CENTRAL GOVERNMENT EMPLOYEES WELFARE HOUSING ORGANISATION
(An autonomous body of GOI under the aegis of M/o Housing & Urban Affairs)

ON BEHALF OF

HOUSING AND URBAN DEVELOPMENT CORPORATION LIMITED
(A NAVRATNA CENTRAL PUBLIC SECTOR ENTERPRISE)

CONSTRUCTION OF RESIDENTIAL COMPLEX OF HUDCO AT PLOT No. 28, SECTOR - 4, VAISHALI, GHAZIABAD, UTTERPRADESH

TENDER

FOR

CIVIL, PLUMBING & SANITATION, INTERNAL ELECTRICAL, FIRE FIGHTING, MECHANICAL VENTILATION, ELEVATORS AND EXTERNAL DEVELOPMENT WORKS

VOLUME – II

GENERAL SPECIFICATIONS

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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 Architect/CGEWHO 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. CGEWHO 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 labour, site grading, leveling and earth work, materials, labour, tools, plants, application, transport equipment, cartage, transportation, insurance, taxes,

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duties, GST, labour Cess,octroi, levies, any other applicable tax, 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 Twelve 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 CGEWHO/Architect therein, irrespective of what is shown on the drawings and specifications, and the CGEWHO/Architect 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 **Treatment Plant** installed at site. The water shall be arranged, if permitted by the Central Ground Water Authority, from tube wells to be bored by him within the site, or procured from outside. The water shall be permitted for use only if certified "Fit for Construction" on testing from laboratory nominated by the CGEWHO/Architect 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 CGEWHO or claiming for the same. The contractor shall make necessary arrangements to obtain the approvals within their quoted price.

1.5.0 SPECIFICATIONS

1.5.1 The entire work under this contract shall be carried out in the manner described by the CGEWHO/Architect 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.

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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 If 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 If 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 Architect/CGEWHO.

The directions and explanations required to complete the provisions of such specifications and give them due effect shall be given by the Architect/CGEWHO.

1.5.6 If 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 labour 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 Civil Works 2009" Volume I and II where ever applicable. General Specifications for electrical works Part I and II (latest addition) with correction slips and addenda up to date or any other printed publication on general specifications referred to elsewhere in the contract.

EARTH WORK

GENERALDEFINITIONS

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
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 scarifies 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/CGEWHO. 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.

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 CGEWHO and will be removed by the Contractor to designated dump or the dumping ground as ascertained by the CGEWHO. 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 CGEWHO/Architect/Project Manager and a Proper record of these levels kept, which shall be jointly signed by the Contractor and the CGEWHO representatives.

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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 CGEWHO representatives.

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 CGEWHO'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 setout 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/CGEWHO. 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 Architect/CGEWHO. 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, extacting&disposing the subsoil water as per specifications and as required by the CGEWHO 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 CGEWHO. 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 CGEWHO. No extra charges shall be admissible on this account. If desired

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by the CGEWHO, the contractors shall prepare relevant shop drawings and obtain approval of the CGEWHO before commencing the work.

The bottom of all excavations shall be trimmed and leveled in accordance with the drawings/directions of the CGEWHO. The bottom of all excavations shall be rammed and wetted before laying of concrete. The contractor shall report to the CGEWHO when the excavations are ready to receive concrete. No concrete shall be placed in foundations until the Contractor has obtained the approval of the CGEWHO 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 Architect/CGEWHO.

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 CGEWHO 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 CGEWHO.

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 GDA.

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 CGEWHO 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 CGEWHO 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

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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 buildingwill be of goodearth / 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. Nothing extra shall be payable for any method of dewatering.

Disposal of the water shall be done as approved by the GDA Office, if mandatory. 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 GDA sewer/drainage system or area.

The excavation shall be kept free from water:-

1. When concreting /reinforcement work/water proofing work are in progress.
2. Till the CGEWHO consider that concrete/mortar is sufficiently set.
3. The roof of Basement & GF shall attain the sufficient strength.
4. As per requirement of Structural Consultant to counter the excessive pore pressure.

LIFT AND LEAD

For this purpose generally excavation is to 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 or carted away as specified. The quoted prices shall be for all leads, lifts & shapes.

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 CGEWHO. Nothing extra shall be paid to the Contractor on this account.

1.9.0 CONTRACT SUM TO INCLUDE

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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 or dewatering by any other mode 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 GDA 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 Architect/CGEWHO. 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 CrystallineWater 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 CGEWHO 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 CGEWHO/Architect in writing along with the credentials and relevant details including name of CGEWHO/company, its location, capacity technical establishment, past experience etc. CGEWHO/Architect shall give approval in writing and the work shall not be started without said written approval of the CGEWHO/Architect. The entire responsibility for the quality of this treatment and its efficiency shall however,rest with the main contractor only.

