill of fire rated Acrylic Sealant and non-combustible core bonded to both faces of sheet with lock seam joints at stile edges and internal reinforcement at top, bottom and stile edges for fire rating. The door frames are manufactured from 1.6mm thick galvanised steel sheet pressed from to double rebate profile of size 143mm x 57mm. The door frames and door shutters are finished with zinc chromate primer in accordance with BS 476 Part 22 and IS 3614 Part II for 2 Hrs. rating complete.
5.0	STEEL WORK
5.1	Providing and fixing MS/Stainless steel (grade 304) balcony railing, staircase railing by welding etc, including applying two or more coats of synthetic enamel paint over a priming coat of approved steel primer complete and fixing to the wall, floor with necessary C.C., holdfast etc & making good the same as per details shown in drawing.
a	M.S. tube (medium), M.S. square bars & M.S. flat or in their combination for staircase railings, ladders, frames etc
b	SS solid/hollow section or in their combination for balcony railings
5.2	GRATINGS
a	Providing & fixing in position M.S. grating made out of M.S. flat iron, angle iron frames including applying two or more coats of synthetic enamel paint over one coat of steel primer complete as per details shown in drawing.
b	Providing & fixing in position D.I. grating made out of Ductile Iron frames complete for covering Drain Channels in basement and ground floor (over Basement Slabs) as per details shown in drawing.
5.3	Structural steel work welded in built up Section trusses and frame work etc. for external façade as shown on drawing for all heights including cutting, hoisting, scaffolding, fixing in position and applying two or more coats of synthetic enamel paint over a priming coat of approved steel primer all complete as shown in drawings.

a	M.S. tubes, plates etc.
5.4	Providing and fixing 14 gauge 50mm dia M.S. pipe/ M.S. D-shape hand rail section for hand rails of required shape and profile, including welding and fixing in position at all places and levels, including 2 or more coats of enamel paint over a coat of red oxide primer on all steel surfaces of approved make and manufacturer complete.
5.5	Providing and fixing T-iron frames for doors, windows of M.S. section, joint, mitred & welded with 15x3mm lugs 10cm long embedded in cement concrete BUILDING BLOCK 15 x 10 x 10cm of 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) or as required including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer including 1mm thick M.S. sheet door with frame of 40 x 40 x 6mm angle iron and 3mm M.S. gusset plate at the junction and corners, all necessary fittings complete including a priming coat of approved steel primer using flats 30 x 6mm for diagonal braces & central cross piece.
5.6	Providing and fixing circular/ hexagonal cast iron or M.S. sheet box for ceiling fan clamp of internal dia 140mm, 73mm height top lid of 1.5mm thick M.S. sheet with its top surface hacked for proper bonding, top lid shall be screwed into the cast iron/M.S. sheet box by means of 3.3mm dia round headed screws, one lock at the corners. Clamp shall be made of 12mm dia M.S. bar bent to shape as per standard drawing.
6.0	FLOORING
6.1	Providing and laying at all floors 1st quality ceramic glazed tiles in flooring conforming to IS: 13 753 of size 300 x 300 mm and 10 mm thickness of approved make in all colours, shades as approved by NCCF/Architect, laid over 20 mm thick bed of cement mortar 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement mixed with pigment of matching shade and cleaning the surface complete in all respects. This shall also be provided in wall dado and flooring of underground and overhead water tank (Basic rate of ceramic tile will be Rs. 300 per sqmtrs)
6.2	Providing and laying Anti skid ceramic glazed floor tiles 300 x 300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS: 13755 of approved brand mentioned in schedule 'E' or equivalent make in all colours, shades except white, Ivory, Grey Fume Red Brown laid on 20 mm thick bed of Cement Mortar 1:4 (1 cement:4 coarse sand) including pointing the joints with white cement and matching pigments etc. complete. (Basic rate of ceramic tile will be Rs 370.00 per sqmtrs). Skirting shall be deemed to be included in same item.
6.3	Providing and fixing at all floors 1st quality Ceramic glazed tiles on walls conforming to IS: 13753 of 8 mm thickness of approved make in all colours, shades and of any size as approved by the NCCF/Architect in skirting, risers of steps and dados laid over 12 mm thick bed of Cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing the joints with white cement mixed with matching pigments and cleaning the surface complete in all respects. This shall also be provided in walls of over head water tank. (Basic rate of ceramic tile will be Rs 370.00 per sqmtrs)
6.4	Providing and laying at all floors 1st quality Polished glazed Vitrified tiles (PGVT) in size 800 x 800 mm and 10 mm thick in flooring with water absorption less than 0.8% and conforming to IS:51622 of approved make, colour, shade and pattern as shown on drawing and approved by NCCF/Architect laid over 20 mm thick bed of cement mortar 1:4 (1 cement:4 Coarse sand) including pointing the joints with white cement mixed with pigment of matching shade and cleaning the surface complete in all respects. (Basic rate of Vitrified tile will be Rs 1080.00 per sqmtrs)
6.5	Providing and fixing at all floors polished glazed vitrified tiles (PGVT) of size 600 x 600 mm and 8-10 mm thickness with water absorption less than 0.8% and conforming to IS:51622 in all colours, shades and of any size as approved by the NCCF/Architect in skirting, risers of steps and dados laid over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3 Kg per sqm including pointing the joints with white cement mixed with matching pigments and cleaning the surface complete in all respects. (Basic rate of Vitrified tile will be Rs 840.00 per sqmtrs)

6.6	Providing and laying at all floors 20 mm thick prepolished Granite stone slab with facia/moulding of colour and shade as approved by the NCCF/Architect on kitchen/toilet counter slab including nosing, rounding of edges over 20 mm thick bed of cement mortar 1:4 (1 cement : 4 coarse sand) including pointing the joints with white cement mixed with pigment of matching shade and cleaning the surface complete in all respects. (Basic rate of Granite Stone will be Rs 1800.00 per sqmtrs)
6.7	25 mm thick sorted Kota stone slab flooring in different shades and pattern as shown on drawing and approved by NCCF/Architect over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab including rubbing and polishing complete with base of cement mortar 1:4 (1 cement : 4 coarse sand) (Basic Rate Rs. 400 per sqmtrs).
6.8	Providing and fixing at all floors 18 mm thick pre polished granite stone slab of colour and shade as approved by the Architect/Project Manager in lift facia walls dados including rounding of edges as shown in drawing laid on 20mm thick bed of cement mortar 1:2 (1 cement: 2 coarse sand) and jointing with grey cement slurry @ 3.3. kg per sqm including pointing the joints with white cement mixed with matching pigment and cleaning the surface complete in all respects including the cost of SS clamp as required. (Basic rate of Granite Stone will be Rs 1500.00 per sqmtrs)
6.9	Providing and laying design mix 75-100 mm Vaccum dewatered cement concrete flooring with broom finish in Stilt, Basement, roads, taxi ways, driveways having a minimum works test beam flexural strength of 30 kg. per cm ² . at 28 days using not less than 340 Kg. of cement per cum of finished concrete, coarse sand and graded stone aggregate of 20mm nominal size in appropriate proportions as per specified design criteria approved by NCCF/Architect mechanically vibrated using needle and surface vibrators including steel form work with sturdy M. S. channel sections including curing and providing and filling construction joints and dummy joints with approved joint filler and primer including rounding of the edges and filling the grooves 10x25mm deep at top for construction joints and 10mmx50mm deep at top for dummy joints with joint sealing compound (conforming to grade B of IS : 1834) including making necessary arrangements for expansion joints etc. all complete as per design and drawing.
7.0	ALUMINIUM WORK
7.1	Providing and fixing of aluminium works for window / door using Kawneer or Reyners or Schuco or equivalent with powder coated (min 60 microns) of approved shade/colour, frame and glazing bead sections selected with suitable moment of Inertia depending upon the wind load and glass load. The frame section depth shall not be less than 45mm (Aluminium section depth) & minimum 1.8mm Aluminium profile Wall thickness . All frame corner's shall be joints assembled using die-cast aluminium corner cleats fixed with external buttons with rapid and secure joint assembly, no screwing of corner joints are allowed as per specifications complete. Handles, rubber gaskets, hinges, locks , Friction stays and required accessories shall be included and provided as per system company design. The system should be tested for Air tightness and water penetration as per EN/BS/IS standards. Weather silicon sealant 789 of dow crowing to be used to make glazing weather and water tight. All windows/Doors Shall be prefabricated factory made through authorized Fabricator of System company. Glass must be 6 MM thick toughened float glass (ST 167 - Sparkling ICE) make of saint gobain or equivalent.
a	Sliding 2 Track Window with wire mesh: The shutter section depth shall not be less than 45 mm with add on fly mesh, minimum profile wall thickness should be 1.8 MM with min Aluminium Profile weight of 7kg/sqm . The section shall be provided with screw flutes to accomodate the SS screw for 90 degree joints.Door bottom seal section,the glazing bead section should be selected depending upon the glass thickness, shall be snap-on type and screw less and complete with all fittings and sealing compound to the satisfaction of Architect / NCCF.
b	Casement Door: The shutter section depth shall not be less than 45 mm with minimum wall thickness should be 1.8 MM with min profile weight including frame section should be 7Kg /sqmt .The section shall be provided with screw flutes to accomodate the SS screw for 90 degree joints.Door bottom seal section, the glazing bead section should be snap-on type and should be screw-less. The system should accommodate proper locking arrangement & all other standard accessories which are part of the System company complete with all fittings and sealing compound to the satisfaction of Architect / NCCF.

c	Casement fly mesh Door: The shutter section depth shall not be less than 45 mm with minimum wall thickness should be 1.8 MM with min Aluminium Profile weight of 7kg/sqm & to put box section(should be minimum 50mm X 50mm size to accomodate the size of handle). Fly mesh should be made of SS(Stainless Steel) and Mosquito Proof. The section shall be provided with screw flutes to accomodate the SS screw for 90 degree joints.Door bottom seal section, the glazing bead section should be snap-on type and should be screw-less. The system should accommodate proper locking arrangement & all other standard accessories which are part of the System company complete with all fittings and sealing compound to the satisfaction of Architect / NCCF.
d	Casement Window: The shutter section depth shall not be less than 45 mm with minimum wall thickness should be 1.8 MM with min profile weight including frame section should be 7Kg /sqmt .The section shall be provided with screw flutes to accomodate the SS screw for 90 degree joints.Window bottom seal section,the glazing bead section should be snap-on type and should be screw-less. The system should accommodate proper locking arrangement & all other standard accessories which are part of the System company complete with all fittings and sealing compound to the satisfaction of Architect / NCCF.
e	Casement fly mesh Window: The shutter section depth shall not be less than 45 mm with minimum wall thickness should be 1.8 MM with min Aluminium Profile weight of 7kg/sqm & to put box section(should be minimum size to accomodate the size of handle).fly mesh should be made of SS(Stainless Steel) and Mosquito Proof.The section shall be provided with screw flutes to accomodate the SS screw for 90 degree joints.Window bottom seal section,the glazing bead section should be snap-on type and should be screw-less. The system should accommodate proper locking arrangement & all other standard accessories which are part of the System company complete with all fittings and sealing compound to the satisfaction of Architect / NCCF.
f	Fixed: The shutter section depth shall not be less than 45 mm with minimum wall thickness should be 1.8mm with min weight of 3.5-4.5kg/sqm . The section shall be provided with screw flutes to accomodate the SS screw for 90 degree joints. The glazing bead section should be snap-on type and should be screw-less. The system should accommodate proper locking arrangement & all other standard accessories which are part of the System company complete with all fittings and sealing compound to the satisfaction of Architect / NCCF.
7.2	Providing and fixing 12 mm thick prelaminated particle board with decorative lamination on both sides, flat pressed three layer or graded wood particle board conforming to IS:12823 Grade I type II, in panelling fixed in aluminum doors, windows, shutters and partitions frames with C.P. brass/stainless steel screws etc complete as per architectural drawings and directions of NCCF/Architect.
7.3	Providing and fixing double hydraulic floor spring of approved brand and manufacture conforming to IS 6315, having brand logo embossed on the body/plate with double spring mechanism and door weight upto 125 kg for door, including cost of cutting the floor, embedding in floors with stainless steel cover plate of minimum thickness 1.25 mm as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single peice M.S. sheet outer box and cover plates with brass pivot and single peice M S sheet outer box with slide plate etc. complete as per the direction of NCCF/Architect.
7.4	Providing and fixing machine moulded aluminium covering of approved patterns & design, made out of machine holed for receiving dashed fastners, over expansion joints on vertical surfaces /ceiling floors , the fixing on plate in one row on one side of jointing shall be done with stainless steel dash fastners of 8mm dia and 75 mm long bolt including providing aluminium washers 2mm thick & 15mm dia, at a staggered pitch of 200mm centre to centre including drilling holes in the receiving surface and providing expandable plastic sleeves in holes etc as per direction of NCCF/Architect.
a	Anodised aluminium sheet 2.5 mm thick (anodised transparent or dyed to required shade according to IS: 1868, minimum anodic coating of grade AC 15)
b	Powder coated aluminium sheet 2.5 mm thick (minimum thickness of powder coating 50 micron)
7.5	Filling the gap in between aluminium frame and adjacent RCC/Brick/Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of NCCF/Architect complete.
a	upto 5mm depth & 5mm width

7.6	Providing and fixing aluminium tubular handle bar 32 mm outer dia, 3.0 mm thick & 2100 mm long with SS screws etc complete as per direction of NCCF/Architect.
a	Anodised (AC 25) aluminium tubular handle bar
b	Powder coated minimum thickness 50micron aluminium tubular handle bar
c	Ployster powder coated minimum thicness 50 micron aluminium tubular handle bar
7.7	Providing and fixing aluminium casement windows fastners of required length for aluminium windows with necessary screws etc complete.
a	Anodised (AC15) aluminium
b	Powder coated minimum thickness 50micron aluminium tubular handle bar
c	Ployster powder coated minimum thicness 50 micron aluminium tubular handle bar
7.8	Providing and fixing aluminium round shape handle of outer dia 100mm with SS screws etc complete as per direction of NCCF/Architect.
a	Anodised (AC15) aluminium
b	Powder coated minimum thickness 50micron aluminium tubular handle bar
c	Ployster powder coated minimum thicness 50 micron aluminium tubular handle bar
7.9	Providing and fixing anodised aluminium grill of approved design/ pattern, with approved standard section and fixed to the existing window frame with CP brass/SS screws @ 200mm c/c including cutting the grill to proper opening size for fixing and operation all complete as per requirement and direction of NCCF/Architect.
7.10	Providing and fixing 10-12mm thick frameless toughened glass door/window/ fixed shutter of approved brand & manufacture including providing & fixing top & bottom pivot & spring type fixing arrangements and making necessary holes etc for fixing required door fittings all complete as per requirement and direction of NCCF/Architect.
7.11	Providing and fixing anodised aluminium z section frame and shutters with 75 mm wide louvers including necessary hinges, handles and all fittings as per drawings for shafts coverings. (Electric, LV, Plumbing etc shafts)
	Aluminum Frame in 50mm x 75 mm z section
	Aluminum Door panel in 25 mm x 50 mm z section
7.12	Providing and fixing Red colour powder coated (60 micron) aluminium box / Z section frame and shutters with 5 mm thick clear glass including necessary hinges, handles, tower bolts, mortised lock etc all fittings as per drawings for shafts coverings. (fire shafts)
	Aluminum Frame in 50mm x 75 mm section
	Aluminum Door panel in 25 mm x 50 mm section
8.0	FINISHING
8.1	12 mm cement plaster of mix: 1:4 on 230mm thick brick walls (1 cement : 4 coarse sand)
8.2	15mm cement plaster on the rough side of single or half brick wall of mix: 1:4 (1 cement : 4 coarse sand)
8.3	6 mm cement plaster to ceiling of mix : 1 : 3 (1 cement : 3 fine sand) including grooves.
8.4	20 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement: 5 coarse sand) and a top layer 8 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) mixed with approved water proofing compound 2% by weight of cement and finished smooth on the external surface of buildings for all heights and levels including forming grooves as per drawings.
8.5	Providing and fixing 150 mm wide chicken wire mesh of 22 gauge on the brick wall/column/beam junctions and over PVC conduit and GI/PPR pipe with nails etc. complete.

8.6	Providing and applying Cement based putty in line and level over plastered surface to prepare the surface even and smooth complete and to the satisfaction of NCCF/Architect as follows:
a	For internal walls 2.5 mm thick
b	For external walls 2.5 mm thick
8.7	Providing POP 75-100 mm cornice on the junction of beam and slab in line and level as per the design shown in drawing.
8.8	Wall painting with Premium acrylic emulsion paint of interior grade having VOC (Volatile Organic compound) content less than 50 gram/litre of approved brand and manufacture, including applying 2 or additional coats where ever required to achieve even shade and colour. (as approved by NCCF/Architect) including one priming coat with primer of approved brand and manufacture, having low VOC content with water thinnable cement primer on wall surface having VOC content less than 50 gram/litre.
8.9	Finishing exterior walls with Textured painting (exterior grade) applied @ 3.28 kg/10 sqm over and including priming coat applied @ 2.20 litre/10Sqm of approved make shade and colour on all heights and levels. The rate shall include all operations of work required for painting at all heights and as per specifications.
8.10	Applying priming coat with ready mixed Red oxide zinc chromatic primer with VOC content less than 250 gram/litre of approved brand and manufacture on steel work.
8.11	Painting with synthetic enamel paint having VOC content less than 150 gram/litre of approved brand and manufacture including applying 2 or additional coats where ever required to give an even shade with two or more coats on new work.
8.12	20 mm Stone cladding work for wall lining (machine cut edge) backing filled with a grout of thick cement mortar 1:3 (1 cement : 3 coarse sand) including pointing in white cement 1:2 (1 white cement ; 2 stone dust) with an admixture of pigment matching the stone shade (to be secured to the backing by means of cramps) complete work in all respects as per direction of NCCF/Architect.
a)	Local stone exposed finish fine dressed without rough backing
8.13	Applying priming coats with Primer of approved brand and manufacture having ready mixed pink or grey primer on wood work having VOC content less than 50 gram/litre
8.15	Distempering with 1st quality Oil Bound Distemper having VOC content less than 50 gram/litre of approved brand and manufacture including 2 or more coats where ever required to achieve even shade and colour.
	Stilt, basement and common areas, terrace etc
9.0	WATER PROOFING/ ROOFING
9.1	Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of balconies, W.C, kitchen, stilt etc and the like consisting of the following operations:
a	1st course of applying cement slurry @ 4.4 kg/sq m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.
b	2nd course of 20 mm cement plaster 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.
c	3rd course of applying three coats of tapecrete or equivalent waterproofing, each coat shall be mixed with cement in the proportions recommended by the manufacturer.
d	4th course of 10 mm cement plaster 1:4 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.

	The rat includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer modified slurry.
9.2	Providing and laying integral cement based treatment for water proofing on horizontal surface at all depth below ground level for under ground structures like retaining wall, UG tank etc as directed by NCCF/Architect and consisting :
a	1st layer of 22mm to 25mm thick approved and specified rough stone slab over a 25mm thick base of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound conforming to IS 2645 in the recommended proportion over the leveling course. Joints sealed and grouted with cement slurry mixed with water proofing compound.
b	2nd layer of 25mm thick cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound in recommended proportions.
c	Finishing top with stone aggregate of 10mm to 12mm nominal size spreading @ 8 cudm/sqm thoroughly embedded in the 2nd layer.
	Using rough kota stone
9.3	Proofing and laying integral cement based treatment for water proofing on the vertical surface of under ground structures like UG tank, Retaining walls etc by fixing specified stone slab 22 mm to 25 mm thick with cement slurry mixed with water proofing compound conforming to IS :2645 in recommended proportions with a gap of 20 mm (minimum) between stone slabs and the receiving surfaces and filling the gaps with neat cement slurry mixed with water proofing compound and finishing the exterior of stone slab with cement mortar 1:3 (1 cement : 3 coarse sand) 20 mm thick with neat cement punning mixed with water proofing compound in recommended proportion complete at all levels and as directed by NCCF/Architect.
	Using rough kota stone
9.4	INTEGRAL CRYSTALLINE WATER PROOFING
	Providing and laying Integral crystalline water proofing material for horizontal and vertical surface and entire thickness of Under ground Structures like U G Tank, Retaining wall, Stitch Slab, Raft etc and Over ground RCC water retaining structures like OHT in specified proportions (minimum 2 % of weight of cement or as specified by the manufacturer). Properly Mixing in RMC/BMC/RCC in specified proportions as per the approved brand of crystalline waterproofing material like Xypex 2000 NF/ Panetron/Kryotone etc with RMC/BMC. Thoroughly mixing to workable consistency and pouring and casting in position within 20 minutes,Vibrating with mechanical vibrators and compaction etc. complete as per direction of Engineer In-charge.
	The water proofing compound used in integral crystalline water proofing treatment shall satisfy all the requirements indicated in relevant BIS standards and shall be got tested before and after its use. Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the NCCF/Architect in writing. Materials shall be kept under double lock and key and proper account of water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements. Contractor shall associate himself with anyone of the specialist firms mentioned in approved list of specialized agencies for the work relating to the Water Proofing Treatment. In case the contractor intends to get the water proofing work executed from an agency other than as specified, he shall apply to the NCCF/Architect in writing along with the credentials and relevant details including name of owner/company, its location, capacity technical establishment, past experience etc. NCCF/Architect shall give approval in writing and the work shall not be started without said written approval of the NCCF/Architect. The entire responsibility for the quality of this treatment and its efficiency shall however, rest with the main contractor only.
9.5	TERRACE ROOF TREATMENT
9.5.1	Providing and laying integral cement based water proofing treatment including preparation of surfaces as required for treatment of roofs and terraces consisting of the following operations:
a	Applying one coat of acrylic polymer modified cement slurry coating over the RCC surface and continued upto height of 250 mm from the roof slab. Laying fibre glass cloth over the applied surface when the coating is still green and there after applying one more coat of acrylic polymer modified cement brush topping over the fibre glass cloth.