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2.0.2 Horizontal Water Proofing of Raft Slab of Basement, UGWT and other underground structure.

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 CGEWHO/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 1.2 mm thick self adhesive HDPE membrane 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 pouredconcrete 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 not less than 60 m head of water as per ASTM D 5385

(vi) Puncture resistance of 1000 N (as per ASTM E154)

(vii) Adhesion to concrete of 880 N/mm.

(viii) Tensile strength of not less than 25.00Mpa(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 CGEWHO as permanufacturer'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 lapsbetween the membrane and fixing overlapped by double sided tape, firm rolling on to the surface to get a tight seal etc complete as directed by CGEWHO at all locations.

(xii) All system to be installed as per manufacturer's specifications complete with all lead and lift for all materials and labour as directed by CGEWHO.

(xiii) Work shall be carried out as per the manufacturer's method statement of waterproofing as approved by the Architect/CGEWHO. Work shall be guaranteed for 10 years against any leakageswith joint agreement between main contractor and associated specialized agency.

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(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 of Basement, UGWT and other underground structure.

(i) The work shall be executed as per manufacturer's specifications.

(ii) Clean and dry condition is to be ensured before applying the water proofingmembrane over Bitumastic primer as per manufacturer's specifications.Holes left in the concrete wall by tie-bolts shall be filled with water proof epoxy grout.

(iii) Self 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 overlaps of 75 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 tohydrostatic 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 or 8MM HDPE Dimple board spot bonded on retaining wall before backfilling.

viii) Providing aluminum flashing, wherever required for termination of self adhesivemembranes at all locations. Item shall include rates for membrane termination on the vertical retaining wall at height as specified in drawings for termination of the membrane and finally sealing the strip using Polysulphide sealant.

ix) All system to be installed as per manufacturer's specifications etc. complete with all lead and lift for all materials and labour as directed by CGEWHO.

x) Work shall be carried out as per the manufacturer's/Applicator's method statement of waterproofing accepted by the CGEWHO.

Work shall be guaranteed for 10 years against anyleakages with joint agreement between main contractor andassociated specialized agency.

(xi) 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.

(xii) Primer is to be applied on a clean dry surface of wall.

(xiii) Screed concrete over water proofing membrane shall be provided on projected raft beyond retaining wall to protect the membrane.

(xiv) A controlled backfilling should be carried out carefully in layers of 150 mm to 300 mm lifts to avoid damage to the membrane.

(xv) 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.

(xvi) Suitable Dumb bell with central bulb (180mm wide, 8mm thick) PVC water stops conforming to IS:12200 for construction/ expansion joints between two RCC members and fixed to the reinforcement with binding wire before pouring concrete etc. complete shall be provided.

(xvii) Providing aluminum flashing, wherever required for termination of self adhesivemembranes at all locations. Item shall include rates for membrane termination on the Vertical retaining wall at height as specified in drawings for termination of the membrane and finally sealing the strip using Polysulphide sealant.

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, toilets, kitchens, stilts, other sunken areas and planters 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 : 4 coarse sand) mixed with water proofing compound in recommendedproportion including rounding off junction of vertical and horizontal surface.

e. The rate includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonarywithpolymer modified slurry.

2.0.4.2 **Horizontal Water Proofing of Roof of Non Tower area of Basement/Extended Basement, underground structure and extended Stilt/Podium Roof.**

Providing and laying 3mm thick APP (Atactic Polypropylene Polymer) modified prefabricated five layer, 3 mm thick water proofing membrane, black finished reinforced with glass fibre matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufactured of density at 25°C, 0.87 - 0.89 kg/litre and viscocity 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 350/300 N/5 cm. Tear strength in longitudinal and transverse direction as 60/80N. 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.

Covering top of membrance with Geotextile, 120 gsmnon 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.

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& geotextile 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

Covering subsoil water/rain water drains in landscape area/podium with Geotextile, 120 gsmnon woven, 100% polyester of thickness 1 to 1.25 mm where ever required or as per manufactures recommendation.

2.0.4.3 **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, STP, Retaining wall, Stitch Slab, Raft, basement roof 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 with RMC/BMC.Throughly mixing to workable consistancy and pouring and casting in position within 20 minutes,Vibrating with mechanical vibrators and compaction etc. complete as per direction of CGEWHO.

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 CGEWHO 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 CGEWHO in writing along with the credentials and relevant details including name of owner/company, its location, capacity technical establishment, past experience etc. CGEWHO shall give approval in writing and the work shall not be started without said writtenapproval of the CGEWHO. The entire responsibility for the quality of this treatment and its efficiency shall however, rest with the main contractor only.

2.0.4.4 WATER PROOFING TREATMANT OF STP & UGWT

Providing and applying two component polymer based cementitious waterproofing system in following sequence;

Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means.

Removal of all surface imperfections, protrusions,loose concrete & filling of cracks using Polymer Modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.

Providing & grouting at construction joints cementitious grout into each nozzles(1mtr c/c) at regular intervals as per the requirements.

Providing and making fillets at the junction of the walls and the slabs using cement mortar of 1:4 mix admixed with 5 % of SBR latex by weight of cement.

Applying 3 coats of 2 component, pre-packed, polymer modified cementitious coating of tensile strength of 5.0 N/Sq.mm as per ASTM D 412,elongation of 120% as per ASTM D 412 ,crack bridging of 2mm as per ASTM C836,applied@ 3kg/sq.mtr all over the slab including the angular fillets and extendable over the vertical walls .Finally sprinkling sand over the third coat for better adhesion with plaster. The interval between each coat of coating application is 6-8 hrs.The entire waterproofing treatment should be guaranteed by the principal manufacturer as a system, for ten years and the work should be executed as per manufacturer recomendations.

Providing & laying a protection layer of 25 mm thick cement mortar admixed with integral waterproofing compound as per IS 2645 .

Providing & applying 2 coats of Coal Tar Epoxy at a consumption of 3 sq.mtr/Kg with Bonding / adhesion of 1.2 to 1.4 N/mm2 as per ASTM D 4541 ,Water resistance, immersion – 7 days passes as per ASTM D 870-09,Chemical resistance, immersion in dilute acid alkali & salt solutions – 7 days -Passes as per ASTM 868 as per manufacturer's instruction for STP only.

The glazed tile shall be fixed inside the water retention chambers upto ceiling over cement mortar 1:3(1cement:3 c sand) mixed with water proofing as per manufactuere’s recommendations.

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 Polyurethane **foam over deck insulation** on roof with cement based integral brick bat coba with waterproofing compound with specialised agency.

2.0.4.5.2**Treatment of roofs and terraces** consisting of the following operations:

a) Clean the RCC slab surfaces by wire brush, raking and cleaning of construction joints, if any.

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 slopeand 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 CGEWHO/Architect.

e) The brick bats coba treatment shall be having average thickness of 120 mm and minimum thickness at khurra as 65 mm.

2.0.4.6 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.

2.0.5 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 underthe 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 SPECIFICATIONS FOR ANTITERMITE TREATMENT

2.1.0 GENERAL

Prevention of termite from reaching the superstructure 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 Part II of 2001 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 Chloropyrifos (CPP) an emulsified concentrate @ 1% or any other approved Chemical concentrate shall be used as per IS: 8944 -2005 and as directed by CGEWHO.

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 2001 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 DISTRUBANCE

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 TREATMENTOF 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 2001 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 2001 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 center to center 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 2001 or the latest edition (surface area) before the sand/sub-grade is laid. Holes up to 50 to 75mm deep at 150mm center to center 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 2001 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 2001 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 2001 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 if 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 with serve as sources of drinking water.

The contractors shall undertake all reasonable care and safety precautions to protect his workmen, other sub contractors/ specialist construction agencies working on the site, Employer/CGEWHO and their representatives against damages due to harmful exposure 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 CGEWHO as and when purchased and record of the same shall be maintained at site of work.

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, labour, 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	:	8112	Ordinary 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 CGEWHO 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 CGEWHO on the quality of materials being supplied.

3.3 PLANT AND EQUIPMENT

The contractor shall submit the following to the CGEWHO 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 CGEWHO.

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 CGEWHO for the approval.

3.6 MATERIALS

Before bringing to the site, all materials for cement concrete shall be approved by the CGEWHO. All approved samples shall be deposited in the office of the CGEWHO 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 CGEWHO 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 CGEWHO 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 CGEWHO 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 CGEWHO shall be rejected forthwith and shall be removed from the site by the contractor at his own cost within the time stipulated by the CGEWHO. The CGEWHO 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: 8112. 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 CGEWHO 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 CGEWHO.

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 II given in Table 1. When the grading falls outside the percentage limits given for sieves other then600 micron, 300 micron and 150 micron (I.S) sieves by not more that 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 CGEWHO shall be within the limits of Grading Zone II 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 CGEWHO'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.

Grading shall be within limits as given in the table below.

IS-Sieve Designation	Percentage passing for graded aggregate of nominal size			
	40 mm	20 mm	16 mm	12.5 mm
80 mm	100	-	-	-
63 mm	-	-	-	-
40 mm	95 - 100	100	-	-
20 mm	30 - 70	95 - 100	100	100
12.5 mm	-	-	-	90 -100
10 mm	10 - 35	25 - 55	30 - 70	40 - 85
4.75 mm	0 - 5	0 - 10	0 - 10	0 - 10
2.36 mm	-	-	-	0-5

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 CGEWHOand 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 CGEWHO. No water shall be used until tested and found suitableby the contractor.