b	Laying cement concrete using broken bricks bats 50 mm to 100mm size with 50% cement mortar 1:4 (1 cement : 4 coarse sand) admixed with approved water proofing compound over 20 mm thick layer of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with approved acrylic polymer based water proofing compound and top layer with 25 mm thick cement mortar 1:4 (1 cement:4 coarse sand) admixed with above water proofing compound to required slope and treating similarly the adjoining walls upto 300mm height including rounding of the junctons of wall and slabs.
c	After two days of proper curing a second coat of cement slurry admixed with approved water proofing compound shall be laid, finishing the surface with 20 mm thick joint less layer of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with approved water proofing compound conforming to IS 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300x300 square.
d	The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for the final test. All above operations to be done in order and as directed and specified by the NCCF/Architect
e	RCC surface to be cleared of all dirt, loose material and kept dry and holes/cracks to be repaired
	With average thickness of 120 mm and minimum thickness at shurra as 65 mm.
9.6	Grading Roof for water proofing treatment with
9.6.1	Cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)
9.7	Brick bat coba water proofing of 110mm average thickness with brick aggregate and admixture of water proofing etc. Necessary gradient for easy flow of water shall be provided and the treated surface shall be covered with joint less water proof layer finished smooth with trowel in cement colour, marked into 300mm false squares. The job shall be completed including round vatas and khurras as per specifications of the specialist. (in Munty and Machine Room)
9.7.1	For additional thickness where required over and above 110 mm (average) thickness.
9.8	EXTENDED BASEMENT WATER PROOFING TREATMENT (HORIZONTAL AND VERTICAL)
	Providing and laying APP (Atactic Polypropylene Polymer) modified prefabricated five layer 3 mm thick water proofing membrane, black finished reinforced with non-woven polyester matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufacture of density of 25°C, 0.87-0.89 kg/ litre and viscosity 70-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc, and preparing the surface complete. The vital physical and chemical parameters of the membrane shall be as under: Joint strength in longitudinal and transverse direction at 23°C as 650/ 450N/5cm. Tear strength in longitudinal and transverse direction as 300/250N. Softening point of membrane not less than 150°C. Cold flexibility shall be upto -2°C when tested in accordance with ASTM, D-5147. The laying of membrane shall be got done through the authorised applicator of the manufacturer of membrane:
9.8.1	3 mm thick
9.9	Covering top of membrane with Geotextile , 120 gsm non woven, 100% polyester of thickness 1 to 1.25 mm bonded to the membrane with intermittent touch by heating the membrane by Butane Torch where ever required or as per manufactures recommendation.
9.10	Covering subsoil water/rain water drains in landscape area/podium with Geotextile , 120 gsm non woven, 100% polyester of thickness 1 to 1.25 mm where ever required or as per manufactures recommendation.
9.11	Providing and laying minimum 50 mm Screed concrete 1:2:4 (1 cement:2 coarse sand:4 graded stone aggregate 20 mm nominal size) above the water proofing membrane as a protection layer to water proofing in slope as per drawing including welded wire mesh of weight 1.5 kg/ sq m and 50mm thickness pressure guniting on top complete as per specification
9.12	Polyurethene foam over deck insulation on roof with cement based integral brick bat coba with waterproofing compound with specialised agency.
9.20	Making khurras 60 x 60 cm with average minimum thickness of 5cm cement concrete 1:2:4 (1 cement : coarse sand : 4 graded stone aggregate of 10 mm nominal size) over P.V.C sheet 1m X 1m X400 micron, finished with 12 mm cement plaster 1:3 (1 cement :3 coarse sand) and a coat of neat

	cement rounding the edges and making and finishing the outlet complete.
9.21	Injection Grouting with cement slurry and admixed with non shrinking grouting compound through nozzle under pressure by pump at every 1m vertical and horizontal distance to all RCC structure, under ground and over ground (water retaining structures like OHT). the nozzle shall be sealed off after injection operation is over with pozzolith 100 HE admixed with cement.
9.22	Providing and fixing of hygroscopic water proofing seal like kuoni seal or equivalent in all expansion/ construction joints in RCC structure works as per the manufacturer's specification
10.0	MISCELLANEOUS WORK
10.1	Making plinth protection 50 mm thick of cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) over 75 mm bed of dry brick ballast 40 mm nominal size well rammed and consolidated and grouted with fine sand including finishing the top smooth, centering and shuttering complete.
10.2	Providing and fixing 1 mm thick aluminium sheet in/over expansion joint including cutting fabrication and fixing etc. complete including the cost of necessary screws, washers etc.
10.3	Providing and placing in position suitable PVC water stopper for construction/expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. & later providing complete.
10.4	Supplying and fixing 10 mm thick multi wall poly carbonate sheet with aluminium profile (powder coated) with EPDM gasket in between with self drilling screws, necessary silicones to make the structure water tight complete as per drawing and fixed to steel structure with necessary base plates complete in all respects, all as per manufacturer's specifications and Architects directions (make: GE or approved equivalent).
10.5	providing and fixing of Letrx make Letter boxes of standard size with locking arrangement with marking of dwelling unit number on letter box of approved colour and make complete.
10.6	Signages with back lit stainless steel letters min 2'-0" high in hindi and english and NCCF logo to be fixed as per design and drawing complete.
10.7	Numbering of each dwelling unit with stainless steel plate with numbers fixed to front door complete as per design.
10.8	Providing and fixing SCI Cowl
10.9	Providing and laying Foam concrete in sunken portion
10.10	Two plastic dust bins of 50 kg capacity to be provided at each and every floor.
11.0	FALSE CEILING

11.1	<p>Providing and fixing tiled false ceiling of approved material of size 595x595mm in true horizontal level , suspended on interlocking metal grid of hot dipped galvanised steel sections (galvanised @ 120gm/sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38mm made from 0.30mm thick sheet, spaced at 1200mm c/c to form a grid of 1200x600mm and secondary cross "T" of length 600mm and size 24x25mm made of 0.30mm thick sheet to be interlocked at middle of the 1200x600mm panel to form grid of 600x600mm and wall angle of size 24x24x0.30mm and laying false ceiling tiles of approved texture in the grid including required cutting/making , opening of services like diffusers, grills, light fittings, fixtures, smoke detectors ect. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27x37x25x1.6 mm fixed to ceiling with 12.5 mm dia and 50mm long dash fastners ,4x0.8mm spaced at 1200 mm c/c along main "T" , bottom exposed width of all T-sections shall be pre painted with polyster paint , all complete for all heights as per specifications, drawings and as directed by NCCF/Architect.</p>
a	<p>GI metal ceiling lay in plain Tegular edge global white color tiles of size 595x595 mm and 0.5 mm thick with 8mm drop; made of GI sheet having galvanising of 100gm/sqm both sides inclusive and electro statically polyster powder coated of thickness 60 microns minimum, including factory painted after bending.</p>
11.2	<p>Providing and fixing 15mm thick tensified tegular edged eco friendly light weight calcium cilicate false ceiling tiles of approved texture spintone/ cosmos/ hexa or equivalent of size 595x595mm in true horizontal level , suspended on interlocking metal grid of hot dipped galvanised steel sections (galvanising @ 120gms/sqm including both sides) consisting of main "T" runner suitably spaced at joints to get required length and of size 24x38mm made from 0.33 mm sheet, spaced 1200mm c/c and cross "T" of size 24x28mm made out of 0.33mm sheet , 1200mm long spaced between main "T" at 600mm c/c to form a grid of 1200x600mm and secondary cross "T" of lenth 600mm and size 24x38mm made of 0.33mm thick sheet to be interlocked at middle of the 1200x600mm panel to form grid of size 600x600mm , resting on periphery walls/ partitions on a perimeter wall angle pre-coated steel of size 24x24x3000mm made of 0.40mm thick sheet with the help of rawl plugs at 450mm c/c with 25mm long dry wall screws @ 230 mm intervals and laying 15mm thick dencified edges calcicum cilicate ceiling tiles of appropriate texture (spintone/cosmos/hexa) in the grid including cutting/making opening for services.Main "T" runners to be suspended from ceiling using GI slotted cleats of size 25x35x1.6 mm fixed to ceiling with 12.5mm dia and 50mm long dash fasteners, 4mm GI adjustable rods with galvanised steel level clips of size 85x30x0.8mm spaced at 1200mm c/c along main "T" bottom exposed with 24mm of all T-sections shall be pre painted with polyster backed paint , for all heights, as per specifications, drawings and as directed by NCCF/architect.</p>
12.0	EXPANSION JOINTS
	<p>Expansion joints shall be provided where shown on the drawings or as directed by NCCF/Architect. They shall be constructed with an initial gap between the adjoining parts of the works of the width specified in the drawings.The contractor shall ensure that no debris is allowed to enter expansion joints. Expansion joints shall be provided as per drawing. Contractor shall ensure that expansion joints are made watertight and that no leakage occurs through these joints for which he shall be responsible to re do at his own cost.</p>
12.1	OPEN JOINT FILLERS
	<p>Where shown on the drawings, open joints in the structure shall be filled with joint fillers. The joint fillers shall be easily and uniformly compressible to its original thickness, tampable, easily cut or sawn, durable resistant to decay due to termite or weathering unaffected by water and free of any constituent, which will bleed into or stain the concrete. The joint filler shall be of same thickness of the joint width, it shall extend through the full thickness of the concrete unless otherwise specified and shall be sufficiently rigid during handling and placing to permit the formation of straight joints.</p>
12.2	JOINT SEALING COMPOUNDS

	<p>Joint sealing compounds shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering. Poly-sulphide joints where specified on the drawings shall be sealed with polysulphide liquid polymer, stored, mixed, handled, applied and cured strictly in accordance with the manufacturer's written instructions. Such joint shall be formed to the correct dimensions, thoroughly cleaned and treated with recommended primer strictly in accordance with the manufacturer's written instructions prior to sealing. The Contractor shall use only competent personnel experienced in the application of polysulphide for such work. Where specified in the drawings, rubber/bituminous based sealants shall be of an approved manufacturer's written instructions.</p>
12.3	<p>WATER BARS</p> <p>Where water bars are shown on the drawings, the joints shall incorporate an approved PVC external type water-bar complete with all necessary molded or prefabricated intersection pieces assembled in accordance with the drawings with bends and butt joints in running lengths made by heat welding in an electrically headed jig. Jointing and fixing of water bars shall be carried out strictly in accordance with the manufacturer's written instructions. The water bars shall be installed so that they are securely held in their correct position during the placing and compacting of the concrete. Where reinforcement is present adjacent to water bars, adequate clearance shall be left between the reinforcement and water bars to facilitate compaction of the concrete. During headed nails may be used in the edge of the water bar outside the line of the external grooves for fixing purposes, but no other holes shall be permitted through the water bar.</p>
12.4	<p>EXPANSION JOINTS IN SLAB</p> <p>Where the expansion joints are provided in the slabs, the joints and their cover slabs shall be suitably treated with water proofing . An expansion joint with the RCC slabs on either side of the joints turned vertically up and covered with precast RCC cover slabs. The cover slabs covering the vertical turned up dwarf walls by not less than 7.5 cm and are provided with throatings on their underside along their length. The water proofing treatment shall be taken up the sloping junction fillets and the vertical faces of the walls to the underside of the cover slabs. The cover slabs are given the water proofing treatment like the roof slabs, after the cross joints between adjacent cover slabs first sealed are with 15 cm width of roofing felt struck to them with bitumen. The water proofing treatment shall be carried down the sides of the cover slabs to their full thickness. Care shall be taken to see that overlaps if any in the roofing over the cover slabs stagger with the joints between cover slabs. The formation of the expansion joints and provision of cover slabs shall be the responsibility of the construction agency. The formation of the junction fillets and the water proofing treatment of the joint and cover slabs shall be carried out by the water proofing agency. No extra shall be paid for the junction fillets or for the sealing of the cross joints in the cover slab with 15 cm width of bitumen strips.</p>

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA

SCHEDULE OF FINISHES- NCCF

SCHEDULE D2B

S.N.	Details	Flooring	Wall finishes		Door	Windows/ Ventilators	Railing
			Interior	Exterior	Frames /Shutters		
1	Class Room	Polished glazed Vitrified tiles (PGVT) 800mm X 800mm	Cement base putty, 2 coat of Low VOC Acrylic Emulsion with POP conice	Exterior weather proof Texture paint over a coat of primer, cement based putty and white cement	Main door : 2nd class Teak wood frame and Panelled double leaf door. Hard wood/Red Mirandi wood Frames/ Double moulded Skin Door	Aluminium sliding system Window	-
2	Toilet	Anti Skid Polished glazed Ceramic Tiles 400mm X 400mm on floors and 400mm x 800mm on walls	Wall Tiles with motives & border	Exterior weather proof Texture paint over a coat of primer, cement based putty and white cement	Hard wood/Red Mirandi wood Frames/ Double moulded Skin Door	Aluminium sliding system Window	-
3	Kitchen/ Pantry	Anti skid, Polished glazed Vitrified tiles 600mm X 600mm	Plastic emulsion, Wall Tiles with motives & border	Exterior weather proof Texture paint over a coat of primer, cement based putty and white cement	Hard wood/Red Mirandi wood Frames/ Double moulded Skin Door	Aluminium sliding system Window	-
		Black/Red Granite on platform		Exterior weather proof	Hard wood/Red Mirandi	Aluminium sliding system	

				Texture paint over a coat of primer, cement based putty and white cement	wood Frames/ Double moulded Skin Door	Window	
4	Common Area	Polished glazed Vitrified tiles (PGVT) 800mm X 800mm	Wall Putty, Premium Acrylic Smooth paint.	Exterior weather proof Texture paint over a coat of primer, cement based putty and white cement	hard wood/Red Mirandi wood Frames/ Double moulded Skin Door	Aluminium sliding system Window	-
5	Stair	18mm thick Udaipur Green stone flooring	Premium Acrylic Smooth paint	Exterior weather proof Texture paint over a coat of primer, cement based putty and white cement	wooden Fire Check Door	-	MS sections and bars railings with plastic/PVC cover
6	Mumty & Machine Room, Lift well Pit	18mm thick Kota stone flooring	O.B.D.	Exterior weather proof Texture paint over a coat of primer, cement based putty and white cement	M.S. D/W frame, M.S. Stair case with synthetic Enamel paint.	M.S. D/W frame, M.S. Stair case with synthetic Enamel paint.	MS sections and bars railings with plastic/PVC cover
7	Ground floor lobby	Polished glazed Vitrified tiles (PGVT) 600mm X 600mm	Premium Acrylic Smooth paint	Exterior weather proof Texture paint over a coat of primer, cement based	Aluminium system Window	Aluminium sliding system Window	-

				putty and white cement			
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NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA

SCHEDULE D2C

Elevators

Sr. No.	DESCRIPTION	UNIT	QTY
	PART - A :		
1	Supplying, installing, testing and commissioning of 13 Passengers- 2 NOS. 8 Passengers- 4 NOS. lifts having contract speed of 1.5 MPS serving different floors in the lift shaft as per CPWD specifications for electrical works (Lifts & Escalators Part - III, 2003) and technical data sheet enclosed.		
1.1	Location of lifts:		
	Speed 1.5 MPS		
	Floors - 8 (G+7)		
	Stops and opening - 8		
	Controller : AC variable voltage and variable frequency		
	Automatic rescue device complete with dry maintenance free batteries as required		
	Operation : Duplex selective collective without attendant.		
	Power - 415 V, 3 phase, 50 HZ, 4 wires- system		
	Type of doors		
	Car : Automatic Power operated center opening horizontal sliding stainless steel scratch proof doors in hairline finish. Mirror on rear wall		

	Landing doors: Automatic Power operated, center opening horizontal sliding stainless steel scratch proof doors in hairline finish.		
	A hand rail not less than 600 mm long at 900 mm above floor level to be fixed adjacent to control panel in the lift car.		
	Operation and maintenance of lift which include routine, preventive break down maintenance including repair/replacement of worn out items with minimum downtime and warranty & guarantee of repaired/replaced items for defect liability period as per maintenance schedule from the date of handing over of work.		
	Voice announcement system in the car	No.	6

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA,
SPECIFICATION FOR 13 PASSENGERS ELEVATOR

SCHEDULE D2C

Type of Lift	Passenger Lift (Housing Complex)
Number of lifts required	6 Nos.
Load: Number of persons	13 Passengers- 2 NOS. 8 Passengers- 4 NOS.
Rated Speed of Travel	1.5 MPS
Travel in meters	37.8 mtr (G+7)
Number of floors served	8
Inside size of lift well	2500mm x 1900 mm
Pit depth	1650 mm
Head room	5590 mm

Clear inside size of lift car	2000mm x 1100mm
Dimension of lift machine room	4550mm x 3830 mm
Position of counter weight	Left Side of Entrance
Type of control	Microprocessor based AC variable voltage variable frequency
Type of operation	Duplex selective- collective operation without attendant.
Car entrance door	900 mm front side only.
Number	One No. per lift.
Size of Door	900 mm x 2100 mm
Type of doors	Power operated Automatic, Centre opening, SS door in hairline finish.
Door Operation	ACVF door operation.
Type of machine	Gearless Machine.
Location of machine	Directly above the hoist well.
Car open in front only or open	In front only
Type of signal system	Digital floor position indicator in the car and at all landings (to be provided above the car/landing doors). The indicator will be dot matrix rolling type.
	Travel direction indicator in the car and at all landings. (to be provided above the car/landing doors). The indicator will be dot matrix type.
	Over load warning audio & visual indicator, inside the car (lift should not start on overload)
	Battery operated alarm bell and emergency light.
	Full Car operation panel with fade proof luminous buttons in car and with intercom. SS hand rail at three side of Lift Car

	Luminous hall buttons at all landings, the hall buttons shall be SS metallic type.
	Fireman's switch at ground floor Close loop controller.
Landing entrance	SS hairline scratch proof panel center operating horizontal sliding doors (automatic) with infrared protection.
Location of landing entrance in different floors	All doors on the same side
Number	As per lifts
Size	900 mm x 2100 mm,
Type of doors	Centre opening horizontal sliding stainless steel doors in hairline finish scratch proof.
Door operation	ACVF door operation
Lift in use/lift out of order sign	A suitable box above the LED illuminated bilingual (in Hindi & English) signs of "Lift out of order " coming up simultaneously at all floors
Electric supply	Power : - 415 V, AC, 3 phase, 50 HZ, 4-wire system
	Lighting: 230 V, AC, 50 HZ
Neutral wire for control circuits	Yes
Counter Weight	Cast Iron
Hoist Rope	Round stranded steel rope
Car Design / Exclusive	<ul style="list-style-type: none"> • Car Panels: Made of Hairline Stainless Steel scratch proof, Car enclosure body of SS 304 (16 gauge) • Floor: Black Granite Flooring • Lighting: Diffused fluorescent lighting in the ceiling • Braille inscriptions on car buttons • Car Operating Panel: Unique telephone keypad type • Ceiling : SS false ceiling in mirror finish • Mirror on rear side car wall

Other Features	<ul style="list-style-type: none">• Call registration in car and at all landings.• Digital floor position indicator in car and all floors.• Emergency Light and alarm• Intercom (From car to machine room) and further connected to Security Room.• Infra-red Door sensors having 132 beams.• One no. fan in ceiling, which is put on when lift in operation.• Pit ladder shall be provided.• Up Down (visual) Floor announcement indicator with single stroke gong at all landing.• Hooter/Alarm to be installed in Central Control Room/Security Gate with switch for the same inside the Car.• Intercom connected with Central Control Room and wiring up to Security Room is the Contractor responsibility.• Voltage stabilizer inbuilt.• AUTO RESCUE DEVICE
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NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
INTERNAL PLUMBING FOR BUILDING BLOCK	
SCHEDULE D2D	
S. NO.	Description
1	SANITARY FIXTURES
1.1	Supply, fixing, testing and commissioning white vitreous china wall hung European type WC with 'P' trap straight/offset type flexible single body push fit type WC - Connection socket with lip seal and body made of PP with C.P. bolts, nuts, C.I. chair or other hanging arrangement, with solid bakelite seat and slow falling cover, C.P. brass hinges rubber buffers with accessories, C.I./M.S. brackets painted with two coats of enamel paint of approved shade over a coat of primer. C.P. brass screws, including cutting and making good the wall and floors wherever required.
1.1a	Providing, fixing, testing & commissioning of concealed cistern-Dual Flush for back to wall floor standing WCs/Wall Hung WCs for standard Height execution front flush, Capacity of 9 Litres with continuous adjustable short flush vol. of approx 3-4 Ltrs or a continuously adjustable full flush volume of 6-9 Ltrs.) suitable for mechanical or Bowden wire actuation technology comprising of corner valve (Gun Metal), premounted water supply with 1/2 female thread, flushing pipe bow, flushing pipe extension, fixing material, without actuator plate and assembly including fixing frame, fixing set complete, providing protection cover over cistern, Body covered with Anti sweat thermocol cover cutting and making good the walls wherever required.
1.2	Providing and fixing vitreous china dual purpose closet suitable for use as squatting pan or Indian type water closet (Indian W.C Orissa pan) with seat & lid fixed with C.P. brass hinges and rubber buffers, 10 litre low level flushing cistern with fitting and brackets, 40 mm flush bend, 20 mm over flow pipe, with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required
	Providing, fixing, testing & commissioning of cistern-Dual Flush for back to wall floor standing WCs for standard Height execution (Make-Hindware, Model :Sleek Fresh Dual Flush or equivalent) front flush, Capacity of 9 Litres with continuous adjustable short flush vol. of approx 3-4Ltrs or a continuously adjustable full flush volume of 6-9 Ltrs.) suitable for mechanical or Bowden wire actuation technology comprising of corner valve (Gun Metal), premounted water supply with 1/2 female thread, flushing pipe bow, flushing pipe extension, fixing material, without actuator plate and assembly including fixing frame, fixing set complete, providing protection cover over cistern, Body covered with Anti sweat thermocol cover cutting and making good the walls wherever required.
1.4	Providing and fixing Wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require with CP bottle trap and basin size Size:780 x 480mm / 610X390mm:
1.4.1	White Vitreous China Wash basin size 630x450 mm with a pair of 15 mm C.P. brass pillar taps
1.5	Low-flow C.P. hand spray with lever control (health faucet) fixed with angular stop cock
1.6	Providing and fixing C.P. brass, bib cock of approved quality conforming to IS : 8931
1.6.1	15 mm nominal bore

1.7	Providing and fixing Stainless Steel A ISI 304 (18/8) Kitchen sink as per IS : 13983 with C.I. brackets and stainless steel plug 40 mm, CP grating with PVC flexible waste pipe including painting of fittings and brackets, cutting and making good the walls wherever required :
	Kitchen sink with drain board
	510 x 1040 bowl depth 250 mm
1.8	Providing and fixing C.P. brass angle valve for basin mixer, geyser points and flushing cisterns of approved quality conforming to IS:8931 a) 15 mm nominal bore
	15mm nominal bore
1.9	S.S. (304) Coat hook / robe hook
1.10	Providing & Fixing CP Toilet paper holder :
1.11	Providing and Fixing of SS Tower Rail
1.12	Providing and fixing PTMT liquid soap container 109 mm wide, 125 mm high and 112 mm distance from wall of standard shape with bracket of the same materials with snap fittings of approved quality and colour, weighing not less than 105 gms.
1.13	Providing and fixing stainless steel jali (grating) without hole for waste pipe for floor trap & floor drain (Make Vijay cat. ADS 1262 or equivalent)
	Size 125mm dia flat cover matt finish(Make Vijay Modal : ADS 1262)
	Size 125mm dia cocrach trap (Make Vijay Modal :ADS 1286)
1.14	Providing, Fixing, Testing & Commissioning of CP Brass Bath and Shower Divertor with overhead shower, spout/shower selector with wall flange complete with all accessories as required and making good the walls wherever required.
1.15	Providing, & Fixing C.P. brass single lever /single hole sink mixer with swinging casted spout, wall mounted complete including cutting and making good the walls wherever required.
1.16	Fixing C.P. brass single lever / single hole basin mixer with spout of required size with 450mm long copper connection pipe and brass Nuts including cutting and making good the walls wherever required.
1.17	Providing and fixing single lever mixer with concealed divertor Over head shower ,C.P. bath spout , C.P. shower head with flexible tube including cutting and making good the walls where required.
1.18	Providing and Fixing of SS Soap Dish
1.19	Providing and Fixing of Braided Hoses for Connction to Gyser, Wash basin and Flushing Cistern
1.20	Providing and fixing of 750 mm x 600 mm beveled edge Mirror of Modi guard or equivalent, mounted on BWP Ply/hardboard and fixed with SS studs and washers complete.
1.21	Providing and fixing 600 x120 x 6 mm toughened glass shelf with edge round off supported on SS frame and guard rails with SS brackets complete
2	<u>INTERNAL WATER SUPPLY SYSTEM</u>
2.1	Providing and fixing G.I. pipes complete with G.I. fittings including trenching and refilling etc as follows:
2.1.1	Providing and fixing G.I. pipes Heavy Duty pipes complete with G.I. fittings including trenching and refilling etc. complete with G.I. Fittings ie tees, elbows, sockets, clamps etc in all respects and as per instructions of the NCCF/Architect.
2.1.1.1	20mm dia

2.1.1.2	25mm dia
2.1.1.3	32mm dia
2.1.1.4	40mm dia
2.1.1.5	50mm dia
2.1.1.6	65mm dia
2.1.2	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes SDR 11, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of NCCF/Architect.
	Concealed work , including cutting chases and making good the walls etc.
2.1.2.1	15 mm nominal outer dia Pipes
2.1.2.2	20 mm nominal outer dia Pipes
2.2	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of NCCF/Architect.
	Internal work
2.2.1	15 mm nominal outer dia Pipes
2.2.2	20 mm nominal outer dia Pipes
2.2.3	25 mm nominal outer dia Pipes
2.3	Providing and fixing G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc.
	Internal work - Exposed on wall
2.3.1	20 mm dia nominal bore
2.3.2	25 mm dia nominal bore
2.3.3	32 mm dia nominal bore
2.3.4	40 mm dia nominal bore
2.3.5	50 mm dia nominal bore
2.3.6	65 mm dia nominal bore
2.4A	Providing and fixing insulation for hot water pipe line with fibre glass wool blankets/mats of 50mm thickness including cleaning of pipes, wrapping of mats around the pipe with 50mm overlap on all the sides and sealing the joints with POP tape, stitching 24 SWG x 20mm G.I wire mesh netting over the mat, complete as per requirement. (Insulation blankets should have a density of 24 Kg/m ³) (Twiga make or equivalent).
2.4.1	20 mm dia nominal bore
2.4.2	25 mm dia nominal bore
2.4.3	32 mm dia nominal bore
2.4.4	40 mm dia nominal bore
2.4.5	50 mm dia nominal bore
2.4 B	Providing and cladding 24 gauge aluminum sheets with 50 mm overlap and fixing with self tapping recessed screws, complete as per requirements over the insulated hot water pipes .
2.4.1	20 mm dia nominal bore

2.4.2	25 mm dia nominal bore
2.4.3	32 mm dia nominal bore
2.4.4	40 mm dia nominal bore
2.4.5	50 mm dia nominal bore
2.4.6	65 mm dia nominal bore
2.5	Providing and fixing nitrile rubber insulation on hot water supply / return pipes.
2.5.1	15 mm dia (13 mm thickness)
2.5.2	20 mm dia (13 mm thickness)
2.6	Providing & fixing full way lever operated forged brass ball valve of brass body with forged brass hard chromeplated steel ball tested to a pressure not less than 15 Kg / sqcm with threaded / flanged joints complete with nuts, bolts, gaskets, washers etc. as per direction of NCCF/Architect.
2.6.1	15 mm dia. Nominal bore
2.6.2	20 mm dia. Nominal bore
2.6.3	25 mm dia. Nominal bore
2.6.4	32 mm dia. Nominal bore
2.6.5	40 mm dia. Nominal bore
2.6.6	50 mm dia. Nominal bore
2.6.7	65 mm dia. Nominal bore
2.7	Supplying, fixing, testing and commissioning of following valves, gauges and strainers for condenser water circulation as per specifications.
2.7.1	BUTTERFLY VALVE (MANUAL) with C I body SS disc nitrile sheet & O - ring & PN 16 pressure rating as specified.
2.7.1.1	65 mm dia. Nominal bore
2.7.1.2	80 mm dia. Nominal bore
2.7.1.3	100 mm dia. Nominal bore
2.8	Providing and fixing pressure reducing valve with strainer delivering desired rate of flow with flanged connection. The complete system is tested to a pressure not less than 10 Kg / Sq.cm and suitable to reduce the pressure upto 1 Kg/Sq.cm) including flanges / unions, nuts, bolts and washers complete as required.
2.8.1	50 mm dia
2.8.2	65 mm dia
2.9	Making connection of G.I. distribution branch with G.I. main of following sizes by providing and fixing tee, including cutting and threading the pipe etc. complete :
2.9.1	25 to 40 mm nominal bore
2.9.2	50 to 80 mm nominal bore
2.10	Providing and fixing G. I. Union in G. I. pipe including cutting and threading the pipe and making long screws etc. complete (new work)
2.10.1	15 mm nominal bore
2.10.2	20 mm nominal bore
2.10.3	25 mm nominal bore
2.10.4	32 mm nominal bore
2.10.5	40 mm nominal bore
2.10.6	50 mm nominal bore
2.11	Providing & fixing Auto Air vent for cold water supply risers, suitable for pressure not less than 15 Kg/Sq.cm.

2.11.1	15 mm dia
2.11.2	20 mm dia
2.12	Providing and fixing in position of approved quality high pressure rated Gun Metal Float Valve with copper ball float and brass rods of required length suitable for test pressure of not less than 15 Kg/sqcm of the following sizes:
2.12.1	40 mm dia
2.12.2	50 mm dia
2.13.1	<u>Hydropneumatic Booster Pump at Terrace Level for Top Two Nos. Floors)</u>
	Providing fixing and commissioning suitable complete composite hydropneumatic system consisting of horizontal/vertical multistage centrifugal pump having stainless steel (SS304) impellers, shaft and housing, with single mechanical seal and pressurised tank of necessary capacity, complete with all standard accessories including pressure switch, pressure gauges, non-return & isolating valves, with necessary protection and operational devices i.e alternate pumping operation and shut-off during dry running conditions etc. with suitable electrical motor to be operated on 210/220 OR 400/440 volt 50 cycle AC supply, suitable for following duty and with total no. of pumps - 2 nos.(1 working+1standby) complete with Control Unit Panel, manifolds & chassis, as per the approval of NCCF/Architect.
	No. of Pumps/Set :2(1 Working +1 stand by) Each tower
	Capacity : app. 80-100 lpm per pump
	Head : app. 25-35 m
2.14..1	To supply all material, labour, fabrication, installation, testing and commissioning of solar hot water heating system complete in all respects to produce hot water at 60°C through solar collectors as per requirement and with all necessary mechanical, electrical and Civil components, internal piping and insulation, recirculation pumps, valves, accessories, control & indication equipment, hot water storage tanks, heat exchangers etc. including civil and structural works complete to make the system completely functional as per site requirement and space availability. System shall be as per guidelines given in attached technical data sheets to be completed by the Vendor. Following shall be the minimum capacities of each system during non-cloudy periods:
	500 Liters per Day Capacity, with 500 Liters Hot Water SS:304 storage tank. (Each Tower shall have 4 No. solar system as per the drawings)
3	<u>DRAINAGE SYSTEM</u>
3.1	Providing and fixing Centrifugally cast (spun) iron socket & spigot (S&S) pipe as per IS: 3989 soil, waste, Rain water and vent pipes alongwith necessary fittings i.e. T, bend, elbow, socket etc. complete including Jointing with drip seal :
3.1.1	75 mm dia
3.1.2	100 mm dia
3.1.3	150 mm dia
3.1.4	200 mm dia
3.2	Providing and fixing M.S. holder-bat clamps of approved design to Sand Cast iron / cast iron (spun) pipe embedded in and including cement concrete BUILDING BLOCK 10x10x10 cm of 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), including cost of cutting holes and making good the walls etc. :
3.2.1	For 75 mm dia pipe

3.2.2	For 100 mm dia pipe
3.2.3	For 150 mm dia pipe
3.2.4	For 200 mm dia pipe
3.3	Providing and fixing M.S. stays and clamps for sand cast iron/ centrifugally cast (spun) iron pipes of diameter :
3.3.1	100 mm
3.4	Providing and fixing Centrifugal sand cast iron as per IS: 3989 P - Trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors :
3.4.1	100 mm inlet and 100 mm outlet
3.5	Painting Centrifugally cast (spun) iron soil waste vent pipes and fittings paint of any colour such as chocolate gray or buff etc. over a coat of primer (of approved quality) for new work:
3.5.1	150 mm diameter pipe
3.5.2	100 mm diameter pipe
3.5.3	75 mm diameter pipe
3.60	Providing and fixing heavy duty G.I. pipes complete with G.I. fittings and clamps, i/c cutting and making good the walls etc.
3.6.1	32 mm dia nominal bore
3.6.2	40 mm dia nominal bore
3.6.3	50 mm dia nominal bore
3.7	Painting G.I. pipes and fittings with two coats of anti-corrosive bitumastic paint of approved quality :
3.7.1	32 mm diameter pipe
3.7.2	40 mm diameter pipe
3.7.3	50 mm diameter pipe
3.80	Providing and fixing G.I. inlet fitting with 1 or 2 inlets fabricated from 100 mm dia G.I. pipes and welded G.I. sockets fixed to C.I. trap with lead caulked joint and set in cement concrete as per drawing complete as per direction of NCCF/Architect.
3.90	Providing and fixing floor drain made out of 100x50 mm G.I. Elbow connected to G.I. Pipe complete as per direction of NCCF/Architect.
3.10	Providing and fixing cast brass clean out plug with suitable insert keys for opening, male threaded joint with G.I socket caulked for centrifugally Cast (spun) Iron pipes.
3.10.1	100 mm dia
3.10.2	150 mm dia
3.11	Providing and fixing Cleaning eye on horizontal CI soil & waste pipes, for med of 300 mm long GI pipe with one plain end lead caulked in to the collar of CI pipe and the other end with flange which in covered by neoprene rubber gasket and blank flange, complete with nuts, bolts etc and hot dip galvanization after fabrication to the satisfaction of and as direction of NCCF/Architect.
3.11.1	150 mm dia

3.12	Providing & fixing spun cast iron deep seal P or S trap of self cleansing design with or without vent arm with provision for connecting G.I.inlet fitting complete including cost of cutting and making good the walls and floors wherever required.
3.12.1	100mm inlet and 100mm outlet.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA		
INVENTORY FOR INTERNAL PLUMBING WORKS FOR BUILDING BLOCK		
SCHEDULE D2E		
S. No.	Material / Item	Brand & Manufacturer/ Supplier
	PLUMBING LOW SIDE	MODEL No. or Equivalent
	MASTER BED-ROOMS' BATHROOM	
1	STARC WALL MOUNTED WC WITH SOFT FALLEN SEAT COVER AND CONCEALED FIXATION (P-19) SIZE- 530X370X330 MM	HINDWARE
	Model No.	CAT NO-92590
2	SINGLE PIECE SLIM CONCEALED CISTERN BODY WALL HUNG WC WITH FLUSH PLATE CONCELEO	HINDWARE
	Model No.	
3	TABLE TOP BASIN. DOVE(440x440)	HINDWARE
	Model No.	CAT NO-100092
4	BOTTLE TRAP	MAYUR
	Model No.	WORLD PATENT NO.US10364558 B2 CAT NO-101
4A	BOTTLE TRAP	JAQUAR
	Model No.	ALD-CHR-769L250X190
5	HAND SHOWER (HEALTH FAUCET) WITH 8mm DIA 1.2 METER LONG FLEXIBLE TUBE AND WALL HOOK	JAQUAR
	Model No.	ALD-CHR-573
6	AQUAMAX CONCEALED BODY OF THERMOSTATIC SHOWER MIXER WITH 2-WAY DIVERTER	JAQUAR
	Model No.	ALD-CHR-681
7	AQUAMAX EXPOSED PART KIT OF THERMOSTATIC SHOWER MIXER WITH 2-WAY DIVERTER (SUITABLE FOR ALD-681)	JAQUAR
	Model No.	ALI-CHR-85681K
8	ANGULAR STOP COCK WITH TRIANGULAR HANDLE AND WALL FLANGE	JAQUAR
	Model No.	AQT-CHR-3057P
9	SINGLE LEVER TALL BOY WITH 125mm EXTENSION BODY FIXED SPOUT WITHOUT POPUP WASTE SYSTEM WITH 600mm LONG BRAIDED HOSES	JAQUAR
	Model No.	ALI-CHR-85005B

10	SHOWER ARM WITH WALL FLANGE	JAQUAR
	Model No.	SHA-CHR-477P
11	OVERHEAD SHOWER 120mm DIA ROUND SHPAE MULTI FLOW (ABS BODY CHROME PLATED WITH GRAY PACE PLATE)	JAQUAR
	Model No.	OHS-CHR-1799
12	TOWEL RACK 600MM LONG, STAINLESS STEEL	JAQUAR
	Model No.	ACN1181FHN
13	DOUBLE HOOK	JAQUAR
	Model No.	ACN-CHR-1161N
14	TOILET PAPER HOLDER	JAQUAR
	Model No.	ACN-CHR-1151N
15	WASTE COUPLING FULL THREAD	HINDWARE
	Model No.	F86002
16	Unique Extension Nipple	MAYUR
	Model No.	CAT- 25,30,40,50,60,70,80,90
16A	Extension Nipple	JAQUAR
		ASS-CHR-EN-50
17	SOAP DISH	JAQUAR
	Model No.	ACN-1131N
18	SOAP DISPENSER	JAQUAR
	Model No.	ACN-1135N
19	TOWEL RING	JAQUAR
	Model No.	ACN-1121BN
20	SS JALI (GATING)	VIJAY
	Model No.	1286&1262
21	BRAIDED HOSES	JAQUAR
	Model No.	ALD-803B
	COMMON BATHROOM	
1	RIMLESS WALL HUNG EWC ELEGANCE WITH SOFT FALLEN SEAT COVER. SIZE 520X370X360 MM	HINDWARE
	Model No.	CAT NO-20109
2	SINGLE PIECE SLIM CONCEALED CISTERN BODY WALL HUNG WC WITH FLUSH PLATE CONCELEO	HINDWARE
	Model No.	
3	UNDER COUNTER ZEN BASIN WITH FIXING ACCESSORIES SET, SIZE: 530X450 MM.	HINDWARE

	Model No.	CAT NO-10049
4	BOTTLE TRAP	MAYUR
	Model No.	WORLD PATENT NO.US10364558 B2 CAT NO-101
4A	BOTTLE TRAP	JAQUAR
	Model No.	ALD-CHR-769L250X190
5	HAND SHOWER (HEALTH FAUCET) WITH 8mm DIA 1.2 METER LONG FLEXIBLE TUBE AND WALL HOOK	JAQUAR
	Model No.	ALD-CHR-573
6	CONCEALED BODY FOR SINGLE LEVER HIGH FLOW DIVERTER WITH BUTTON ASSEMBLY, CARTRIDGE SLEEVE BUT W/O EXPOSED PARTS	JAQUAR
	Model No.	ALD-CHR-079
7	SINGLE LEVER EXPOSED PARTS KIT CONSISTING OF OPERATING LEVER, WALL FLANGE (WITH SEALS) & BUTTON ONLY (SUITABLE FOR ITEM ALD-079)	JAQUAR
	Model No.	FUS-CHR-29079K
8	ANGULAR STOP COCK WITH TRIANGULAR HANDLE AND WALL FLANGE	JAQUAR
	Model No.	AQT-CHR-3057P
9	SINGLE LEVER EXTENDED BASIN MIXER (HEIGHT-85mm) WITHOUT POPUP WASTE SYSTEM WITH 450mm LONG BRAIDED HOSES	JAQUAR
	Model No.	FUS-CHR-29023B
10	CONTINENTAL BATH TUB SPOUT WITH WALL FLANAGE	JAQUAR
	Model No.	SPJ-CHR-429
11	SHOWER ARM WITH WALL FLANGE	JAQUAR
	Model No.	SHA-CHR-477P
12	OVER HEAD SHOWER SINGLEFLOW 100mm DIA(ABS CP)	JAQUAR
	Model No.	OHS-CHR-1989
13	TOWEL RACK 600MM LONG, STAINLESS STEEL	JAQUAR

	Model No.	ACN1181FHN
14	DOUBLE HOOK	JAQUAR
	Model No.	ACN-CHR-1161N
15	TOILET PAPER HOLDER	JAQUAR
	Model No.	ACN-CHR-1151N
16	WASTE COUPLING FULL THREAD	HINDWARE
	Model No.	F86002
7	Unique Extension Nipple	MAYUR
	Model No.	CAT- 25,30,40,50,60,70,80,90
7A	Extension Nipple	JAQUAR
		ASS-CHR-EN-50
18	SOAP DISH	JAQUAR
	Model No.	ACN-1131N
19	SOAP DISPENSER	JAQUAR
	Model No.	ACN-1135N
20	GRAB BAR (only in one toilet)	JAQUAR
	Model No.	AHS-1507
21	GRAB BAR (only in one toilet)	JAQUAR
	Model No.	WAC-WHT-BR0600
22	TOWEL RING	JAQUAR
	Model No.	ACN-1121BN
20	SS JALI (GATING)	VIJAY
	Model No.	1286&1262
21	BRAIDED HOSES	JAQUAR
	Model No.	ALD-803B
	KITCHEN	
1	SINGLE LEVER SINK MIXER WITH SWINGING SPOUT (TABLE MOUNTED MODEL) WITH 450mm LONG BRAIDED HOSES	JAQUAR
	Model No.	FLR5179B
2	ANGULAR STOP COCK WITH TRIANGULAR HANDLE AND WALL FLANGE	JAQUAR
	Model No.	AQT-CHR-3057P
3	KITCHEN SINK (STAINLESS STEEL ISI 304)	JAYNA
	Model No.	DBF02DX
4	Unique Extension Nipple	MAYUR
	Model No.	CAT- 25,30,40,50,60,70,80,90
4A	Extension Nipple	JAQUAR
		ASS-CHR-EN-50

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
INTERNAL ELECTRICAL WORKS FOR BUILDING BLOCK	
SCHEDULE D2F	
Sl. No.	DESCRIPTION
A.	POINT WIRING AND ACCESSORIES
1	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed Heavy class PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc as required.
a	Group B
b	Group C
2	Wiring for twin control light point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed heavy class PVC conduit, 2 way modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FRLS PVC insulated copper conductor single core cable etc. as required.
3	Wiring for light/ power plug with 2X4 sq.mm FRLS PVC insulated copper conductor single core cable in surface/ recessed heavy class PVC conduit along with 1 No 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.
4	Wiring for circuit/ submain wiring along with earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed Heavy class PVC conduit as required.
a	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire
b	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire
c	2 X 4 sq. mm + 1 X 4 sq. mm earth wire
d	2 X 6 sq. mm + 1 X 6 sq. mm earth wire
e	4 X 6 sq. mm + 2 X 6 sq. mm earth wire
f	4 X 10 sq. mm + 2 X 10 sq. mm earth wire
g	4 X 16 sq. mm + 2 X 16 sq. mm earth wire
5	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 amps modular socket outlet and 5/6 amps modular switch , connection etc. as required.
6	Supply and fixing suitable size GI box with modular plate and cover in front on surface or in recess including providing and fixing 6 pin, 5/6 & 15/16 Amps modular socket outlet and 15/16 Amps modular switch , connection etc. as required.
7	Supply and fixing 3 pin, 5 amp ceiling rose on the existing junction/ wooden block including connection etc. as required.

8	Erection of wall bracket /ceiling fittings of all sizes and shapes containing upto two GLS lamps per fitting, complete with all accessories including connection etc. as required.
9	Installation, testing & commissioning of pre wired, fluroscnet fitting/compact LED fitting of all types, complete with all accessories and tube etc. directly on ceiling/wall, including connection with 1.5 sq. mm. FRLS PVC insulated, copper conductor, single core cable and earthing etc. as required.
10	Supplying and fixing modular blanking plate on the existing modular plate & switch box excluding modular plate as required.
11	S/F Modular Type Electronic Fan Regulator : Supplying and fixing stepped type electronic fan regulator on the existing modular plate & switch box including connections but excluding modular plate etc. as required.
B.	MCCB, MCB & DB'S
1	Supplying & fixing following way prewired TP&N MCB distributionboard of steel sheet for 415 volts on surface/ recess complete with loose wire box, terminal connectors for all incoming and outgoing circuits, duly prewired with suitable size FRLS PVC insulated copper conductor up to terminal BUILDING BLOCK, tinned copper bus bar, neutral link, earth bar, din bar, detachable gland plate, interconnections, powder painted including earthing etc. as required. (But without MCB/ RCCB/ Isolator).
a	4 way (4+12), Double door
b	6 way (4+18), Double door
c	8 way (4+24), Double door
d	12 way (4+36), Double door
2	S/F 'C' Curve , SP MCB : Supplying and fixing 5 amps to 32 amps, rating, 240/415 volts, 'C' Curve , miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a	Single Pole
3	Supplying and fixing following rating, double pole, (single phase and neutral), 240 volts, residual current circuit breaker (RCCB) , having a sensitivity current upto 300 milliamperes in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a	25 amps.
b	40 amps.
c	63 amps.
4	Supplying and fixing following rating, four pole, 415 volts, isolator in the existing MCB DB complete with connections, testing and commissioning etc. as required.
a	40 amps
b	63 amps
5	Supplying and fixing single pole blanking plate in the existing MCB DB complete etc. as required.
C.	RISING MAINS - INDOOR

1	Design, Manufacture, Supply, Installation, Testing, and Commissioning of Sandwich type 1100 volts rising mains with cooling Fins, 4bar - 3P & 1N. Aluminum conductor with aluminium body / powder coated sheet steel enclosure with 2x40x6 G.I. earth tape as earth throughout the continuous length, as per specification, suitable for 3ph 4wire 50HZ, of short circuit fault withstand capacity, for 1 Sec as specified below. The busway shall have a system for plug in tap off box at desired levels and single bolt double head section jointing system including vertical & straight joints. The Tap off boxes shall have Door Interlocking mechanism and mechanical interlocking with Bus duct housing during 'ON' position to prevent being taking of in energized condition. Supporting system shall be fail proof even in the earth quake situations, as per seismic requirement of site.
Notes:	
i.	For Rising Mains, no temperature deration upto 45°C Ambient temperature.
ii.	Flexible connections need to be included and need to be provided as required for thermal expansion/ building expansion joints / panel end connections /one vertical expansion for every floor.
iii.	100% sized Neutral as of phase current to be provided.
a	Cable feed end unit (Adaptor Box) with 630 Amp, 4 Pole, ACB 50 KA, with microprocessor based inbuilt O/C, S/C & E/F releases with suitable cable termination arrangement. (For incoming cable connection) . (IP54)
c	RISING MAIN INSIDE ELECTRICAL SHAFT/INSIDE ELECTRICAL ROOM ON TYPICAL FLOORS: Straight Vertical Run inside Floor Electrical Shaft / Floor Electrical Room
i.	630 Amp, 50 KA 4P,Aluminum (IP54)
ii.	400 Amp, 50 KA 4P,Aluminum (IP54)
d.	Reducer Unit inside Floor Electrical Shaft / Floor Electrical Room
i.	630 Amp to 400 Amp, 50 KA, Aluminum (IP54)
e.	End Cap at top (at last floor) (IP54)
2	TAP-OFF BOXES - INDOOR:
	Supply and installation of following 4P MCCB of breaking capacity as called for, for fixing in the incoming Tap-off box . Tap-off box housing shall be fabricated out of 14G CRCA painted or powder coated (as approved) sheet steel. The tap-off box should be factory fabricated and complete with solid aluminium links of rated capacity from MCCB to rising mains and suitable size of gland plate etc. The tap-off box shall be suitable for termination of XLPE insulated Al. conductor armoured cable including shrouding of terminal ends. as required.
a.	160 Amp, 4P MCCB, 35KA (with adjustable thermal & adjustable magnetic release upto 250A & microprocessor based release beyond 250A) (IP54)
b.	100 Amp, 4P MCCB, 35KA (with adjustable thermal & adjustable magnetic release upto 250A & microprocessor based release beyond 250A) (IP54)
D.	LIGHT FIXTURES & FAN
	It shall include all lighting fixtures complete with lamps, control gear, power factor improvement capacitor.
	All the lighting fixtures and fans samples must be gotten approved from the Owner/ Architect/ PMC before ordering on the Sub-vendor and before supply.
	All the ceiling fans shall be complete with down rods of required length. The colour and shade of fans shall be gotten approved by the Owner / Architect / PMC.
	All Exhaust fans shall be complete with mounting frames, colour and shade shall be gotten approved from Owner / Architect / PMC.
	All the fixtures / fans shall be of good quality and technically safe as per approved standard and codes.

	All fixtures shall have low watt loss, high power factor, low THD, high frequency electronic ballasts for T5, T8 fluorescent and CFL lamps. THD to be limited to <10%, unless specified otherwise.
	Colour rendering index of lamps to be decided by the architect / client.
	All Light fittings/fixture except in dowelling units are to be provided by the contractor.
	All exhaust fans including kitchen and toilets in dowelling units are to be provided by the contractor.
1	<u>Bulk Heads for:</u>
	• Lift Wells
	• Lift Shafts
	Supply, Installation, testing & commissioning 10 W LED Bulkhead light similar to 'LHEUA0P7UZ6W010' of Havells or equivalent as approved in tender document.
2	<u>Bulk Heads for:</u>
	• Terrace Parapet Walls
	Supply, Installation, testing & commissioning 10 W LED Bulkhead light similar to 'LHEUA0P7UZ6W010' of Havells or equivalent as approved in tender document.
3	Supply, Installation, testing & commissioning 1x22 W LED Tube light similar to 'LHEWEBP7PL1W022' of Havells or equivalent as approved in tender document.
4	<u>Surface Mounted Downlighter :</u>
	Supply, Installation, testing & commissioning 1x12-15 W LED downlighter similar to 'LHEAAGP7IA2W012' of Havells or equivalent as approved in tender document.
5	<u>Recessed Mounted Downlighter :</u>
	Supply, Installation, testing & commissioning 1x15 W LED downlighter similar to 'LHEBJNP7IN1W015' of Havells or equivalent as approved in tender document.
6	<u>Wall Washer :</u>
	Supply, Installation, testing & commissioning 1x22 W LED wall washer Light similar to 'Luxspace IP54 22w ' of Philips or equivalent as approved in tender document.
7	<u>Exit Signs</u>
	Supply, Installation, testing & commissioning 'Prolite' make "PEL LED NE" sleek exit sign with <u>5W LED</u> or equivalent as approved.
8	<u>Supply, Installation, testing & commissioning of Aviation Obstruction Light: (It shall essentially meet ICAO, DARA & Govt. Civil Aviation Deptt. Standards)</u>
	Design, supply & installation of Aviation Obstruction Light System 'Binay' make or equivalent as approved Aviation obstruction light with LED light source, with Flasher complete as per the requirement of Aviation Department of Govt. of India for the site in consideration including providing all fixing accessories:
a.	Medium Intensity (mounting height: from 45M to 150M)
	LED Based Aviation Obstruction Light (AOL) for 45M to 150M of mounting height (Medium Intensity) with a minimum (radial, in each & every direction, over 360°) intensity of 1600 Candela in flashing RED.

	<p>The lamp shall have normal continuous life of not less than 100,000 burning hours with light deprecation not more than 50% at end of life, shall be shock proof, vibration resistant & ability to withstand voltage fluctuations & with improved power factor. LED lights shall be provided with EMI / RFI filters.</p> <p>The design of LED's shall be failsafe, redundancy built-in with multiple series parallel circuits. The AOL shall be rugged heavy duty construction made in LM-6 alloy cast steel and shall be sealed against duct & water ingress (IP 65). The dome shall be made with toughened clear borosilicate hard glass. LED's shall be able to withstand extreme temperature & humidity conditions and construction of dome shall be UV protected.</p> <p>The AOL shall be as per civil Aviation Ministry's guide lines for the site / area under consideration. It shall be suitable for 230V, 1 phase AC supply. Maximum wattage shall be 85 watts. Fixture shall be complete with earthing terminals. Unit shall also be complete with a solid state flasher unit with adjustable flash rate.</p>
9	<p>Ceiling Fan : Supplying of capacitor type 1200 mm sweep ceiling fan complete with blades, shakle etc. with high breeze, high speed for operation on 230V, 50 Cy. Single phase A.C. supply confirming to IS 374-1979 and with double ball bearing system similar to ES-50 oremium 5 of Havells or equivalent .</p>
10	<p>Supply of Exhaust fans with Gravity Louvers in kitchen, Toilets, common area, Lift M/C room etc.:</p>
a	300 mm dia
E.	CONDUITING & CABLING FOR TELEPHONE TV SYSTEM
1	TELEPHONE SYSTEM :
a.	Supply and fixing of following sizes of ISI marked heavy duty PVC conduit alongwith the accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of conduit in recessed as required.
i.	20 mm dia
ii.	25 mm dia
b.	Supplying and fixing following modular switch / socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required.
i.	Telephone socket outlet (RJ-45)
c.	Supplying and fixing following size / modules, GI box along with modular base & cover plate for modular switches in recess etc as required.
i.	1 or 2 Module (75mm X 75mm)
d.	Supplying and drawing of UTP 4 pair CAT 6 LAN Cable in the existing surface/ recessed PVC heavy duty conduit as required.
e.	Supply and fixing of Telephone Instrument Model no. M-75 cordsed landline of Beetel as approved.
2	TV SYSTEM
	Conduit for mostly points of TV & Telephone to be used common.
a.	Supply and fixing of following sizes of ISI marked PVC heavy duty conduit alongwith the accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.
i.	20 mm dia
ii.	25 mm dia

b.	Supplying and fixing following modular switch / socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required.
i.	TV antenna socket outlet
c.	Supplying and fixing following size / modules, GI box along with modular base & cover plate for modular switches in recess etc as required.
i.	1 or 2 Module (75mm X 75mm)
d.	Supplying and drawing co-axial TV cable RG-6 grade, 0.7 mm solid copper conductor PE insulated, shielded with fine tinned copper braid and protected with PVC sheath in the existing surface/ recessed steel/ PVC conduit as required.
3	Fiber Direct to Home
	Equipments
a.	Supply,Installation,testing & commisioning of 48 Fiber LIU, 2U, SC/APC SM OS2, Loaded with Splice tray, adapter, Pigtails & splice protectors
b.	Supply Installation,testing & commisioning of SM Simplex Patchcord, 10 mtr from LIU to OLT.
c.	Supply Installation,testing & commisioning of iFDH with 2# 2x32 Loaded with SCAPC Couplers and Adapters
d.	Supply, Installation,testing & commisioning of iFDH with 4# 2x32 splitter Loaded with SCAPC Couplers and Adapters
e.	Supply , Installation,testing & commisioning of IFDB-S Splice.
f.	Supply , Installation,testing & commisioning of IFDB-M Splice.
g.	Supply , Installation,testing & commisioning of SCAPC SC APC G 657A Patchcord 3 mtrs from HFTP to ONT
h.	Supply, Installation,testing & commisioning of HFTP with 1# SCAPC Pigtail and Coupler
i.	Supply, Installation,testing & commisioning of Wall mount Home Distribution Box (GPON Box) for 4-Port SDU ONTs and 1 Nos. Copper Jack Panel as per site requirement.
	Cabling
a.	Supply,laying,testing & commisioning of 24 Core Multitube Armoured Cable, 6 tubes with 4 Fiber each 6 runs
b.	Supply,laying,testing & commisioning of Mini Break out 24 fiber Cable
c.	Supply,laying,testing & commisioning of 1 Core, 3mm Drop Cable 9/125 μm SM G657A CABLE WITH LSZH SHEATH - iFDH to HFTP
d.	Supply,laying,testing & commisioning of 1 Core, 3mm Drop Cable 9/125 μm SM G657A CABLEWITH LSZH SHEATH - iFDH to HFTP
F.	EARTHING SYSTEM
1	EARTHING STATION :
2	G.I. Earthing Strip/Wire
	Supply, installation, testing & commissioning of following sizes of G.I. strip/wire clamped to walls, cable trays, bus ducts, cables in recess or surface etc for equipment / system/ lighting protection earthing complete as required including inter connection between length at joints, all fixing accessories saddles, clamps etc. and other fixing hardware material as required for proper installation.
a)	50 x 6 mm strip
b)	40 x 6 mm strip
c)	32 x 6 mm strip
d)	25 x 6 mm strip
e)	25x 3 mm strip
f)	8 SWG GI Wire in 15 mm dia G.I. Pipe as required .

g)	6 SWG GI Wire in 15 mm dia G.I. Pipe as required .
G.	MV / LV CABLING & ITS TERMINATIONS, CABLE TRAYS AND RACEWAYS
1	Laying and fixing of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size on cable tray as required.
a	Upto 35 sq. mm (clamped with 1mm thick saddle)
b	Above 35 sq. mm and upto 95 sq. mm (clamped with 25x3mm MS flat clamp)
c	Above 95 sq. mm and upto 185 sq. mm (clamped with 25/40x3mm MS flat clamp)
d	Above 185 sq. mm and upto 400 sq. mm (clamped with 40x3mm MS flat clamp)
2	Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 KV grade as required.
a	3½ X 35 sq. mm (32mm)
b	3½ x 50 Sqmm(35mm)
c	3½ x 70 Sqmm(38mm)
d	3½ x 95 Sqmm(45mm)
e	3½ x 120 Sqmm(45 mm)
f	3½ x 150 Sqmm(50 mm)
g	3½ X 185 sq. mm (57mm)
h	3½ X 240 sq. mm (62mm)
i	3½ X 300 sq. mm (70mm)
j	4 X 10 sq. mm (25mm)
k	4 X 16 sq. mm (28mm)
l	4 X 25 sq. mm (28mm)
m	3 X 16 sq. mm (25mm)
n	3 X 10 sq. mm (22mm)
o	2 X 10 sq. mm (19 mm)
3	Supply, loading, transportation unloading at site, storages at site ,shifting from storage place to site of following sizes of XLPE insulated PVC sheathed, FRLS, Aluminium conductor armoured power cable of 1.1 KV grade conforming to IS amended upto date and as per specifications.
a	3.5 C x 300 Sqmm
b	3.5 C x 240 Sqmm
c	3.5 C x 185 Sqmm
d	3.5 C x 150 Sqmm
e	3.5 C x 120 Sqmm
f	3.5 C x 95 Sqmm
g	3.5 C x 70 Sqmm
h	3.5 C x 50 Sqmm
i	3.5 C x 35 Sqmm
j	4 C x 25 Sqmm
k	4 C x 16 Sqmm
l	4 C x 10 Sqmm
m	3 C x 16 Sqmm
n	3 C x 10 Sqmm
o	2 C x 10 Sqmm

4	Supplying and installing following size of perforated pre-painted M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.
a	600 mm width X 75 mm depth X 2.0 mm thickness
b	450 mm width X 62.5 mm depth X 2.0 mm thickness
c	300 mm width X 62.5 mm depth X 2.0 mm thickness
d	150 mm width X 50 mm depth X 2.0 mm thickness
5	Supplying and installing following size of perforated pre-painted M.S. cable trays bends with perforation not more than 17.5%, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.
a	600 mm width X 75 mm depth X 2.0 mm thickness
b	450 mm width X 62.5 mm depth X 2.0 mm thickness
c	300 mm width X 62.5 mm depth X 2.0 mm thickness
d	150 mm width X 50 mm depth X 2.0 mm thickness
6	Supplying & installing following size of perforated pre-painted M.S. cable trays Tee's with perforation not more than 17.5%, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.
a	600 mm width X 75 mm depth X 2.0 mm thickness
b	450 mm width X 62.5 mm depth X 2.0 mm thickness
c	300 mm width X 62.5 mm depth X 2.0 mm thickness
d	150 mm width X 50 mm depth X 2.0 mm thickness
H.	FIRE DETECTION AND ALARM SYSTEM - ANALOG ADDRESSABLE
	Design, Supply, installation, testing & commissioning of Fire Detection & Alarm system as per local fire norms & NBC / NFPA Codes:
1	SMOKE DETECTOR (PHOTO ELECTRIC)
	Supply, installing, testing and commissioning of UL listed addressable intelligent Smoke detector (Photo Electric) with mounting base, dual LED, complete with base as required. Detectors should be suitable for the multi co-operative sensing.
3	MANUAL CALL POINT
	Supply, installing, testing & commissioning of addressable Manual call point (Pull station-double action) .
4	MONITOR MODULES (In FHC Shaft on each floor)
	Supply, Installation, testing and commissioning of Addressable Monitor modules for :
a	Sprinkler flow switches
5	RELAY CONTROL MODULES (Basement)
	Supply, installing, testing and commissioning of addressable and automatic commandable Relay control modules for:
a.	Staircase and lift Pressurisation fans (one for each Fan)
b.	Basement Ventilation Fans start up/ Stop (one for each Fan)
6	CONTROL MODULES (In LV Shaft on each floor)
	Supply, installing, testing and commissioning of addressable and automatic commandable control modules for:

a.	Fireman's Telephone jack & hooter circuits
8	FIRE ALARM CONTROL PANEL (Stilt Floor Guard Room)
	Supply, installing, testing and commissioning of Microprocessor based intelligent and electronically addressable, modular, expandable, networkable, loops as given below (each loop consist of 159 detector & 159 devices) Fire Alarm Control Panel with minimum 6 inch / 640 character LCD display, multiple access levels, event history file in non-volatile memory (EEPROM). The panel shall support programmable relays for controlling lifts, staircase pressurizations fans, lift shaft and lift lobby pressurization fans, AHU's, ventilation fans, fire pump, monitoring of fire sprinkler and fire hydrant pump controlled by powerful Boolean logic equation. The panel shall have 240 volts AC power supply, automatic battery charger, 24 volts, sealed lead acid maintenance free batteries sufficient for 24 hours normal working and then be capable of operating the system for 60 minutes during emergency condition. The panel shall be UL listed 9th Edition.
a.	6 Loop (each loop consist of 159 detector & 159 devices)
9	INTIGRATED DIGITAL VOICE EVACUATION & DIGITAL 2 WAY FIRE FIGHTERS COMMUNICATIONS
a.	DIGITAL VOICE EVACUATION AND 2 WAY COMMUNICATION FIRE FIGHTER SYSTEM (ON STILT FLOOR GUARD ROOM NEAR FIRE ALARM PANEL)
	Supply, installing, testing and commissioning of Integrated 8 channel Digital Voice Evacuation and 2 way Communication Fire Fighters System capable to supervise of all the speaker circuits, with required number of zone control as given below and accessories required to complete the system. The equipment shall be of same make as panel. DVC shall offer minimum one fire man's telephone circuit & one speaker's circuit. DVC shall be with in-built digital microphone & fire man's telephone hand set.
i.	DVC with 3 zone control
b.	DIGITAL AMPLIFIERS (ON STILT FLOOR GUARD ROOM NEAR FIRE ALARM PANEL)
	Supply, installing, testing and commissioning of Addressable & fully supervised DIGITAL AMPLIFIERS with minimum Wattage as given below with 70.7 VRMS . The Digital Amplifiers shall have inbuilt minimum of 4 Speakers Zone Circuits and minimum 1 Fire Fighters communication. The Amplifiers shall be stands alone with its own battery backup incase of Main fire Alarm panel / Digital Voice Panel failure the Digital Amplifiers shall still be in position to carry out Voice Evacuation.
i.	240 Watts
ii.	480 Watts
c.	CEILING MOUNTED HOOTER CUM SPEAKERS
	Supply, installing, testing and commissioning of Fire panel supervised 78db-90db Ceiling Mounted Hooter cum Speakers as specified & same make as of panel. Speakers shall be 2 Watt with multi taps of 0.25W, 0.5W, 1W and 2W.
d.	WALL MOUNTED HOOTER CUM SPEAKERS
	Supply, installing, testing and commissioning of Fire panel supervised 78db-90db Wall Mounted Hooter cum Speakers as specified & same make as of panel. Speakers shall be 2 Watt with multi taps of 0.25W, 0.5W, 1W and 2W.
e.	FIRE FIGHTERS TELEPHONE JACK
	Supply, installing, testing and commissioning of 2 way communication Fire Fighter's Telephone Jack
f.	FIRE FIGHTERS HANDSET (ON STILT FLOOR GUARD ROOM)
	Supply, installing, testing and commissioning of 6 Nos. 2 way communication Fire Fighter's Handset

10	CABLES AND CONDUITS
a.	Supply & laying of mineral insulated copper cable (MICC), fire survival cable, manufactured with seamless tube, manufacturing standard BSEN 60702, size 1.5 sq mm x 2 core, LPCB certified, fire tests as per BS 6387 CWZ, BSEN 50200. (950°C for 3 hrs) (For fire detection signal, for fire loop, for speakers, for tele jacks).
b.	Supply & laying of mineral insulated copper cable (MICC), fire survival cable, manufactured with seamless tube, manufacturing standard BSEN 60702, size 1.5 sq mm x 2 core, LPCB certified, fire tests as per BS 6387 CWZ, BSEN 50200. (950°C for 3 hrs) (For Hooters / Strobes power).
c.	Supplying, making end termination with glands and required accessories as per MICC cable termination.
Notes :	
i.	All hooters / strobes shall also be power wired directly from the fire control panel with 2x1.5 sq.mm in separate conduits in a loop.
ii.	Necessary interlocking, relays, power supplies and wiring etc. that may be required to automatically start smoke exhaust fans and staircase / lift well pressurization fans and to stop automatically air-conditioning plant and indoor air supply units and fire dampers on the detection of a fire signal through the fire alarm panel to be included in the scope of work and costs quoted above. It should also ensure automatic opening of all access controlled doors on fire signal.
iii.	It will be an absolute responsibility of the contractor to ensure design of fire safety system / sequence as per NFPA / NBC / Indian standards.
iv.	Contractor shall submit the fire life safety sequence of operation of various exhaust and pressurization fans and AC plants for approval to client / architect / consultant before implementation.
v.	Contractor to submit fire detection schematic.
I.	DVR BASED CCTV SURVEILLANCE SYSTEMS - ANALOGUE
1	Supply, installing, testing and commissioning of Super High Resolution Indore Dome Camera 1/3 CCD 960 H Super -HAD IT CCD with 720 TVL with Minm illumination 0.12 lux with 2.8 – 10.5 mm
2	Supply, installing, testing and commissioning of ¼" Double Scan Super HAD CCD II High Resolution, True Day / Night Colour High Speed Dome Camera with Pole/ wall / Ceiling Mount Facility; with programmable presets for Pan & Tilt operations. WDR PTZ Dome Camera - Mediatronix 1/4" 26 X Optical Zoom with 600 TVL D/N , Compact, vandal-resistant (IK10 rated) enclosure, UL Listed, 210 Presets
3	Supply, laying & termination of Armored AB Copper Multistranded Cable, 8 c x 0.75 Sq.mm PVC insulated, shielded Outer PVC Sheathed complete with fittings & G.I Supports at 0.3mtr (for PTZ Control)
4	Supply, laying & termination of Armoured 2 X 1.5 Sqmm cable Laid on Surface / Ceiling, complete with G.I Saddles & Spacers at 0.3 mtr (ISI)
5	Supply, laying & termination of video cable in existing conduits/raceway/cable tray if required (for short connections i.e. decoder to monitor).
a	RG 6 cable
6	Supply, installing, testing and commissioning of 21" inches 720 TVL high resolution CCTV monitor

7	Supply, installing, testing and commissioning of Power Supply with Input 230VAC +/- 10%,Output 12V +/- 2Volt, load regulation & line regulation less than 0.1%, Electronic protection against overload & short circuit,outout ripple less than 1 milli volt RMS,with Redundacy mode facility.10Amps output.
8	Supply, installing, testing and commissioning of 16 Channel Networkable Digital Video Recorder.
	Hybrid camera viewing and recording
	H.264 compression
	With on Board Ethernet LAN Port, and Built in Web Server for Remote Login with Standard IE commercial packages.
	Remote viewing, playback, control, and configuration
	Mobile Device support for viewing
	UL Listed
	Alarm Notification Via e-mail
	8 or 16 inputs configurable NO/NC, max., input voltage 15 VDC
	Recording - Max. 30 IPS per channel, configurable: 30, 15, 7.5, 5, 3, 1
	Minimum 2000GB internal HDD storage
	Multisite Connectivity Capability
	Display 400fps ,Recording 400fps Recording and Viewing rate Selectable for each Camera.
9	Supplying and fixing of following sizes of heavy class PVC conduit along with accessories in surface/recess including cutting the wall and making good the same in case of recessed conduitas required.
a.	20 mm dia conduit
b.	25 mm dia conduit
J.	DISTRIBUTION BOARDS AND PANELS:
	Design, manufacture, assembly, wiring, testing at works, supply to site, Installation & Commisioning of following panels/distribution boards/switch boards. The boards shall be designed and fabricated as per general specifications, technical details, specifications and notes as part of this tender /BOQ and relevant BIS codes.
	Also, refer to General Notes and Specifications for Panels/ Boards
	GENERAL NOTES FOR MCCB's:
a.	MCCB's shall be of 3P or 4P as called for in the BOQ.
b.	Ics = Icu = 100% for the breakers.
c.	If nothing is specified in the BOQ, MCCB's upto 250A shall be only with magnetic release for motor duty and shall be with thermal magnetic release upto 250A for non motor duty and above 250A shall be with microprocessor based releases - motor duty / non motor duty as the case may be.
e.	MCCB's shall be with extended rotary handle.
g.	For UPS output panels, MCCB's shall be of 3Pole with 2N, neutral links (twice rated neutral link).
h.	Exact rating (Amps), Poles, Type/Duty, Short circuit rating of MCCB is to be selected by the contractor as per load, fault and requirement and also approval taken.
	GENERAL NOTES FOR TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS):
a.	Transient Voltage Surge Suppressors (TVSS) shall be mounted out side the panel / switch board in a sheet steel enclosure.
b.	It shall be suitable for handling required (specified) surge handling capacity, shall be 10 modes protection with noise filters. (EMI & RFI) and with inbuilt back up fuse protection.
c.	Surge suppressor shall be complete with isolating / protective device in the form of MCB / MCCB of KA rating (breaking capacity) as of switch board.

Notes:	
1.0	All Switchgear selections shall be as per manufacturer's recommendation.
2.0	Contractor to submit manufacturer's selection charts for approval.
3.0	Only one make of switchgear to be used in a board /panel.
1	Tower panel
	IP Rating: IP 42
	Incomer
	1000 A, 50 kA, 4P, EDO, ACB with:
i.	230V, AC spring charging motor
ii.	230V, AC closing coil
iii.	24V, DC shunt trip coil
iv.	4 NO + 4NC Aux. contacts
v.	In built trip LED's
vi.	Breaker control switch
	Protection:
i.	In built micro processor based releases (O/C, S/C & E/F).
	Metering & Indications
i.	R, Y, B LED indications (110V)
ii.	ON, OFF, TRIP LED indications (24V DC)
iii.	Trip circuit healthy indications (24V DC)
iv.	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT. This metering PT shall be of Class-1 accuracy.
v.	3 Nos. cast resin class 1 metering CT's of adequate burden & ratio.
vi.	MFM meter (with RS 485 port) with following parameter: A,V, PF, Hz, KW, KWH, KVA, KVAR, KVARH. (110V AC)
vii.	1 No. Digital Energy KWH meter (with RS 485 port)
	Bus Bars:
	1200 A, 4P, Aluminium bus bars of electrolytic grade with Heat shrinkable sleeves 50 kA.
	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT. (Bus PT's for metering of outgoing feeders) This metering PT shall be of Class-1 accuracy.
	Out goings:
	1 Nos. 630 A 50 kA, 4P EDO ACB with inbuilt Micro Processor based releases, with 3 Nos. Class-1 Cast resin metering CT's of suitable ratio & burden, ON/OFF/Trip LED indications (24V DC) for Rising main.
	With digital ammeter with inbuilt selector switch
	1 No. 100 A 35 kA, 4P MCCB with 2NO + 2NC Auxiliary contacts + One trip contact, with inbuilt Micro Processor based releases, with 3 Nos. Class-1 Cast resin metering CT's of suitable ratio & burden, ON/OFF/Trip LED indications (24V DC).

	With digital ammeter with inbuilt selector switch
	1 No. 63 A 35 kA, 4P <u>MCCB</u> with 2NO + 2NC Auxiliary contacts + One trip contact, with <u>inbuilt Micro Processor based releases</u> , with 3 Nos. Class-1 Cast resin metering CT's of suitable ratio & burden, ON/OFF/Trip LED indications (24V DC).
	With digital ammeter with inbuilt selector switch
	<u>Spare Feeders:</u>
	1 No. 100 A 35 kA, 4P <u>MCCB</u> with 2NO + 2NC Auxiliary contacts + One trip contact, with <u>inbuilt Micro Processor based releases</u> , with 3 Nos. Class-1 Cast resin metering CT's of suitable ratio & burden, ON/OFF/Trip LED indications (24V DC).
	1 No. 63 A 35 kA, 4P <u>MCCB</u> with 2NO + 2NC Auxiliary contacts + One trip contact, with <u>inbuilt Micro Processor based releases</u> , with 3 Nos. Class-1 Cast resin metering CT's of suitable ratio & burden, ON/OFF/Trip LED indications (24V DC).
	Tower Panel- as described above.
2	LIFT PANEL
	IP Rating : IP 42
	Incomer
	1 No. 100 A 4P, ATS <u>without bypass</u> and complete with overlapping neutral.
	1 No. 100 A 25 KA, 4P MCCB of motor duty (Adjustable Magnetic release upto 250A MCCB OR Micro-Processor based release above 250A MCCB). MCCB shall have 1NO + 1NC auxiliary contacts + a trip contact.
	<u>Incomer Metering & Indication:</u>
	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT. This metering PT shall be of Class-1 accuracy.
	R,Y,B phase indication lamps (110V) LED Type
	ON' & Trip indication lamps (110V) LED Type
	Cast resin metering CT's for each phase of class-1 accuracy & of suitable burden & ratio
	1 No. Digital VAF + PF Meter (110V) (With RS 485 Port)
	1 No. Digital Energy Meter (KWH) (With RS 485 Port)
	Bus bars
	150 A, TPN <u>Aluminium</u> Bus bars of electrolytic grade with heat shrinkable sleeve 25 KA.
	Outgoings
	2 Nos. 63 A 25 KA, 3P, MCCB's, motor duty for 13.5 KW Lift.
	2 Nos.40 A 10KA, 4P MCB's
	<u>Spares:</u>
	1 No. 63 A 25 KA, 3P, MCCB's, motor duty for 13.5 KW Lift.
	1 No. 40 A 10 KA, 4P MCB.
Note:	Vendor to ensure selection of MCCB & MCB through cascading effect to mitigate the prospective fault circuit current.

	Lift Panel as described above.
3	Common Area PANEL
	IP Rating : IP 42
	Incomer
	1 No. 63 A 25 KA, 4P MCCB (Adjustable Magnetic release upto 250A MCCB OR Micro-Processor based release above 250A MCCB). MCCB shall have 1NO + 1NC auxiliary contacts + a trip contact.
	<u>Incomer Metering & Indication:</u>
	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT. This metering PT shall be of Class-1 accuracy.
	R,Y,B phase indication lamps (110V) LED Type
	ON' & Trip indication lamps (110V) LED Type
	Cast resin metering CT's for each phase of class-1 accuracy & of suitable burden & ratio
	1 No. Digital VAF + PF Meter (110V) (With RS 485 Port)
	1 No. Digital Energy Meter (KWH) (With RS 485 Port)
	Bus bars
	100 A, TPN <u>Aluminium</u> Bus bars of electrolytic grade with heat shrinkable sleeve 25 KA.
	Outgoings
	2 Nos.63 A 10KA, 4P MCB's
	<u>Spares:</u>
	2 Nos.63 A 10KA, 4P MCB's
Note:	Vendor to ensure selection of MCCB & MCB through cascading effect to mitigate the prospective fault circuit current.
	Common Area PANEL as described above.
4	MDB UPS
	IP Rating : IP 42
	Incomer
	1 No. 63 A 25 KA, 4P MCCB (Adjustable Magnetic release upto 250A MCCB OR Micro-Processor based release above 250A MCCB). MCCB shall have 1NO + 1NC auxiliary contacts + a trip contact.
	<u>Incomer Metering & Indication:</u>
	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT. This metering PT shall be of Class-1 accuracy.
	R,Y,B phase indication lamps (110V) LED Type
	ON' & Trip indication lamps (110V) LED Type
	Cast resin metering CT's for each phase of class-1 accuracy & of suitable burden & ratio
	1 No. Digital VAF + PF Meter (110V) (With RS 485 Port)
	1 No. Digital Energy Meter (KWH) (With RS 485 Port)
	Bus bars
	100 A, TPN <u>Aluminium</u> Bus bars of electrolytic grade with heat shrinkable sleeve 25 KA.

	Outgoings
	8 Nos. 32 A 10KA, DP MCB's
	Spares:
	2 Nos. 32 A 10KA, DP MCB's
Note:	Vendor to ensure selection of MCCB & MCB through cascading effect to mitigate the prospective fault circuit current.
	MDB UPS as described above.
5	Meter Board (Housing) : Non Compartmentalized Design
	Meter Board kept close to Rising Mains, hence incomer switch is not required in the meter board but Indication lamp required with suitable CTs.
a.	Meter Board (4 Meters):
	Incoming Cable connection link work & Bus Bars:
	4 Pole 200 Amp 25 KA Aluminium link work & bus bars with heat shrinkable sleeves.
	LED type R,Y,B Phase Indication lamps with suitable rating CTs.
	Outgoings:
	5 Nos.63 A, 4P, MCB's
	Space to be provided for 4 Nos. Dual source KWH meter, Class-1 accuracy, (Direct reading type without CT's) 0-80A, 3 Phase, 4 Wire with auto cut-off, With pre-paid facility with room unit and complete with internal HR FRLS PVC Insulated unsheathed flexible copper conductor wiring of adequate size and input & output wiring terminal BUILDING BLOCK as required.
	Meter Board (4 Meters) as described above.
K.	LIGHTNING ARRESTOR SYSTEM - INTELLIGENT
1	Systems:
	Supply, Erection, Installation and Commissioning of Lightning Protection System 3000 comprising of Dynasphere MK-IV SS Air Terminal, AL Mast 3 M with Base Plate welded together, Insulated 2 M FRP Mast and U-Bolts.
	The Dynasphere Air Terminal should be Controlled Streamer Emission CSE Type with Stainless Steel Semi Spherical shape to reduce the build up of sharp point corona discharge under static field thunderstorm conditions. It should have no power requirement for its operation and be based on controlled emission of streamer technology and taking into account the intensification factor and effect of e-field and collection volume modeling. The solution should be compliant to UL-96 Lightning Protection Safety Standards.
	The FRP Mast should be with min height of 2 mts and thickness of 4 mm with the Downconductor to pass through centre of the FRP Mast. The Aluminium Mast Light of suitable height 3 mtrs minimum along with fixing arrangements including U-Bolts for connecting FRP Mast with AL Mast.
2	Down Conductor

	Supply, Erection, Installation and Commissioning of the Down Conductor which is a Multi Layered stranded cable with Maximum outer diameter of 36 mm, Stranded Copper Conductor of Cross Sectional Area of maximum 55 sq. mm, Characteristics impedance of less than 12 ohms, Inductance of maximum 37 nH/m, Capacitance of 0.75 pF/m, Voltage Withstand of maximum 250 kV, Resistance of 0.5 mΩ/m. The Down Conductor should be supplied with saddles and screws for fixing. The Down Conductor should be compliant to UL-96 Lightning Protection Safety Standards.
3	Terminations of Down Conductor
	The Down conductor should come with Upper Termination for connecting the down conductor to the Dynasphere Air terminal and Lower Termination for connecting the down conductor to Lightning Protection Earth Pit.
4	Lightning Protection System Earth:
	Supply, Erection, Installation and Commissioning of the Earthing system which should cater for the Lightning Protection System earthing and should be maintenance free. Earth Enhancing Compounds should be used to treat the soil for lowering the effective ground impedance. Maintenance free earth pits made of ground enhancing material (GEM) - 3 or 4 bags of 11.3 Kg each and copper bonded ground rods - 4 nos of size 5' length and 5/8" diameter connected with each other with 25x3mm Copper Strip and high performance earth clamps
5	Lightning Event Counter:
	Supply, Erection, Installation and Commissioning of Lightning Event Counter for counting the number of lightning strikes without any power supply. The Counter should be mounted on the Down Conductor and the triggering impulse should be ≥ 1.5 KA for 8/20 μ s. The Lightning Event Counter should be robust, non-resettable mechanical counter with IP65 rated enclosure suitable for external application.
Notes:	1. Contractor shall be responsible for obtaining earth-pit resistance results as per IS codes.
	2. Depth of earth pits to be decided accordingly to achieve desired results.
	3. Contractor shall be responsible for the adequacy of the design of the lightning protection system. The number of lightning conductors and earth pits to be decided as per requirement. The quantities given below need to be confirmed by the contractor for system suitability or else to be increased as required.
L.	UPS SYSTEM
1	UPS for Emergency Lighting & Security Systems
	Supply, Installation, testing & commissioning of IGBT Rectifier based, micro processor controlled True On line double conversion 3 phase input and 3 phase 415V output <u>5_KVA</u> UPS consisting of following:
	1 No. UPS module with integrated 100% rectifier + inverter.
	Battery Circuit breaker for UPS module in CRCA housing with all required fixing accessories & hardware.
	In-built static switch for bypass & inverter in UPS module.
	In-built Manual maintenance bypass.
	Interconnecting copper cabling (DC cabling) between UPS, Active filter, Battery breaker & Batteries of required length and size.
	OC Web card for web enabling with an inbuilt facility of event logging.
	Sealed maintenance free batteries for <u>5_KVA</u> UPS with 90 <u>mins.</u> backup time on UPS module with interconnectors, Rack and accessories. Rack shall have shrouds for safety from live battery terminals.
	Suitable MS stand of 450mm high for UPS module duly painted.
	RAM module with UPS and Cat 5 cable for RAM connectivity.
	Charger Capacity 120%
	5 KVA UPS described above.

	Notes:
a.	Base frames for UPS and batteries up to the height of the raised floor to be considered.
b	Quoted prices to include cost of equipment including Packing, Forwarding charges, Transport Charges, Transit insurance, loading etc.
c	Quoted price to include cost of supervision, installation and commissioning of above UPS systems
M	SUPPLY, INSTALLATION, TESTING & COMMISIONING OF SMART METERING SYSTEM
1	Supply, Installation testing & commisioning of B 3 phase 4 wire, smart energy meter (Whole current upto 60 amp (IB-IMAX:60A) compatabile for automatic meter reading system with internal disconnection, dual source, Kwh & Kvah with bidiretional communication between smart meter controller card.
2	Smart Meter Controller Hardware
a	Supply, Installation testing & commisioning of RF enabled Data concentrator supporting embedded client server module for 12 energy meters suppoting feature like source based dynamic load allocation facility for every meter with RF communication.
b	Supply, Installation testing & commisioning of embedded firmware for each consumer to perform interval based and on-demand data acquisition and storage for each consumer Meter, Communication protocol for wired link with each meter and embedded encryption hardware, Protocol multiplexer and aggregator functionality, alert generation and Configuration management for each meter

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
INTERNAL FIRE FIGHTING FOR BUILDING BLOCK	
SCHEDULE D2G	
S. NO.	DESCRIPTION
S.No.	DESCRIPTION
A	FIRE HYDRANT SYSTEM
1.0	Providing, laying, jointing, testing and commissioning of following sizes of MS 'C' Class (Heavy duty) pipes conforming to IS-1239 with all accessories like orifice plate (of required dia), all fittings (standard MS fitting with welded joint shall be used on the pipes) including tees, elbows, reducers, union, flanges, rubber gaskets, GI nuts bolts, washer including supporting/fixing the pipe on floor / wall / ceiling with clamps, hangers (using anchor fasteners) as per specification. G.I. pipe sleeve of suitable higher size shall be provided wherever the pipes are crossing the walls/floors and sealing the sleeves with glass wool in between & fire sealant compound at either end all as per Project Manager's / Consultants requirements including cutting holes and chases in brick, RCC work and making good the same to original conditions complete in all respects. All hangers, clamps, brackets etc. shall be of galvanized iron unless specified otherwise and then supply of the same shall also be included for rates under this head.
	Welding of any kind on the galvanized support / hanger shall not be permitted including synthetic enamel paint of approved shade over a coat of zinc primer.
	Note: Pipe upto 50 mm dia shall be threaded joints, above 50 mm shall be welded joints.
	For wet riser System - MS 'C' Heavy class pipe
a.	25 mm dia
b.	80 mm dia
c.	100 mm dia
d.	150 mm dia
2.0	Providing two coats of synthetic enamel paint of approved shade over a coat of primer. Prior to application of primer the surface should be cleaned for any dirt, rusts, rough substance etc. Including painting of legends both direction arrow as per the approval of the Project Manager.
a.	25 mm dia
b.	80 mm dia
c.	100 mm dia
d.	150 mm dia

3.0	Providing and fixing M.S. structural work fabricated from standard sections, (MS rounds, angles, channels etc.) including cutting to size, drilling, welding, including cost of fasteners, clamps in RCC structural members as directed, including two or more coats of synthetic paint over one coat of primer after surface preparation including cutting and making good walls.
4.0	Providing & fixing Gunmetal fire hydrant single headed landing valve with 80 NB flanged inlet, brass spindle controlled 63 mm dia female instantaneous outlet type coupling, blank cap, chain, twist release type lug & all accessories. Conforming to IS standard. Including fixing with anchor fastener and flanged tapping from wet riser and providing pressure gauge with gun metal ball valve complete as required.
5.0	Providing & Fixing of 63 mm dia 15 m long non-percolating flexible hose (RRL- type A) as per IS : 636. Type A with Gunmetal male & female instantaneous type coupling (IS 903) (For internal hydrant system).
6.0	Providing and Fixing 63 mm dia Gunmetal instantaneous pattern branch short pipe , 20 mm dia nozzle conforming to IS 903, suitable for inter connection to hose pipe coupling complete as required.
7.0	Providing & Fixing of standard Fireman's Axe with heavy insulated handle.
8.0	Providing & Fixing of wall mounting swinging type first aid fire hose reel with drum, hanging bracket, 36.5 Mtr. length x 20 mm dia high pressure hose reel tubing as per IS: 444 with gun metal (GM) shut off nozzle having 5 mm dia orifice. The hose reel shall be conforming to IS : 884-1985. Rate shall include 25 mm dia M.S. pipe connection from Riser to hose reel, sockets, nipples, elbows and ball valve (25 mm dia). Drum shall be fixed on adjoining wall through anchor fasteners / cement concrete block as and when required. (For internal hydrant system).
9.0	Providing & fixing fire authority approved powder coated Aluminum door frame and shutter (size 1200 (L) x 2100 (H) mm) frame capable of accommodating fire hose reel, fire hydrant, hose pipe, fittings & accessories. The box shall have a single or double glazed front glass door (with 5 mm thick glass) with lock & key arrangement & shall be Powder coated with Fire red as per IS:5, shade no. 536. (For Internal Hydrant)
10.0	Supplying, fixing, testing and commissioning of following valves, gauges and strainers for condenser water circulation as per specifications.
	BUTTERFLY VALVE (MANUAL) with C I body SS disc nitrile sheet & O - ring & PN 16 pressure rating as specified.
a.	150 mm dia
b.	100 mm dia
11.0	NON - RETURN VALVE with dual plate of C I body SS plates vulcanized NBR seal flanged end & PN 16 pressure rating as specified.
a.	150 mm dia

12.0	Providing & fixing air release valve of 25mm dia and 25mm dia gun metal gate valve with fittings etc. as per the requirement.
	<u>Note: All valves shall be of minimum 16 Kg/sq.cm working pressure</u>
B.	PORTABLE FIRE EXTINGUISHERS
1.0	Providing & fixing of ISI marked (IS:15683) portable fire extinguisher , carbondioxide type flat base including valve, discharge hose of not less than 10 mm dia. 1 M long & complete in all respects including initial fill with CO ₂ gas confirming to IS:307-1966 filled to a filling ratio of not more than 0.667 of not more than 0.667 and wall suspension bracket
a)	Capacity 4.5 kg
2.0	6 Kg. ABC Powder type fire extinguishers are manufactured and marked to Indian standard IS: 15683. Suitable first aid appliance for fighting fires in Class A, B & C fire that is wood, textile, flammable liquids & gases.
C	FIRE HOSE CABINET
1.00	Providing and fixing standard fire hose cabinet (1000 mm x 2000 mm x 450 mm) indoor type suitable for accomodating internal hydrant, hose reel made of not less than 16 SWG MS sheet having full fronted glass hinged door (5 mm thick clear glass) including necessary locking arrangement with handle for housing two nos. 15 meter long fire hose pipes, 30 meter long hose reel, branch pipe and hydrant valve as required as per drawings, including brackets for mounting accessories, painting (one coat primer and two coat of fire red colour). The cabinet shall be mounted on suitable raised platform. The words " FIRE HOSE " to be painted on the box.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
CIVIL & PLUMBING WORKS FOR UNDER GROUND WATER TANK, WATER SUPPLY PUMPS AND WATER TREATMENT PLANT	
SCHEDULE D3	
S. NO.	Description
	ALL CIVIL WORKS REQUIRED TO CONSTRUCT THE UNDER GROUND WATER TANK WITH KOTA STONE BOX TYPE WATER PROOFING FOR BASE AND WALLS, A.P.P. SHEET WATER PROOFING FOR ROOF SHALL ALSO BE IN THE SCOPE OF THE CONTRACTOR AS PER DRAWINGS AND SPECIFICATIONS OF SCHEDULE-D2A ETC. ALL COMPLETE AS REQUIRED.
A	<u>WATER SUPPLY, DRAINAGE, PUMPS & EQUIPMENT</u>
	Providing and fixing centralized water level controller cum indicator system, as per the following details:
	<u>Centralised PLC control panel</u> along with touch-screen display board (min. 8" Diag. size) along with all accessories for complete controls & indication. Panel shall be made out of CRCA sheet min. 2mm thick having necessary interlocks, I/O's, required number of repeater amplifiers, all audio-visual alarms as required specifications as listed below. An emergency stop push button shall be provided in the panel. The panel shall have Modbus compatibility for seamless BMS/BAS Integration and shall be of approved make. The complete system control matrix, wiring diagram, SLD's and technical details shall be submitted by the vendor and gotten approved before commencement of execution of works.
	<u>Water level indicators cum controllers</u> working on hydrostatic pressure measurement principle made of Stainless Steel for installation on storage tanks, and capable of providing 4 to 20 mA analog signal compatible with PLC signal inputs and complete as per working requirements for details of equipment below. All control outputs to MCC panel shall be included as per requirements.
	Fire Static Underground tanks
	Real-Time water level indication monitoring
	V. Low Level audio-visual alarm at less than 25% total capacity.
	Raw Water Underground tanks
	Real-Time water level indication monitoring
	V. Low Level audio-visual alarm at less than 30% total capacity.
	V. High Level audio-visual alarm at more than 100% total capacity.
	Auto cut-in of tubewell pumps at 35%
	Auto cut-out of tubewell pumps at 95%
	Auto cut-out of raw water pumps at 35%
	Domestic Water Underground tanks
	Real-Time water level indication monitoring
	V. Low Level audio-visual alarm at less than 30% total capacity.
	V. High Level audio-visual alarm at more than 100% total capacity.

	Auto cut-in of raw water pumps at 35%
	Auto cut-out of domestic water pumps at 35%
	Flushing Water Underground tanks At STP
	Real-Time water level indication monitoring
	V. Low Level audio-visual alarm at less than 30% total capacity.
	V. High Level audio-visual alarm at more than 100% total capacity.
	Auto cut-in of raw water pumps (from STP) at 35%
	Auto cut-out of flushing water pumps at 35%
	Providing complete testing kit with all chemicals complete suitable for conducting test on water quality. The test kit shall be suitable to measure TDS, pH, Hardness, Iron content and other parameters
B	Hydro-pneumatic pumping system for Domestic Water For OHT Filling
	Providing, fixing and testing of packaged type skid mounted hydropneumatic system with variable frequency drive type comprising of :
	(i) Vertical, inline multistage centrifugal pumping set with stainless steel SS-304 stage casing and SS-304 impellers with stainless steel SS-304 shaft as per IEC standards and GJL250 cast iron suction & discharge casing, connected to TEFC ventilated induction motor of 2 pole, 2900rpm, suitable for 400/440 Volts, 3 phase, 50 Hz A.C. supply.
	(ii) Pressure vessel of non corrosive FRP composite construction lined with NSF and/or FDA listed material, like high density polyethylene with fully replaceable polyurethane. Air cell burst pressure of minimum of 5 times the vessel operating pressure and cycle tested for 2,50,000 cycles.
	(iii) Control Panel with programmable logic controller (PLC) for cyclic operation of pumps + Variable Frequency Drive. The Pump working sequence should change after every operation. Contractor overload relays and MCBs should confirm to IEC 898 – 1995/ specifications. Blinking indications for pumps start, trip, low level trip, health supply should be provided in the panel along with the ammeter & voltmeter. Control panel should also consist of cooling fan.
	(iv) Pressure switches bellow type fitted with micro switch and having maximum pressure and differential scale should confirming BS-6134 standards and IP55 protection class.
	(v) All required Ball Valves, Non-return valves, flexible connectors etc. and all required accessories, Heavy Duty G.I. Manifold to make the system completely operational as a skid mounted system. Ball valves to be used should be Hot Pressed brass OT-58 with stainless steel ball and P.T.F.E seal and O-Ring. NRVs to be used should be with Springs and O-Ring arrangement.
	(Vendor to submit performance curves and technical catalog of the proposed model for review & information)
	Complete manifold system shall be factory assembled & totally mounted on a common base frame with following duties:
	Note: Contractor to note that the suction header is required to have inlet connection from the Puddle Flange @ water tanks and to the pump suction. Provision of delivery header is required to have outlet connection from the pumps. Suitable outlet flanges from the delivery manifold / header shall be provided as required.
	pumping system -1
	No. of Pumps :3 (2 Working +1 Standby)

	Capacity : 250 LPM each pump
	Head : 75 Meters
	Location : Package-1 Plumbing Plant Room
	pumping system -2
	No. of Pumps :3 (2 Working +1 Standby)
	Capacity : 250 LPM each pump
	Head : 75 Meters
	Location : Plumbing Plant Room
D	Garden Water Relift pump
	Providing and fixing vertical, inline multistage centrifugal pumping set (Complete manufactured Skid- Mounted arrangement with manifold and accessories) with stainless steel SS-304 stage casing and SS-304 impellers with stainless steel shaft as per IEC standards and GJL250 cast iron suction & discharge casing, connected to TEFC ventilated induction motor of 2 pole, 2900 RPM, suitable for 400/440 Volts, 3 phase, 50 Hz A.C. supply with pressure gauge and with gunmetal isolation cocks, vibration elimination pads etc. complete with base and frame, nuts and bolts and necessary RCC foundations as per requirement as per instructions and pump shall have following duty:
	No. of Pumps :2(1 Working +1 Standby)
	Capacity : 250 LPM each pump
	Head : 65 Meters
	HP (Motors) : 7 HP
	Location : Plumbing Plant Room
	Providing & fixing self-acting, membrane controlled pressure reducing control valve (Altitude Float Valve) equipped with a 3-way valve operated by a mechanical 2- positions float. The valve shall close at a high level and open at a low level (fully opened or fully closed) and shall regulate the volume of flow instead of level. Body and top cap shall be made of Cast Iron (PN 16), membrane made of reinforced NBR, pilot circuit of Brass, seat of Bronze, and reversible seat seal of NBR/ EPDM. No plastic parts in the main valve & the pilot circuit shall be allowed and there shall be provision for the Pressure Gauge installation on the valve, complete in all respects for installation on tank inlets as specified. Make:Singer (USA)
	100mm dia
E	<u>WATER TREATMENT PLANT</u>
	Providing & fixing vertical, inline multistage centrifugal pumping set (Complete manufactured Skid-Mounted arrangement with manifold and accessories) with stainless steel SS-304 stage casing and SS-304 impellers with stainless steel shaft as per IEC standards and GJL250 cast iron suction & discharge casing, connected to TEFC ventilated induction motor of 2 pole, 2900 RPM, suitable for 400/440 Volts, 3 phase, 50 Hz A.C. supply with pressure gauge and with gunmetal isolation cocks, vibration elimination pads etc. complete with base and frame, nuts and bolts and necessary RCC foundations as per requirement as per instructions and pump shall have following duty:
	No. of Pumps : 3(2 Working + 1 Standby)
	Flow rate :1200 LPM each
	Head : 30 Mts
	Required for : Filter feed pump in Plumbing Plant room

F	<p>Providing and fixing vertical Dual Media Pressure Filter (comprising of minimum 300mm bed depth of Anthracite and support media and minimum Height on Straight 1500mm) fabricated from high performance M.S plate of minimum 10mm thick for shell & 12mm thick for dished ends (Quality of Steel as per IS:2062 Grade B, thickness as per ASME Section 8) internally treated with FRP, complete with air scouring, collection system complete with initial charge of media, M.S face piping, valves, accessories, external painting with 2 coats of red oxide primer and enamel paint, testing and commissioning complete. (Tested to 5.0 Kg/m²)</p>
	Filter for Domestic Water services.
	Filtration Rate 17500L/Sqm/Hr
	Working pressure 3Kg/Sq.cm
	Capacity 1200 LPM
	Activated Carbon Filter
	Filtration Rate 14000L/Sqm/Hr
	Working pressure 3Kg/Sq.cm
	Capacity 1200 LPM
G	<p>Providing and fixing 'Cation' ION exchange water softener fabricated from minimum 10mm thick M.S. plate on min. shell and 12mm thick M.S. plate on dished ends (Quality of Steel as per IS:2062 Grade B, thickness as per ASME Section 8) complete with initial charge of filter media and ION exchange resins, face piping accessories, diaphragm valves of approved specifications, HDPE Brine tank of min. 500 Liters, piping testing and commissioning complete with resins of approved quality and make and regeneration assembly complete with valves, ejector, brine suction valves and piping. (Bidder must indicate type and quantity of resin used and quantity of salt required per regeneration). All internal parts of the softener shall be rubber lined as per approved specifications.</p>
	Raw water hardness 600 Mg/L
	Treated water harness 10 Mg/L
	Capacity 500 LPM
H	<p>Supplying, installing, testing and commissioning of dosing system (for domestic water treatment plant) consisting of one HDPE tank of 200 litres capacity with a positive displacement diaphragm dosing pump having variable flowrate of 0-6 lph of efficiency EF1 and of approved make. The motor shall be suitable for operation at 240 V/single phase/50 Hz. Supply. The pump shall be supplied complete with necessary polypropylene piping, valves, strainers, low level switch and injection fittings. The pump shall be speed & stroke control Asia LMI / equivalent make.</p>
	The cost shall be inclusive of providing salt for the testing and operation of system before handover to the owner.
I	PLUMBING PANEL
	Design, manufacture, assembly, wiring, testing at works and supply to site of following panels/distribution boards/switch boards. The boards shall be designed and fabricated as per general specifications, technical details, specifications and notes as part of this tender /BOQ and relevant BIS codes.
	IP Rating: IP 54
	Incomer :

	1 No. 250 A 25 KA, 3P MCCB of motor duty - only Magnetic release. (Adjustable Magnetic release upto 250A MCCB OR Micro-Processor based release above 250A MCCB).
	Incomer Metering & Indication:
	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT.
	R,Y,B phase indication lamps (110V) LED Type
	Cast resin metering CT's for each phase of class-1 accuracy & of suitable burden & ratio
	*1 No. Digital VAF + PF Meter (110V) (*With / Without RS 485 Port)
	Bus bars:
	400A, TP, Aluminium Bus Bars of Electrolytic grade with heat shrinkable sleeves 25 KA.
	Control Transformer & Control Circuiting for Starters / Contactors & Indication Lamps :
	1 No. 415V / 55-0-55V Cast resin Dry type control transformer of adequate 'VA' burden to take care of load of all the contactor coils. (Transformer with primary taps at $\pm 2.5\%$, $\pm 5\%$, 50 Hz, centre tap earthed).
	Suitable rated 6A, DP, MPCB of the fault withstand capacity as of the panel for control circuiting for contactors coils on the primary side of control transformer & suitable rated 6A, DP MCB on the secondary side of control transformer.
	110V Control circuiting
	110V Control supply healthy indication (LED Type).
	Outgoings:
	<u>DOL Starter comprising the following (for Upto 3 HP Motors) for Raw Water Pumps / Treated water transfer pump / Borewell/For Pump Room Fresh Air Fan / For Pump Room Exhaust Air Fan:</u>
	For 1HP. (2 Nos.) (Chemical dosing Pump)
	Type-2 Co-ordination
	1 No. suitable rated TP MPCB, 10KA, with inbuilt O/L relay & inbuilt SPP feature (site adjustable)
	Suitable sized 3P contactor with 2 NO & 2 NC Auxiliary contacts
	ON/OFF / Trip indication lamps (110V) (LED Type)
	ON/OFF Push buttons
	2 Pole A/M Selector switch for BMS application
	Suitable rated single cast resin CT for metering on 'Y' phase, of Class-1 accuracy & of suitable burden & ratio.
	Digital ammeter
	ON/OFF-Trip / A/M potential free contacts for BMS
	Control wiring terminals for auto operation through potential free contacts of water tank level controllers.
	<u>DOL Starter comprising the following (for 3 HP to 5 HP Motors) for Raw Water Pumps / Treated water transfer pump / Flushing water transfer pump / Borewell / Soft water transfer pump /For Pump Room Fresh Air Fan / For Pump Room Exhaust Air Fan:</u>
	For 4 HP. (2 Nos.) (For Pump Room Exhaust Air Fan)

Type-2 Co-ordination
1 No. suitable rated TP MPCB, 25 KA, with inbuilt O/L relay & inbuilt SPP feature (site adjustable)
Suitable sized 3P contactor with 2 NO & 2 NC Auxiliary contacts
ON/OFF / Trip indication lamps (110V) (LED Type)
ON/OFF Push buttons
2 Pole A/M Selector switch for BMS application
Suitable rated single cast resin CT for metering on 'Y' phase, of Class-1 accuracy and of suitable burden & ratio
Digital ammeter
ON/OFF-Trip / A/M potential free contacts for BMS
Control wiring terminals for auto operation through potential free contacts of water tank level controllers.
<u>DOL Starter comprising the following (for 7.5 HP to 10 HP Motors) for Raw Water Pumps / Treated water transfer pump / Flushing water transfer pump / Borewell / Soft water transfer pump / For Pump Room Fresh Air Fan / For Pump Room Exhaust Air Fan:</u>
For 7.5HP. (2 Nos.) (Raw water/Filter feed Pump)
For 6 HP. (2 Nos.) (Soft water relifting Pump)
Type-2 Co-ordination
1 No. suitable rated TP MPCB, 10 KA, with inbuilt O/L relay & inbuilt SPP feature (site adjustable)
Suitable sized 3P contactor with 2 NO & 2 NC Auxiliary contacts
ON/OFF / Trip indication lamps (110V) (LED Type)
ON/OFF Push buttons (with lockable off)
2 Pole A/M Selector switch for BMS application
Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio
Digital ammeter with inbuilt selector switch
ON/OFF-Trip / A/M potential free contacts for BMS
Control wiring terminals for auto operation through potential free contacts of water tank level controllers.
<u>Star-Delta Starter comprising the following (for 12.5 HP to 25 HP Motors) for Raw Water Pumps / Treated water transfer pump / Flushing water transfer pump / Borewell / Soft water transfer pump / For Pump Room Fresh Air Fan / For Pump Room Exhaust Air Fan:</u>
For 12.5 HP. (3 Nos.) (Tubewells Pump)
Type-2 Co-ordination
1 No. suitable rated TP MPCB, KA, without inbuilt O/L relay (only magnetic)
Suitable sized 3P Contactors (Star, Delta & Run contactors) with 2 NO & 2 NC Auxiliary contacts
Star-Delta Timer
Suitable O/L relay with inbuilt SPP
ON/OFF / Trip indication lamps (110V) (LED Type)
ON/OFF Push buttons (with lockable off)
2 Pole A/M Selector switch for BMS application
Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio
Digital ammeter with inbuilt selector switch
ON/OFF-Trip / A/M potential free contacts for BMS

	Control wiring terminals for auto operation through potential free contacts of water tank level controllers.
	Feeders (without Starters) for Hydronumatic Pump Panels :
	1 No. suitable rated 15 KA, TP, MPCB without inbuilt O/L relay & with 1 NO + 1 NC Auxiliary contacts & 'ON' indication lamp 110V (LED Type) for 10 HP Sump Pump panel. Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio. Digital ammeter with inbuilt selector switch.
	Feeders (without Starters) for Sump Pump Panels :
	2 No. suitable rated 15 KA, TP, MPCB without inbuilt O/L relay & with 1 NO + 1 NC Auxiliary contacts & 'ON' indication lamp 110V (LED Type) for 15 HP Sewarage Sump Pump panel. Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio. Digital ammeter with inbuilt selector switch.
	Feeders (without starters) for R.O WATER Booster Pump Panels :
	1 No. suitable rated 10 KA, TP, MPCB without inbuilt O/L relay & with 1 NO + 1 NC Auxiliary contacts & 'ON' indication lamp 110V (LED Type) for 3 HP R.O Water Booster Pump panel. Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio. Digital ammeter with inbuilt selector switch.
	<u>Spare Starter feeders with same components as described in above written similar starter feeders:</u>
	5 HP Motors, DOL Starter (2 Nos.) (Spare feeders)
	<u>Spare Motor Feeders (Without Starters) with same components as described in above written similar feeders:</u>
	2 No. suitable rated 15 KA, TP, MPCB without inbuilt O/L relay & 1 NO + 1 NC auxiliary contacts & 'ON' indication lamp (110V) LED Type for 10 HP feeder. Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio. Digital ammeter with inbuilt selector switch.
	1 No. suitable rated 10 KA, TP, MPCB without inbuilt O/L relay & 1 NO + 1 NC auxiliary contacts & 'ON' indication lamp (110V) LED Type for 5 HP feeder. Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio. Digital ammeter with inbuilt selector switch.
	Vendor can also consider integrated total co-ordinated starter upto 15HP.
	Plumbing Panel as described above.
	SUMP PUMP PANEL (UPTO 5.0HP MOTOR):
	It shall control two pumps P-1 and P-2. The operation sequence will be as under :
	P-1 & P-2 to stop at L-1
	P-1 to start at L-2
	P-2 to start at L-3 (At L-3 both pump will be running) audible alarm at L-4 (50 mtr range).
	Hooter for annunciation (Solid State Buzzer)
	Where L-1 < L-2 < L-3 < L-4 (level of water in the sump) (probes/ sensors to control operation)

	There shall be selector switch to interchange the starting sequence between P1 & P2. (Selection mode)
	IMPORTANT FEATURES :
	Sump Pump Panel shall have following essential features:
	R,Y,B Phase indicating lamps with backup. Auto/ Manual selector switch. Starter ON/ OFF & high level Indications, Digital ammeters for both pumps. MPCB with inbuilt O/L & SPP, DOL starter and dry run protection suitable for motors and as per details given below :
	Incomer:
	1 No. suitable rated 35 KA, TP, MPCB without inbuilt O/L & with 1NO + 1NC auxiliary contacts for total 10 HP of Sump Pumps (Both Pumps working simultaneously).
	Incomer Metering & PT's :
	415V / $\sqrt{3}$ / 110V/ $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT.
	3 Nos. Cast Resin CT's of adequate class, burden & ratio at the incomer metering.
	R,Y,B (110V AC) LED lamp & ON/OFF indications (110V AC) LED type.
	Digital VAF meter at the incomer (110V).
	Control Transformer & Control Circuiting for Starters / Contactors & Indication Lamps :
	1 No. 415V / 55-0-55V Cast resin Dry type control transformer of adequate 'VA' burden to take care of load of all the contactor coils.
	Suitable rated 6A, DP, MPCB of the fault withstand capacity as of the panel for control circuiting for contactors coils on the primary side of control transformer & suitable rated 6A, DP MCB on the secondary side of control transformer. (Transformer with primary taps at $\pm 2.5\%$, $\pm 5\%$, 50 Hz, centre tap earthed).
	110V Control circuiting
	110V Control supply healthy indication (LED Type).
	PT of adequate burden can also be used for powering contactor coils of starters and in that case control transformer can be eliminated.
	Bus bars :
	100A, TP, Aluminium bus bars of required capacity & KA rating with heat shrinkable sleeves.
	Outgoings:
	Sump Pump Panel (Upto 5.0HP Motors):
	2 Sets suitable rated 15 KA, TP, MPCB's with inbuilt O/L relay & inbuilt SPP features (site adjustable) & with 1NO + 1NC auxiliary contacts for 5HP each Sump Pump motor & each set with the following:
	Suitable sized 3P contactor with 2NO + 2NC auxiliary contacts
	ON/OFF/Trip LED Indications (110V)
	ON/OFF Push buttons
	2 Pole A/M selector switch for BMS application
	Suitable rated Single Cast Resin CT for metering on 'Y' phase, Class-1 accuracy & of suitable burden & ratio.

Digital Ammeter
ON/OFF/Trip/A/M potential free contacts for BMS
3 Nos. suitable water level controllers with three electrodes (110AC)
The Sump pump control panel shall be complete with all interconnections, water level controllers & sensors / probes, risers, internal wiring, labels, terminal block etc complete as required.
SUMP PUMP PANEL (FOR 7.5HP TO 10.0HP MOTOR):
It shall control two pumps P-1 and P-2. The operation sequence will be as under :
P-1 & P-2 to stop at L-1
P-1 to start at L-2
P-2 to start at L-3 (At L-3 both pump will be running) audible alarm at L-4 (50 mtr range).
Hooter for annunciation (Solid State Buzzer)
Where $L-1 < L-2 < L-3 < L-4$ (level of water in the sump) (probes/ sensors to control operation)
There shall be selector switch to interchange the starting sequence between P1 & P2. (Selection mode)
IMPORTANT FEATURES :
Sump Pump Panel shall have following essential features:
R,Y,B Phase indicating lamps with backup. Auto/ Manual selector switch. Starter ON/ OFF & high level Indications, Digital ammeters for both pumps. MPCB with inbuilt O/L & SPP, DOL starter and dry run protection suitable for motors and as per details given below :
Incomer:
1 No. suitable rated 35KA, TP, MPCB without inbuilt O/L & with 1NO + 1NC auxiliary contacts for total 10HP of Sump Pumps (Both Pumps working simultaneously).
Incomer Metering & PT's :
415V / $\sqrt{3}$ / 110V / $\sqrt{3}$ PT's, Cast Resin type, 3 Phase for metering & indications, suitable rated 6A, TP MPCB of the fault withstand capacity as of the panel on the primary side of PT & suitable rated 6A, TP MCB on the secondary side of PT.
3 Nos. Cast Resin CT's of adequate class, burden & ratio at the incomer metering.
R,Y,B (110V AC) LED lamp & ON/OFF indications (110V AC) LED type.
Digital VAF meter at the incomer (110V).
Control Transformer & Control Circuiting for Starters / Contactors & Indication Lamps :
1 No. 415V / 55-0-55V Cast resin Dry type control transformer of adequate 'VA' burden to take care of load of all the contactor coils.
Suitable rated 6A, DP, MPCB of the fault withstand capacity as of the panel for control circuiting for contactors coils on the primary side of control transformer & suitable rated 6A, DP MCB on the secondary side of control transformer. (Transformer with primary taps at $\pm 2.5\%$, $\pm 5\%$, 50 Hz, centre tap earthed).
110V Control circuiting

	110V Control supply healthy indication (LED Type).
	PT of adequate burden can also be used for powering contactor coils of starters and in that case control transformer can be eliminated.
	Bus bars :
	100A, TP, Aluminium bus bars of required capacity & KA rating with heat shrinkable sleeves.
	Outgoings:
	Sump Pump Panel (For 7.5HP to 10.0HP Motors):
	2 Sets suitable rated 15KA, TP, MPCB's with inbuilt O/L relay & inbuilt SPP features (site adjustable) & with 1NO + 1NC auxiliary contacts for 10 HP each Sump Pump motor & each set with the following:
	Suitable sized 3P contactor with 2NO + 2NC auxiliary contacts
	ON/OFF/Trip LED Indications (110V)
	ON/OFF Push buttons
	2 Pole A/M selector switch for BMS application
	Suitable rated cast resin CT's for metering on each phase, of Class-1 accuracy and of suitable burden & ratio
	Digital Ammeter with inbuilt selector switch
	ON/OFF/Trip/A/M potential free contacts for BMS
	3 Nos. suitable water level controllers with three electrodes (110AC)
	The Sump pump control panel shall be complete with all interconnections, water level controllers & sensors / probes, risers, internal wiring, labels, terminal block etc complete as required.
	All pumps components & drawings to be approved by consultant prior to excute at Site.
	Indicated for all pumps include port charges, port handling charges, other local duties, loading, transportation /insurance upto site, octroi charges and all other taxes and incidentals complete till delivered at site.
	Receiving at site above imported equipment, unloading, storing, handling, hoisting, installing in position effecting connections,anchoring, grouting, testing and commissioning above equipment all complete with necessary indigenus accessories as required to complete the installation.
	The Sump pump control panel shall be complete with all interconnections, water level controllers & sensors / probes, risers, internal wiring, labels, terminal block etc complete as required.
	Supplying and drawing following sizes of FRLS PVC insulated copper conductor, single core cable in the existing surface/recessed steel/ PVC conduit as required.
	6 x 1.5 sq. mm
	4 x 1.5 sq. mm
	2 x 1.5 sq. mm
	Providing and fixing heavy duty copper armored cables 1.1 KVA grade including necessary support clamps at ceiling level, connection lugs and double compression glands, complete in all respects.
	Power cable 3 core 2.5 Sq.mm

	Power cable 3 core 4 Sq.mm
	Power cable 3 core 6 Sq.mm
	Power cable 3 core 10 Sq.mm
	Power cable 3 core 16 Sq.mm
	G.I. earthing wire 8 gauge from all motor and M.C.C panel to be connected in as approved manner to the general earthing system complete.
	Providing earthing station for pumps and M.C.C panel including excavation, C.I. manhole cover and frame complete as per specifications and I.E. rules.
	Supply and fixing of 14 SWG sheet steel slotted cable trays as per approved design and MS painted angle supports spaced 1000 mm apart throughout the length as specified, including the cost of MS threaded rod hangers duly painted, hooks, dash fasteners etc. for suspension from ceiling etc. as per specification and/or as per direction of Project in-charge.(Structural steel to be paid separately)
	300 mm x 50 mm x 50 mm (with 40 x 40 x 6 mm MS angle supports and 10 mm dia MS rod hangers up to one meter long)
	150mm x 50 mm x 50 mm (with 40 x 40 x 6 mm MS angle supports and 8 mm dia MS rod hangers up to one meter long)
	Providing and fixing chemical dosing system consisting of 2 nos. electronic dosing pumps (1W+1S) with all accessories, suitable to doze chemical solution upto 1 ppm doze (of Sodium Hypo-chloride solution) to a filtered water flow of approx. upto 50,000 lph. against a pressure of 1.5 kg/cm ² complete with FRP moulded solution holding tank of min. 500 litre with all standard accessories.
	Providing, fixing and testing Water Flow Meters in C.I./brass body flanged at both ends with companion flanges, gaskets, bolts nuts and washers, with electronic digital type display for real time & totalized flow rate of water, with panel and cabinet, memory facility, flow switches and sensors and required accessories complete including cutting and making good the pipeline, and making all electrical connections. Testing to be carried out at 200 lbs/psi with cold water for consistent quality. (With bypass arrangements with 3 valves).
	100 mm dia.
	80 mm dia.
	65 mm dia.
	Providing and Fixing 25 mm x 5 mm G.I. Strip In 40 mm dia G.I. Pipe from earth electrode as required

	Providing & fixing M.S. structural work fabricated from standard sections e.g. M.S rounds, angles, channels, plates including cutting to size,drilling,welding fixing and welding to insert plates in RCC structural members as directed by engineer-in-charge including cutting and making good the walls, ceilings and floors (for all pipe supports, clamps etc. within the Plant Rooms)
J	MISCELLANEOUS
	Providing and fixing insect-proof coupling to vent pipes of underground tank/overhead tank with threaded or flanged joints, including M.S. flanges, nuts, bolts, 3mm thick rubber insertions complete.
	80mm dia
	100mm dia
	Providing and fixing G.I./M.S puddle flange to R.C.C tanks, complete as per drawing.
	50mm dia
	65mm dia
	80mm dia
	100mm dia
	150mm dia
	200mm dia
	250mm dia
	Manhole Cover for U.G Tanks and Sumps
	Supplying and fixing C.I. cover without frame for manholes :
	Providing and fixing extra heavy duty, double seal, water tight C.I manhole cover and frame specially casted for placing over the underground water tanks with lifting and locking arrangements as per approved sample, complete in all respect including fixing in PCC as per site requirement.
	Providing and placing on terrace (at all floor levels) polyethylene water storage tank, IS : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.
	Providing and fixing rectangular high density polyethylene water storage loft tank with cover, conforming to ISI : 12701, colour of opaque white or as approved by Engineer-in-charge. The rate includes making necessary holes for inlet, outlet & over flow pipes. The base support i/c fittings & fixtures for tank shall be paid separately.
	Cutting holes up to 15x15 cm in R.C.C. floors and roofs for passing drain pipe etc. and repairing the hole after insertion of drain pipe etc. with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), including finishing complete so as to make it leak proof.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR ROAD WORK	
SCHEDULE D4	
S.No.	DESCRIPTION
1.0	Box cutting upto 25 cm depth in road in all sorts of soil (incl. soft or hard soil) spreading the soil uniformly over the trenches or disposal of the earth within the site in low lying areas as per direction of the site engineer and consolidation of the sub grade to correct level and grade by using 8 ton roller etc. and disposal of surplus earth outside the boundary complete in all respects inclusive of cost of all labour and materials carries etc. as per specifications and the direction of NCCF/Architect.
1.1	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth lead up to 50 meters.
1.2	Extra for compaction of earth work in embankment under optimum moisture conditions to give at least 95% of the maximum dry density(proctor density)
1.3	Supplying and laying spreading and compacting stone aggregate of specified sizes of WBM specifications including spreading in uniform thickness, hand picking, rolling with 3 wheeled road / vibratory roller 8-10 tonne in stages to proper grade and camber, applying and brooming requisite type of screening / binding material to fill up interstics of coarse aggregate watering and compacting to the required density as per design and drawing.
1.3.1	90mm to 63mm size stone aggregate.
1.3.2	63mm to 45mm size stone aggregate.
1.3.3	53mm to 22.45mm size stone aggregate.
1.3.4	Stone screening 13.2mm nominal size (Type A)
1.3.5	Stone screening 11.2mm nominal size (Type B)
1.3.6	Moorum
1.4	Providing and laying design mix Vaccum dewatered cement concrete broom finish in roads, taxi ways, driveways having a minimum works test beam flexural strength of 30 kg. per cm ² . at 28 days using not less than 340 Kg. of cement per cum of finished concrete, coarse sand and graded stone aggregate of 20mm nominal size in appropriate proportions as per specified design criteria approved by NCCF/Architect mechanically vibrated using needle and surface vibrators including steel form work with sturdy M. S. channel sections including curing and providing and filling construction joints and dummy joints with approved joint filler and primer including rounding of the edges and filling the grooves 10x25mm deep at top for construction joints and 10mmx50mm deep at top for dummy joints with joint sealing compound (conforming to grade B of IS : 1834) including making necessary arrangements for expansion joints etc. all complete as per design and drawing.

1.5	Painting roads, pathways, driveways etc and marking with adequate no. of coats to give uniform finish with road marking paint of superior make as approved by the NCCF/Architect i/c cleaning the surface of all dirt, scales, oil, grease and other foreign material etc. and lining out complete.
	New work (two or more coats)
1.6	Manufacturing supplying and fixing retro reflective overhead signage boards made up of 2mm thick aluminium sheet face to be fully covered with high intensity and encapsulated lens type heat activated retro reflective sheeting conforming to type - III of ASTM-D-4956-01 as approved by NCCF/Architect letters, borders etc. as per IRC : 67-2001 in silver white with blue colour back ground and with high intensity grade, pasted on substrate by pressure sensitive adhesive backing which shall be activated by applying pressure conforming to class II of ASTM-D-4956-01 and fixing the same to the plate of structural frame work by means of suitable sized aluminium alloys, rivets or bolts & nuts @ 300 mm centre to centre all along the periphery as well as in two vertical rows along with theft resistant measures including the cost of painting with two or more coats of epoxy paint in grey colour on the back side of aluminium sheet including appropriate priming coat. The rate includes the cost of rounding off the corners, lowering down the structural frame work from the gantry, fixing and erecting the same in position all complete as per drawings, specification and direction of the NCCF/Architect. Structural frame work including M.S. plate to be provided.
	Overhead informatory road signage.
1.7	Providing and laying 60mm thick factory made cement concrete interlocking paver block of M-30 grade made by block making machine with strong vibratory compaction and of approved size and design/shape laid in required colour and pattern over and including 50mm thick compacted bed of coarse sand, filling the joints with coarse sand etc. all complete as per the direction of NCCF/Architect.
1.8	Providing and laying at or near ground level factory made kerb stone of M-25 grade cement in position to the required line, level and curvature jointed with cement mortar 1:3 (1 cement : 3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm) including making drainage opening wherever required complete etc. as per direction of NCCF/Architect. Precast C.C. kerb stone shall be approved by NCCF/Architect.
1.9	SPEED BREAKER
	Providing and fixing Factory made heavy duty Modified Thermoplastics (Polymer Rubberized) speed breakers fixed securely to the roads with fastners as per specification and as directed by NCCF/Architect.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
EXTERNAL FIRE FIGHTING WORKS	
SCHEDULE D5	
S.No.	DESCRIPTION
A.	FIRE HYDRANT SYSTEM
1.0	<p>Providing, laying, jointing, testing and commissioning of following sizes of MS 'C' Class (Heavy duty) pipconforming to IS-1239 with all accessories like orifice plate(of required dia), all fittings (standard MS fitting welded joint shall be used on the pipes) including tees, elbows, reducers, union, flanges, rubber gaskets, nuts bolts, washer including supporting/fixing the pipe on floor / wall /ceiling with clamps, hangers (using anc fastners) as per specification. G.I. pipe sleeve of suitable higher size shall be provided wherever the pipes crossing the walls/floors and sealing the sleeves with glass wool in between & fire sealent compound at eit end all as per Project Manager's / Consultants requirements including cutting holes and chases in brick, R work and making good the same to original conditions complete in all respects. All hangers, clamps, brack etc. shall be of galvanized iron unless specified otherwire and then supply of the same shall also be included rates under this head.</p> <p>Welding of any kind on the galvanized support / hanger shall not be permitted including synthetic enamel paof approved shade over a coat of zinc primer.</p> <p>For wet riser System - MS `C' Heavy class pipe</p> <p>a. 80 mm dia</p> <p>b. 100 mm dia</p> <p>c. 150 mm dia</p>
2.0	<p>Providing two coats of synthetic enamel paint of approved shade over a coat of primer. Prior to application primer the surface should be cleaned for any dirt, rusts, rough substance etc. Including painting of leger both direction arrow as per the approval of the Project Manager.</p> <p>a. 80 mm dia</p> <p>b. 100 mm dia</p> <p>c. 150 mm dia</p>
3.0	<p>Providing, laying, jointing and testing in trenches the following sizes of MS class `C' (heavy duty) pipconforming to IS:1239 with accessories like orifice plate(of required dia), fittings including tees, elbo reducers, flanges, rubber gaskets, GI nuts, bolts and washers including excavation in all kind of soil, refilli ramming, removing the excavated surplus material, providing adequate support to the pipe and making gothe same complete as required. Rate shall include for dewatering necessary to execute the work. The pipe shnot be less than 1.0 m below ground level at any point. Pipes shall be embedded all around 150mm th compacted silver sand and providing protection to embedded MS pipes and fittings by applying pyp kprimer (@ 100 gm/sqm) thereafter wrapping 4 mm thick pyp kote (AW 4 mm) protection coating by ther fusion process. Overlap shall be maintained at 15 mm including thrust BUILDING BLOCK in cement concr (1:2:4). The application process shall be strictly according to manufacturer's specification.</p> <p>a. 80 mm dia</p> <p>b. 100 mm dia</p> <p>c. 150 mm dia</p>

4.0	Providing & fixing Gunmetal fire hydrant single headed landing valve with 80 NB flanged inlet, brass spincontrolled 63 mm dia female instantaneous outlet type coupling, blank cap, chain, twist release type lug & accessories. Conforming to IS standard. Including fixing with anchor fastner and flanged tapping from wet ri and providing pressure gauge with gun metal ball valve complete as required.
5.0	Providing & Fixing of 63 mm dia 15 m long controlled per collating (C.P.) type hose pipe, as per IS : 8423 Ty A with Gunmetal male & female instantaneous type coupling bound and riveted to hose pipe with copper riv and 1.5 mm copper wire with wire to pipe. (For external hydrant system).
6.0	Providing and Fixing 63 mm dia Gunmetal instantaneous pattern branch short pipe , 20 mm dia nozzle conforming to IS 903, suitable for inter connection to hose pipe coupling complete as required.
7.0	Providing & Fixing of weather proof standard fire hose cabinet (900 mm x 600 mm x 300 mm deep) for hydrants made of 16 SWG powder coated M.S. sheet having single or double opening glazed (4.0 mm t glass) shutter including necessary locking arrangement by allan key, stove enamelled Fire red finish with "F Hose" marked on front, suitable for housing 2 nos. Hose pipe, 1 No. branch pipe & nozzle spanner. (external hydrant system)
8.0	Providing & Fixing of gun metal two way fire brigade inlet to hydrant ring with 63 mm dia instantaneous inlet and 150 mm dia flanges outlet conforming to IS:904 with blank cap and chain including 150 mm butterfly valve (PN 1.6 rating) and wafer type non-return valve complete with nuts, bolts, flanges and compl in all respect. Cost shall include a wall mounted box of M.S. construction (16 SWG) with glass door (4.0 mthick) to house the above mentioned component. (Location : External hydrant ring)
9.0	Constructing masonry chamber 120x120x100 cm inside, in brickwork in cement mortar 1:4 (1 cement : 4 coarsand) for sluice valve with CI surface box 100mm top dia 160mm bottom dia, and 180mm deep (inside) wchained lid and RCC top slab 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size including necessary excavation, foundation concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggreg 40mm nominal size) and inside plastering with cement mortar 1:3 (1cement: 3 coarse sand) 12mm thi finished with a floating coat of neat cement complete as per standard design.
a.	With common burnt clay F.P.S (non modular) bricks of class designation 7.5
10.0	Providing & fixing Sluice valve (double flanged) of CI body and brass rising type spindle for PN 1.6 raticonforming to IS:14846 complete in all respects.
<u>Note: All valves shall be of minimum 16 Kg/sq.cm working pressure</u>	

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR EXTERNAL WATER SUPPLY	
SCHEDULE D6	
S. No.	DESCRIPTION
A. MAINS WATER SUPPLY LINE FROM TUBE WELL AND MUNICIPAL LINE TO U.G.T.	
1	Excavating trenches upto 1.5 meter depth in all kind of soil of required width for pipes. including excavation for sockets a dressing of sides ramming of bottoms including getting out the excavated soil & then returning the soil as required, in lay not exceeding 20 cm in depth including consolidating each deposited layer by ramming, watering, etc & disposing of surp excavated soil as directed within a lead of 50m or as directed at site by NCCF/Architect.
	Pipes etc from 80 mm and above but not exceeding 300 mm dia.
2	Supply, laying, jointing, testing and commissioning of ISI marked Ductile Iron pipes & fittings class K-9 complete in respects.
	80 mm
	100 mm
	150 mm
3	Supply, fixing in position, testing ISI marked cast iron double flanged sluice valves as per IS:14846-2000, (PN 10) with stem, bolts, nuts, 3 mm thick rubber gaskets including transporting to worksite, Complete as per drawings & directions of NCCF/Architect.
	80 mm nominal dia
	100 mm nominal dia
	150 mm nominal dia
4	Constructing brick masonry chamber 1200 x1200 x 1000 mm inside with F.P.S. brick work in cement mortar 1: cement : 4 coarse sand) for Sluice Valve/Butterfly Valve , necessary excavation, foundation concrete 1:4:8 (1 cemen coarse sand: 8 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1 : 3 (1 cemen coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design includin fix of CI/SFRC cover and frame in 150 mm thick cement concrete 1:2:4 (1cement : 2 coarse sand : 4 graded ston aggregate 20 mm nominal size) including centering, shuttering, excavation, refilling and disposal of surplus earth a directed completeall respects.
5	Providing Precast Cement Concrete / SFRC Valve Chamber cover and frame conforming to IS : 12592-2002., Tconcrete mix should be not less than M 30.
	Heavy duty, HD-20 grade designation - 600x600 mm internal size.
B. EXTERNAL RECYCLE WATER SUPPLY LINE FOR GARDEN HYDERNTS SYSTEM	
1	Excavating trenches upto 1.5 meter depth in all kind of soil of required width for pipes. including excavation for sockets a dressing of sides ramming of bottoms including getting out the excavated soil & then returning the soil as required, in lay not exceeding 20 cm in depth including consolidating each deposited layer by ramming, watering, etc & disposing of surp excavated soil as directed within a lead of 50m or as directed at site by NCCF/Architect.
	Pipes etc from 80 mm and above but not exceeding 300 mm dia.
2	Providing and Fixing HDPE Pipes (PE-100 grade) IS: 4984 of 10 Kg / cm2 including all fittings bends,Ball va junctions, tee, end cap etc. jointing as per manufacturer's instructions including trenching, refilling & testing joints complete as per directions of the engineer-in-charge. (For Garden Hydernts)
	100 mm dia
	All dia pipes

3	<p>Supply, fixing in position, testing ISI marked Cast iron double flanged sluice valves as per IS:14846-2000, (PN 10) with stem, bolts, nuts, 3 mm thick rubber gaskets including transporting to worksite, Complete as per drawings & directions of NCCF/Architect.</p> <p>80 mm nominal dia</p> <p>100 mm nominal dia</p>
	<p>Constructing masonry chamber 300x300x600mm inside (Garden Hydrant Chambers) with 75 class designation brick w in cement mortar 1:4 (1cement : 4 coarse sand) for garden hydrant valves of dia 32 mm and below with Pre-cast RCC cover, complete including all necessary excavation, back filling and disposal of surplus earth as per instructions, foundat concrete 1:5:10 (1 cement: 5 coarse sand : 8 graded stone aggregate 40mm nominal size) and inside plastering w cement mortar 1:3 (1 cement: 3 coarse sand) 12mm thick finished with a floating coat of neat cement complete as standard design and as per attached sketch.</p>
4	<p>Constructing Brick masonry chamber 600 x 600 x 1000 mm inside with F.P.S. brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for Sluice Valve/Butterfly Valve, necessary excavation, foundation concrete 1:4:8 (1 cement : 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1 : 3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design including fixin CI/SFRC cover and frame in 150 mm thick cement concrete 1:2:4 (1cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) including centering, shuttering, excavation, refilling and disposal of surplus earth as directed complete all respects.</p>
5	<p>Providing Precast Cement Concrete / SFRC Valve Chamber cover and frame conforming to IS : 12592-2002., Tconcrete mix should be not less than M 30.</p> <p>Heavy duty, HD-20 grade designation - 300x300 mm internal size.</p> <p>Heavy duty, HD-20 grade designation - 600x600 mm internal size.</p>
6	<p>Providing and laying cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone agg. 20 mm nominal size) for the BUILDING BLOCK at bends and junctions of water lines including necessary excavation, centering, shuttering etc as directed and required at site to complete the work..</p>

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR EXTERNAL DRAINAGE SYSTEM	
SCHEDULE D7	
S. No.	DESCRIPTION
1	<p>Excavating trenches in all kind of soil of required width for pipes including excavation for sockets and dressing of sides ramming of bottoms, including getting out the excavated soil & then returning the soil as required, in layers not exceeding 15 cm in depth including consolidating each deposited layer by ramming, watering, etc & disposing of surplus excavated soil directed within a lead of 50m.</p> <p>up to 1.50 m depth Pipes 80 mm to 300 mm diameter</p> <p>1.50 m to 3.00 m depth Pipes 80 mm to 300 mm diameter Pipes exceeding 300 mm diameter</p>
2	<p>Supply of ISI marked (IS:458) Spigot & Socket type R.C.C. NP-2 Pipe suitable for rubber ring joint including supplying rubber rings conforming to IS:5382 complete.</p> <p>300 mm. dia. Spigot & Socket type RCC Pipes 400 mm. dia. Spigot & Socket type RCC Pipes</p>
3	<p>Laying and jointing Spigot & Socket type R.C.C. NP-2 Pipe suitable for rubber ring joints, including lowering in trenches, to correct levels up to required depth including testing of joints and connection with the respective manhole complete in respects as per the direction of engg-in-charge.</p> <p>300 mm. dia. Spigot & Socket type RCC Pipes 400 mm. dia. Spigot & Socket type RCC Pipes</p>
4	<p>Providing and laying cement concrete 1:4:8 (1cement : 4 coarse sand : 8 graded stone agg. 40 mm nominal size) bedding & haunches of RCC pipes.</p> <p>300 mm diameter RCC Pipe 400 mm diameter RCC Pipe</p>
5	<p>Constructing brick masonry circular catch pit of 560 mm internal diameter at top with F.P.S. bricks in cement mortar 1:4 cement: 4 coarse sand) inside cement plaster 12 mm thick with cement mortar 1:3 (1 cement: 3 coarse sand) finished with floating coat of neat cement, foundation concrete 1:4:8 mix (1 cement : 4 coarse sand : 8 graded stone aggregate 40mm nominal size) and making necessary channel in cement concrete 1:2:4 (1 cement:2 coarse sand: 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement all complete as per standard design with PVC encased 6 mm dia steel bar foot rests fixing with 20x20x10 cm cement concrete BUILDING BLOCK 1:2:4, including fixing of C PCCC / SFRC grating / cover and frame in 150 mm thick cement concrete 1:2:4 (1cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) including centering, shuttering, excavation, refilling and disposal of surplus earth directed complete in all respects.</p> <p>900 mm internal dia at bottom & 900 mm deep 1200 mm internal dia at bottom & 1650 mm deep</p>
6	<p>Extra for depth for circular manhole with F.P.S. bricks in cement mortar 1 : 4 (1 cement : 4 coarse sand) as per above item</p> <p>900 mm internal dia at bottom from 900 to 1650 mm 1200 mm internal dia at bottom from 1650 to 2250 mm</p>
7	<p>Providing Precast Cement Concrete / SFRC catch pit grating and frame conforming to IS : 12592-2002., The concrete should be not less than M 30.</p> <p>Heavy duty, HD-20 grade designation - 560 mm internal diameter.</p>

8	Providing & fixing in position D.I. grating made out of Ductile Iron frames complete for covering Drain Channel in basement and ground floor (over Basement Slabs) as per details shown in drawing.
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NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR EXTERNAL SEWERAGE SYSTEM	
SCHEDULE D8	
S. No.	DESCRIPTION
1	Excavating trenches in all kind of soil of required width for pipes including excavation for sockets and dressing of sides ramming of bottoms, including getting out the excavated soil & then returning the soil as required, in layers not exceeding 15 cm in depth including consolidating each deposited layer by ramming, watering, etc & disposing of surplus excavated soil directed within a lead of 50m.
	up to 1.50 m depth
	Pipes 80 mm to 300 mm diameter
	1.50 m to 3.00 m depth
	Pipes 80 mm to 300 mm diameter
2	Open timbering in trenches including strutting and shoring complete. (Measurement to be taken of the face area timbered) The timbering will be done for pipes laid below 1.5 meter depth.
	Depth not exceeding 1.5 meter
	Depth 1.5 to 3.00 meter
3	Supply of ISI marked (IS:458) Spigot & Socket type R.C.C. NP-2 Pipe suitable for rubber ring joint including supplying rubber rings conforming to IS:5382 complete.
	200 mm. dia. Spigot & Socket type RCC Pipes
	250 mm. dia. Spigot & Socket type RCC Pipes
	300 mm. dia. Spigot & Socket type RCC Pipes
4	Laying and jointing Spigot & Socket type R.C.C. NP-2 Pipe suitable for rubber ring joints, including lowering in trench laid to correct levels up to required depth including testing of joints and connection with the respective manhole complete all respects as per the direction of NCCF/Architect.
	200 mm. dia. Spigot & Socket type RCC Pipes
	250 mm. dia. Spigot & Socket type RCC Pipes
	300 mm. dia. Spigot & Socket type RCC Pipes
5	Providing and laying cement concrete 1:4:8 (1 cement : 4 coarse sand : 8 graded stone agg. 40 mm nominal size) bedding & haunches of RCC pipes.
	200 mm diameter RCC Pipe
	250 mm diameter RCC Pipe
	300 mm diameter RCC Pipe

6	Constructing brick masonry circular manhole of 560 mm internal diameter at top with F.P.S. bricks in cement mortar 1:4 cement: 4 coarse sand) inside cement plaster 12 mm thick with cement mortar 1:3 (1 cement: 3 coarse sand) finished with floating coat of neat cement, foundation concrete 1:4:8 mix (1 cement : 4 coarse sand : 8 graded stone aggregate 40mm nominal size) and making necessary channel in cement concrete 1:2:4 (1 cement:2 coarse sand: 4 graded stone aggregate 20mm nominal size) finished with a floating coat of neat cement all complete as per standard design with P encased 16 mm dia PVC coated steel bar foot rests fixing with 20x20x10 cm cement concrete BUILDING BLOCK 1:2 including fixing of SFRC MH cover and frame in 150 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) including centering, shuttering, excavation, refilling and disposal of surplus earth directed complete in all respects.
	900 mm internal dia at bottom & 900 mm deep
	1200 mm internal dia at bottom & 1650 mm deep
	1500 mm internal dia at bottom & 2250 mm deep
7	Extra for depth for circular manhole with F.P.S. bricks in cement mortar 1 : 4 (1 cement : 4 coarse sand) as per above
	ite
	900 mm internal dia at bottom from 900 to 1650 mm
	1200 mm internal dia at bottom from 1650 to 2250 mm
	1500 mm internal dia at bottom from 2250 to 3000 mm
	1500 mm internal dia at bottom from 3000 to 5000 mm
8	Providing SFRC Manhole cover and frame conforming to IS : 12592-2002., The concrete mix should be not less than M
	3 Heavy duty, HD-20 grade designation - 560 mm internal diameter.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR TUBE WELL	
SCHEDULE D9	
S. No.	DESCRIPTION
CONSTRUCTION OF TUBE WELL	
1	Drilling 300 mm dia by ODEX method in all type of soil including hard & soft rock but including boulders.
2	Supply & fixing 200 mm dia uPVC casing pipe of Tirupati or equivalent make as per IS: 4985.
3	Supply & fixing of 200 mm dia well cap with nuts & bolts complete.
4	Flushing charges of the development of the tubewell by air compressor.
5	Water sample testing of the newly developed tubewell. Tests should be :
	Physical analysis
	Chemical analysis
	Bacteriological analysis
6	Providing, Fixing, testing and commissioning of submersible pump of approved make with suitable capacity motor having 3.5 LPS discharge and 80 Mt. head.
7	Supply and installing cage for submersible pumps, motor, fabricated out of 40 mm x 6 mm M.S. flat, welded construction and put to proper shape to hold pump enclosed and fixed around the mouth of pump set including painting with two coats of primer complete.
8	Providing, Fixing, testing and commissioning of control panel of submersible set including starter, light indicator MCB, voltmeter, ammeter, single phase preventor, dry running cut off.
9	Providing & fixing submersible cable of size 3 x 2.5 sqmm.
10	Supply & fixing of 65 mm dia G.I. pipe C-class with G.I. socket and accessories, gate valve, nipple, elbow erection, clamp stainless steel rope complete.
11	Providing & fixing bulk water meter.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR LANDSCAPING AND HORTICULTURE WORKS	
SCHEDULE D10	
SR. NO.	DESCRIPTION OF ITEM
	The contractor shall maintain the landscaped area, equipments and play courts etc along with horticulture upto 1 year from the date of completion of work
	The scope of work of landscape and horticulture if not specifically mentioned below shall broadly includes soft and hard landscape including roads, pavements, pathways on top of basement top, slopes, gradients, water bodies, feature walls, pergolas, irrigation hydrants, playcourts, plantation, seating, benches, Kids play area, amphitheater, kids play equipments, dustbins, vertical plantations, moulds, irrigation systems etc complete.
1	Trenching in ordinary soil up to a depth of 60cm including removal and stacking of serviceable materials and then disposing of by spreading and neatly levelling with in a lead of 50m and making up the trenched area to proper levels by filling with earth or earth mixed with sludge or/and manure before and after flooding trench with water.
2	Supplying and stacking of sludge at site including royalty and carriage.
3	Supplying and stacking of good earth at site including royalty and carriage.
4	Supplying and stacking at site dump manure from approved source: Screened through sieve of I.S. designation 20mm
5	Supplying and stacking at site dump manure from approved source : Screened through sieve of I.S. designation 16mm
6	Supplying and stacking at site dump manure from approved source : Screened through sieve of I.S. designation 4.75mm
7	Rough dressing the trenched ground including breaking clods.
8	Uprooting weeds from the trenched area after 10 to 15 days of its flooding with water including disposal of uprooted vegetation.
9	Fine dressing of the ground.
10	Spreading of sludge, dump manure or/and good earth in required thickness.
11	Mixing earth and sludge or manure in proportion specified or directed.
12	Grassing with ' Doob ' grass or any other specified grass including watering and maintenance of the lawn till one year after completion of project. A thick lawn free from weeds and fit for mowing including supplying good earth if needed. In rows 7.5 cm apart or as specified in either direction.

13	Preparation of beds for hedging and shrubbery by excavating 60cm deep and trenching the excavated base to a further depth of 30cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20%), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed, within a lead of 50m lift up to 1.5 m complete.
14	Digging holes in ordinary soil and refilling the same with the excavated earth mixed with manure or sludge in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any with all leads and lifts : Holes 60 cm dia, and 60 cm deep.
15	Providing and laying at or near ground level factory made kerb stone of M-25 grade cement in position to therequired line, level and curvature jointed with cement mortar 1:3 (1 cement: 3 coarse sand) including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm) including making drainage opening wherever required complete etc. as per direction of NCCF/Architect (length of finished kerb edging shall be measured for payment). (Precast C.C. kerb stone shall be approved byNCCF/Architect).
16	Painting of kerb stone with 02 coats of approved brand synthetic enamel paint over a coat of primer. Onename plate of 1 mm thick MS sheet of size 250x100 mm shall be welded to the tree guard of approved brand.
17	Supplying & planting of Trees in holes, including spreading of manure sludge & pesticise etc. complete.
	1.8 m high trees
	2.0 m high trees
	shrubs etc
	Flower plants etc
18	Making Tree guard 53 cm dia and 2 m high as per design including providing & fixing four leg 40 cm long of 30x3 mm flat riveted to tree guard and fixing 2 nos MS sheet rings 50x0.5 mm fixed with rivets complete in allrespect including painting.
19	Providing & placing sufficient stainless steel dust bins at appropriate places.
20	Providing & fixing Sign boards/ Signages, block markers, direction indicators etc as directed byNCCF/Architect.
21	Providing and fixing Stainless Steel/Wrought Iron and Stone /RCC decorative benches as directed byNCCF/Architect.
22	Providing and fixing at or near ground level PCC (1 cement: 3 coarse sand) including the cost of requiredcentering, shuttering and finishing including bed mortar complete.
	a) (300mmx125mmx600mm) precast cement concrete in kerb.
	b) (300x100x600) granite in kerbs, edging etc. as approved pattern and setting in position with cementmortar 1:3 (1 cement : 3 coarse sand)
23	Providing and laying precast interlocking Concrete paving BUILDING BLOCK of approved quality, shade, shape and colour as per Architect's design and to be laid over stone soling or PCC with fine sand as a sub- base or as per manufacture's specification complete:
	a) 80 mm thick.

	a) 60 mm thick.
	b) 40mm thick.
24	Providing and laying 30/40 mm thick pre polished granite stone flooring and treads over 20mm thick(average) base of cement mortar 1:4 mix (1cement: 4coarse sand) laid and jointed with white cement slurry including matching pigment complete as per design with approved quality of stone. (Basic cost of stone will be Rs.180/- per sft.)
	a) Granite stone FLAME finish
	b) Granite stone SHOT BLAST finish
	c) Granite stone LEATHER finish
25	Grass Track Grass Pavers
	a) The Grass Paver to have interlock system to lock each other. The Grass Paver should have compressive strength of minimum 150 tons/sq mt , capable to take the load of the fire tender. The panel should have high level of porosity greater than 90%, porous for Grass, shrubs and low planters. Laying to be done on 50 mm sand bed over well compacted subbase / WBM/PCC as per manufacture specifications and directions of Engineer in charge
	b) Providing & laying 70mm thick factory made cement concrete grass paver block of M-30 grade with white cement cast in PVC/Rubber mould made by block macking machine with strong vibratory compaction with smooth finish & required size and design/shape laid in the permanent colour of bay or company and pattern oer and including 50mm thick compacted bed of coarse sand filling the joints with fine sand etc.all complete as per the direction of Engineer -in-charge.
	Providing & laying 80mm thick factory made cement concrete interlocking paver block of M-40 grade with white cement cast in PVC / Rubber mould made by making machine strong vibratory compaction with smoothfinish and required size and design / shape laid in with permanent colour of bay or company and patter over and including 50mm thick compacted bed of coarse sand and filing the joints with fine sand etc. complete as per the directions of the Engineer-in-charge.
26	Providing and laying 75 mm thick. river bed pebbles of required shape and size as per the approved sample complete.
27	Providing and laying SAND of approved quality for Sand pit (kids area) as per requirement etc. complete..
28	Providing and fixing 20 mm thick granite stone of approved quality on CLADDING with cement mortar 1:3 (1 cement : 3 coarse sand) with approved design and pattern, jointed with white cement slurry mixed with pigment to match the shade of the stone including necessary holdfasts, clamps and pins etc. as per requiment as per design and drawing of the Architects complete.
	a) Granite stone FLAME finish
	b) Granite stone SHOT BLAST finish
	c) Granite stone LEATHER finish
	d) Granite stone HAND CHISEL finish
	e) Granite stone MACHINE PULLED finish
29	Providing and fixing GLASS MOSAIC tiles or equivalent or approved by the Architects on floors and dado of the water feature as per design and pattern over a 20mm(average) thick cement mortar 1:3 (1cement :3 coarse sand) and jointed with white cement slurry mixed with pigment to match of the colour of tiles includingcleaning of the tile surface complete . (Basic cost of tile Rs.80/-per sqft.)

30	Providing and fixing Bisaza mosaic tiles of approved make, colour and shade including premium colours as approved by the Architect of 20mmx20mmx4mm thick using rubber latex adhesive of approved quality in flooring and cladding overall including cost of base with cement mortar/cement plaster 1:2 (1 cement : 2 coarse sand). Joints grouted with white cement slurry mixed with pigment to match the shade of tiles complete at all height and depth.
31	Providing and fixing Handmade Procelein tiles 75mm x75mm size of approved make, colour and shade including premium colours as approved by the Architect using rubber latex adhesive of approved quality in flooring and cladding overall including cost of base with cement mortar/cement plaster 1:2 (1 cement : 2 coarse sand). Joints grouted with white cement slurry mixed with pigment to match the shade of tiles complete at all height and depth.
31.1	Providing and fixing of 7 mm thick Exterior matt glazed ceramic body wall cladding tiles in approved shade and sizes with specially designed deep grooves on back side of the tile for superior adhesion. The tiles weight shall be 1 kg per sq fts and having zero absorbtion from top surface and should be efflorescence proof. The tiles shall be fixed on surface having rough plaster of cement mortar in 1:3 ratio (1 cement :3 corase sand) and the tile should be fixed with 1 : 1 ratio by volume. and mixed with polymix liquid cement admixture, which should be applied by notch trowel application complete work in all respects as per directionof NCCF/Architect.
32	WATER BODIES
	Providing, fixing, testing & commissioning of Bowl with Trickling water fall Fountain (water features) and fountainswith civil work, waterproofing and all accessories complete.
	Filtration Systems & its accessories
a	Bio Filter 400 Dia
b	Dry Pump 5 HP
c	Dry Pump 0.5 HP
d	Chlorine dosing unit
e	Suction Point
f	NL 409 W
g	Deck Box
h	Floor Inlet Nozzles
i	Diffuser
j	Main Drain Cover
k	Plumbing & electrical
33	PLANTERS
	Construction of planters with civil work including RCC, brick works, plaster, claddingetc complete.
	Providing and fixing 40 mm thick (two stones to be used) Prepolished granite of approved quality on COPING / SEATS with cement mortar 1:3 (1 cement : 3 coarse sand) with approved design and pattern, jointed with white cement slurry mixed with pigment to match the shade of the stone including making the moulding and edge polishing as per design and drawing of the Architects complete. (Basic cost of stonewill be Rs.180/- per sft.)
	Providing and fixing 20 mm thick Pre polished granite of approved quality on CLADDING with cement mortar 1:3 (1 cement : 3 coarse sand) with approved design and pattern, jointed with white cement slurry mixed with pigment to match the shade of the stone including necessary holdfasts, clamps and pins etc. as per requirement as per design and drawing of the Architects complete.
	a) Granite stone FLAME finish
	b) Granite stone SHOT BLAST finish
	c) Granite stone LEATHER finish

34	Providing and fixing 20mm dia, 30cm long medium class GI pipe spouts cut to required shape and fixed in brick or R.C.C work.
35	Providing and fixing 20mm thick Drain board in planter and landscape area to drain water to the drain channels in all green areas above basement with pre fixed GEO TEXTILE FABRIC as per specifications and details complete to the satisfaction of architect/ NCCF.
36	Providing and fixing stone BALUSTRADE
37	Providing and fixing decorative stone basins for waterbodies out of Indian Marble 1000 mm dia, 600 mm ht and 100 mm thk.
38	Providing and fixing decorative stone benches out of hand carved Dholpur 1500mm long, 450 mm high, 100 mm thk. and size of stone support is 300 mm x 200 mm.
39	Providing water jet cut decorative metal jaali in feature wall out of 10mm thk. Ms sheet fixed to ms frame out of 100mx100ms tube. The frame is fixed to the ground by embedding in concrete pier /post as per Architects design including the cost two or more coats of enamel paint of approved shade and colour over a coat of red oxide approved quality primer etc. complete.
40	Supply of decorative stone planters (750 mm high, 750mm dia)
41	Supply of decorative Pots (yucca) 1200 dia/ 1500 dia
42	Civil Construction and finishing of Feature wall including RCC, brick works, vertical plantation, and lighting with light fittings and wiring complete, plaster, stone/High Pressure Laminate cladding, fixing of block numbers etc complete.
43	PERGOLA Providing, fabricating and erecting MS structural in MS pipe, RSJ channels, angles, flats, rods, plates for columns for PERGOLA or frames etc. in welded and bolted as per design including the cost of all consumable materials such as welded rods, gases etc. including cutting bending, notching, nuts and bolts, drilling holes, washers gusset plates etc. complete with all tools and tackles, hoisting equipments, fabricated to the Architects design including the cost two or more coats of enamel paint of approved shade and colour over a coat of red oxide approved quality primer etc. complete.
44	Providing and fixing MS pergola with 1" thk. Wooden cladding seasoned or with High Pressure Laminate a) Providing and applying 12 to 15mm thick plaster to masonry and RCC walls, columns etc. in cement mortar 1:5 (1 cement : 5 fine and coarse sand in equal proportion) finished smooth including hacking the surfaces, scaffolding, curing, making grooves at desired location etc. complete as per drawing. b) Providing and applying 20 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) finished with a top layer 8mm thick cement plaster 1:6 (1 cement : 6 fine sand) including making of grooves, bands, drip course as shown in drawing, scaffolding, curing, providing & mixing water proofing compound (CICO) in both layers as per manufacturer specification etc. complete as per drawing. c) Providing and applying weather shield paint on exterior paint of NEROLAC, ASIAN or equivalent or approved by the Architects of approved shade / colour and type complete as per manufacturer's specifications.
45	BASKET BALL COURT

	Excavation in all kinds of soil excluding soft rock and hard rock for foundation of walls upto a depth of 300mm below ground level including well compacting.
	Providing and laying in position 150 mm thick Soling with base preparation by mechanical compaction using 8 - 10 power Road Roller using Granite hand broken metal Rubble and smaller Pebbles for void filling after spreading murrum sand upto 33 % by volume of soling metal and thoroughly watering etc for bedding layer as directed by NCCF/Architect including watering , packing , compaction etc. 80mm PCC 1:5:10 over WBM complete
	Providing and laying 63 mm thick Plain Cement Concrete (M-20 Grade) to required line and level including hardener.
	Supply & application of Rubberized paint finish in colour
	G.I Chain link fence around basket ball - 4Mtr ht
	Providing and fixing 1 set of necessary accessories with two poles & 20mm Thick Acrylic Board with marking ring & net
	Providing and fixing 1 set of Flood Lights- 4 Poles with 2 Metal Halides 400W each
46	BADMINTON COURT
	Excavation in all kinds of soil excluding soft rock and hard rock for foundation of walls upto a depth of 300mm below ground level including well compacting.
	Providing and laying in position 150 mm thick Soling with base preparation by mechanical compaction using 8 - 10 power Road Roller using Granite hand broken metal Rubble and smaller Pebbles for void filling after spreading murrum sand upto 33 % by volume of soling metal and thoroughly watering etc for bedding layer as directed by Engineer in charge including watering , packing , compaction etc. 80mm PCC 1:5:10 over WBM complete
	Providing and laying 63 mm thick Plain Cement Concrete (M-20 Grade) to required line and level including hardener.
	Supply & application of Rubberized paint finish in colour
	Providing and fixing 1 set of necessary accessories with two poles & net
	Providing and fixing 1 set of Flood Lights- 4 Poles with 2 Metal Halides 400W each
47	RUBBER FLOORING
	Providing and fixing rubber safety surface tiles 25mm thick complete with bevelled edge tiles for transition to grade, interlocking pins if any with BASF adhesive or its equivalent on PCC surface. (Brand Koochie/Sunflex)
	KIDS PLAY AREA AND PLAY EQUIPMENTS
48	Providing and fixing Artificial grass
49	Providing and fixing of Kids play area equipments like slide, swings, maze, jungle walks etc complete
50	Civil construction and finishing, Stone cladding of Kids play area with sand filling and rubberised Floors
	SPRINKLER AND DRIP IRRIGATION SYSTEM
51	Sprinkler Irrigation Systems manufactured as per IS 14151 : Part 1 & 2 standards. Fittings, Gun Metal Sprinkler & HDPE Pipe. The system should be portable & flexible system as required to cover the entire landscape areas.
52	Drip Irrigation Systems through a network of valves, pipes, tubing and emitter as required to cover the entire landscaped area
53	Suction / Delivery Hoses & Garden tubing In grades as per application requirements manufactured as per IS:15265 standards as required for garden irrigation as required to cover the entire landscaped area.

NATIONAL COOPERATIVE CONSUMER FEDERATION OF INDIA	
SCOPE OF WORK	
FOR RAIN WATER HARVESTING	
SCHEDULE D11	
S.No.	Description
1	Constructing recharge well of 3m diameter & 3m deep with brick work in class designation 7.5 in cement mortar 1:4 including excavation, removing of earth, plaster in cement mortar, foundation concrete 1:4:8, PCC around pipe, 200mm outer dia u.P.V.C. class II (plain or slotted) conforming to IS:4985, 300mm dia bore upto 5m deep from first water level with filled pea gravel after fixing pipe, RCC top slab in RCC 1:2:4, 2 Nos. manhole covers, 2 Nos. 110 OD class A vent pipe, geotextile layer over top surface of filter media, 300mm height boulders, 200mm high coarse sand, 300mm high gravel complete as per standard drawing. (location as/site) (Rates including boring 40 to 50 m length and 200 mm dia PVC pipe of same length)
2	Providing and fixing RCC de-silting chamber as per design and drawing.

MATERIALS:

Sr. No.	ITEM	BRANDS SPECIFIED
A	CIVIL	
1	Pre-Laminated Flush Doors	Bhutan Tuff Century Jayna
2	Plywood/Block board/Soft Board	Duro Bhutan tuff Greenpanel
3	Iron Mongery (SS)	Godrej Dorset Dorma
4	Locks	Godrej Dorset IPSA
5	Polished Glazed Vitrified Tiles (PGVT)	Kajaria Neom Johnson Somany
6	Glazed Tiles	Kajaria Somany Neom Johnson
7	Ceramic Tiles	Kajaria Somany Neom Johnson
8	Stone Tiles	Unistone or equivalent
9	Pre laminated Particle Board	Greenlam Novapan Greenpanel
10	Wooden Door Frames/Shutters	Jayna doors Bhutan Tuff Maurya & Co.
11	Water proofing compound	Zypex Vandex Krytone
12	Atactic Polypropylene Polymer	Tiki Tar STP Sika
13	Sealant/ Additive	Asian Paints Fosroc
14	Glass	Modi Guard (Guardian) Saint-Gobain Asahi India
15	Polymers Sealant Concrete Additive	Sika CICO Fosroc
16	Cement OPC and PPC	UltraTech Birla Jaypee JK Lakshmi Cement Nuvoco
17	Expanded Poly Strene	BASF Fosroc
18	Cement (White)	JK

		Birla Jaypee
19	Anti-Termite Treatment Agency	M/s Pest Control Co. M/s Pest Control Incorp. M/s Pest (I) Co. M/s Pest Killers
20	Cement Board False Ceiling	Everest Shera Board
21	Paints	Nerolac ICI Asian Paints Berger
22	Adhesive	Dunlop Fevicol Mowicol
23	Steel Reinforcement	TISCO SAIL
24	Letter Boxes	PVC LETRX
25	False Ceiling	Armstrong Ramco Hilux Aerolite Deckelite
26	False Ceiling GI Grid	Gridline Armstrong Aerolite Deckelite
27	Cement Based Putty	Birla JK
28	SFRC Covers/Kerb Stones/saucer drain	KK Manholes JK Duratuff Tuff Tech
29	Concrete Benches	KK Manholes
30	High Pressure laminate	Fundermax G-next
31	AAC Blocks	Kansal AAC Block Laxmi En-Fab Pvt. Ltd Clavecon (India) Pvt. Ltd. Modcrete
32	Dash Fastener	Hilti Wurth Fisher
33	POP	Birla White Zypsofine JK Lakshmiplast Ultra Shree
34	Admixture	Fosroc Sika Cico
35	SS Railing Section (Grade-304)	Jindal
36	Solar Panel	Supreme solar V-guard Havells Luminous
37	Aluminum system Door & Windows	Schueco Reyners

		Domal Fenesta Aluminium (Alumil)
38	ACP sheet	Alucobond Alstrong Eurobond
39	Glass reinforced concrete (GRC)	Unistone GRC Kingfisher GRC Group Asian GRC Everest GRC Birla GRC
40	Grid Ceiling Tiles	Aerolite or equivalent
41	Ready Mix Concrete (RMC)	UltraTech Prism RMC RMC Readymix (India) ACC Limited Nuvoco
B	SANITARY	
1	Vitreous China Ware	Hindware Jaquar Kohler
2	Concealed Cisterns	Hindware Gebrit Jaquar Kohler
3	Plastic WC Seats covers	Diplomat Hindware Jaquar Kohler
4	Stainless Steel Sinks	Prestige Jayna Nirali
5	CP Fittings, Accessories	Jaquar Grohe Kohler Schell
5.A	Bottle trap, Unique Extension Nipple	Mayur
6	CP Waste & Flush Pipes	Jaquar Hindware Kohler
7	Gun Metal Valves	GIACOMINI TIMME RB Danfoss Zoloto
8	CPVC Pipes & Fittings	Astral Ashirwad

		Supreme Finolex
9	PVC Cisterns	Kohler Hindware Jaquar
10	MS Pipes	TATA Jindal
11	uPVC Pipe	Astral Ashirwad Supreme Finolex
12	Asbestos cement pipe	Hyderabad Asbestos Everest
13	DI Pipes, fittings	Kesoram Electrosteel Jainsons
14	Pumps	Grundfoss DP Holland ITT Wilo Kirloskar Xylem
15	Elec. Switchgear & Starters	Siemens ABB Schneider
16	Floor drain fixture & channel Grating	Neer Chilly Kitch
17	Pipe clamps & supports	Chilly Euro clamp Kitch
18	Butterfly Valve	Audco SKF Kirloskar Zoloto
19	Pressure reducing valve	Zoloto Honeywell RB
20	Valves	Zoloto Honeywell RBM

		RB
21	Electric Flow Meter	Rockwin Marshal Karanti Fair Flow
22	Level Controller/ Indicator (Water)	Advance automation Diamond
23	Insulation for hot water pipe	Thermoflex Kflex Armacell
24	Submersible/Drainage/Sewerage Pumps	Grundfos KSB ITT
25	HDPE pipe	Jain Finolex Supreme
26	HDPE Water Tanks	Sintex Supreme Plasto Gold
27	RCC Pipes (NP2 Class)	Om Spun BHRC Pragati Shreeram
C	ELECTRICAL	
1	MCCB's (Adjustable overload and adjustable short circuit release)	Schneider Siemens ABB Hager
2	Cables	Finolex Havells Batra Henley Polycab Capp
3	MCB's, ELCB's, RCBO's & RCCB's	Siemens Legrand Schneider ABB
4	ACB's	Schneider: NW Series Siemens: 3WT Series Mitsubishi: WS Series
5	MCB & DB/ONT	Legrand Schneider ABB Hager LLVT
6	Indication Lamps	Schneider Electric

		Rishabh Siemens
7	Push Buttons	Schneider Electric Siemens
8	Selector Switches	ABB Kaycee Siemens Rishabh
9	Electrical Terminals	Elmax Connectwell
10	Meters-Analogue	AE Schneider-Conzerv
12	Cast Resin Current Transformers	AE Gilberts & Maxwell Matrix
13	Cast Resin PT's for metering in LT Panels	AE Gilberts & Maxwell Matrix
14	FRLS PVC Conduits & Accessories	BEC Polypack AKG Atul Precision
15	Ceiling rose & holder	Kay Khosla MMP Anchor
16	MS / GI Conduits & Accessories	BEC ATUL AKG Polypack
17	Switches & Sockets- Modular type & Industrial Type and G.I Box	WIPRO NORTHWEST PLATIA HAVELLS- CRABTREE- MURANO

		LEGRAND-MYRIOUS ABB-IVIE SCHINDER-UNICA
18	Lighting Fixtures	HAVELLS POLYCAB BAJAJ PHILIPS
19	Tube Lights & Lamps	Philips Osram Havells
20	Exhaust Fans / Ceiling Fans	Usha Crompton Greaves Havells Polycab
21	1100 V grade ZHLS (Zero Halogen low smoke) ZHLS Polymer insulated, unsheathed, flexible, copper conductor wires	Finolex Havells Batra Hanley RR KABEL Polycab
22	1100 V grade FRLS (Fire Retardant low smoke) HR FRLS PVC insulated unsheathed, flexible, copper conductor wires	Finolex Havells Batra Hanley RR KABEL Polycab
23	1.1kV grade LT XLPE insulated, HR PVC sheathed, stranded Al. / Cu. conductor, Armoured/ Un-armoured cables as per IS:7098 Part-I	Finolex Havells Batra Hanley
24	Cable lugs & thimbles	Dowell Convert Cosmos Commel

25	TV Co-axial Cable	Finolex Havells Batra Hanley Polycab Balten
26	Jelly Filled Armoured Tele. Cables	Finolex Havells Batra Hanley
28	Exit Signage	Prolite Glolite Cease Fire MK Prestolite
29	Cat-5 / Cat-6 Voice / Data Cables	Batra Hanley AMP Havells Beltron
30	Voice / Data Face Plates	WIPRO NORTHWEST PLATIA HAVELLS- CRABTREE- MURANO LEGRAND-MYRIOUS ABB-IVIE Schneider Unica Beltron
31	Tele Tag Blocks	Krone
32	Sub Panels	SCHNEIDER ABB Siemens
33	Final Distribution Boards	SCHNEIDER ABB Siemens
34	Lightning Arrestor System (Control steamer Emission Type)	Erico

		LPI OBC
35	Maintenance free chemical earthing	Erico JK OBC
36	Fire sealing compound	Hilti Birla-3M Promat
38	UPS	Emerson APC Schneider Eaton Pegasus (AAL)
39	Batteries (Sealed Maintenance Free)	Panasonic Exide Hitachi Amaron
40	Boom Barrier	Gandhi Automation FAAC
41	Copper pipe	Godrej VISIARO
(a)	LOW VOLTAGE & SECURITY SYSTEM:	
	INTELLIGENT FIRE ALARM SYSTEM:	
1	Intelligent fire alarm system	Notifier Honeywell XLS 3000 Siemens Johnson Control (IFC Series)
2	Detectors / Manual call points / Hooters / speakers / control modules / Monitor modules / graphic software etc.	Notifier Honeywell XLS 3000-Eclipse Johnson Control (IFC Series)

3	Response Indicator	Honeywell XLS 3000-Eclipse Anshul Johnson Control (IFC Series)
4	Evacuation PA System	Notifier Honeywell XLS 3000-Eclipse Johnson Control (IFC Series)
5	Twisted FRLS Cu. Conductor Cable/MICC Cable	Finolex Batra Hanley Havells Bonton
6	MS /GI Conduit (Heavy duty)	BEC Steel Craft AKG Precision
(b)	CCTV SYSTEM:	
1	Cameras	PELCO (Schneider) Bosch Honeywell
2	Monitor	PELCO (Schneider) Sony LG Honeywell
3	DVR	Interlogix PELCO Honeywell
4	Co- axial / Multi core Cable	Finolex Batra Hanley Havells
5	FRLS PVC Conduit (heavy duty)	BEC Polypack AKG Atul
D	FIRE PROTECTION	
1	Hosepipe of type 63mm dia RRL	Lifeguard Safeguard Eversafe Newage
2	Hydrant Valves with 63mm dia single outlet	Lifeguard Safeguard Eversafe Newage
3	Branch pipe with nozzle	Lifeguard Safeguard Eversafe Newage
4	Cl gaze valves class PN 1.0	Leader Sant SKS Zoloto
5	Non-return valve	Kirloskar Leader

		Sant SKS Zoloto
6	Motor	Kirloskar Siemens Crompton
7	Fire Alarm Panel	Electroequip UEC
8	Hooter	Electroequip UEC
9	Fire extinguishers	Mimmax Life Guard Safe Guard Ever Safe Newage
10	Battery	Exide Amaron Hitachi Panasonic
11	Fire Resistance Paint	Viper
12	FHC Door	Lifeguard Safeguard Eversafe Newage
13	Hose Box	Leader Sant SKS Zoloto
14	Sprinkler	Tyco Newage Ho Viking
15	Hose Reel	Life guard Safe guard Eversafe Newage
E	ELEVATORS	
	Lifts	OTIS KONE JOHNSON SCHINDLER THYSSENKRUPP