3.6.4 ADMIXTURES AND ADDITIVES

Chemical admixtures are not to be used until permitted by the CGEWHO. 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 CGEWHO for approval.

The contractor shall further provide the following information concerning each admixture to the CGEWHO.

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 lingosulphonates 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 CGEWHO 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 CGEWHO.

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 CGEWHO'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 CGEWHOshall 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 CGEWHObefore 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 CGEWHO. 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, 1:1:1/2:3, 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 be permitted in Design Mix Concrete unless otherwise specifically mentioned.The minimum cement content shall be as mentioned in IS code.

3.9.3.3**The cement arranged by the contractor will be OPC only**. However, CGEWHO 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 NABL approvedlabouratories/Test houses to be approved by CGEWHO. CGEWHO 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.

3.9.3.5 The various ingredients for mix design/labouratory tests shall be sent to the approved lab/test houses through the CGEWHO 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.

3.9.3.6 The Contractor shall submit the mix design report from approved labouratory for approval of CGEWHO 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 CGEWHO. The contractor shall make cubes of trial mixes as per approved mix design at site labouratory for all grades of concrete in presence of the CGEWHO using same ingredients as adopted for design mix, prior to commencement of concreting and get them tested in presence of CGEWHO . 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 labouratory established at site by the contractor and remaining 10% in the labouratory of Central Design Organization, CPWD or in any other labouratory 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 thecontractor. 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 CGEWHO shall be atliberty to test representative sample(s) of each item of schedule of quantity in any approved labouratory as decided by him. The sample of testing shall beprovided by the contractor free of cost. Any expenditure required to be incurredfor 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 boundto replace the entire lot with fresh material of prescribed specifications. Therejected 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 mixshall 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 Labouratory established at site or CGEWHO may order for testing of thesecubes from the independent labouratory and shall be submitted by the contractor as per the direction of the CGEWHO.

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 isawarded.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.

3.9.8.2 The contractor shall, within a period of 20 days of award of the work, submit text of MOU proposed to be entered between purchaser (the contractor) and supplier (RMC) producer) to the CGEWHO for his approval. The contractor shall draw the MOU with approved RMC producer and submit to the CGEWHO within a week of such approval. The contractor will not beallowed to use ready mix concrete without completion of above stated formalities.

3.9.9 Notwithstanding the approval granted by the CGEWHO in aforesaidmanner 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 theplacement contractor and the manufacturer of concrete.

3.9.11 The CGEWHO 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 CGEWHO 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 CGEWHO 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 CGEWHO and/or his authorizedrepresentative 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 CGEWHO or his authorized representative. The Architect/CGEWHO shall asrequired, 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 CGEWHO shall be produced in RMC plant and transported to the site.

3.9.15 OPC/Containing to IS: 8112 of brand/make/source as approved by the CGEWHO 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 CGEWHO or his authorized representative at any time. Anymodification in mix design shall be done only after the approval of the CGEWHO.

(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 CGEWHO 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 eachload, written, printed or graphical records shall be made of the weights ofthe 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 loadingthe 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 concreteshall 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 forfurther batches.

III. Adequate testing equipments at the plant including equipment for measuring surface moisture content of aggregates shall be provided by the RMCproducer.

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 scheduleapproved by CGEWHO. Nothing extra shall be payable on thisaccount.

IX. CGEWHO 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 ofAcceptance” as above, the work for which samples have failed shall be redone at the cost of the contractor. However, the CGEWHO 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 theportion 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 CGEWHO 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 para5.4.10.5 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 velocityof 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 andother 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 temperatureduring concreting shall not exceed 30 degree centigrade.Except where otherwise agreed to by the CGEWHO, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450mm. unless agreed to by the CGEWHO; 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 soadjusted that concrete flows without the use of excessive quantity of water. Thedelivery 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 theformwork. The concrete shall be compacted by using immersion type vibrators.When the concrete is being continuously deposited to a uniform depth along amember, vibrator shall not be operated within one meter of free end of theadvancing 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 perpetrated by the vibrator but is still fresh (that is, just after initialset), un-imposed bond shall be achieved between the top and underlying layerby 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 actionoverlap to some extent and the freshly filled concrete is sufficiently consolidated at all locations. The spacing between the dipping positions ofvibrator shall be maintained uniformly throughout the surface of concrete sothat concrete is uniformly vibrated. The vibrating head

shall be regularly anduniformly inserted in the concrete so that in 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 particle have blended into the surface but have disappeared. The contractor shall keep at least one additional vibrator in serviceablecondition to be used in the event of breakdowns and maintenance problems. The vibrator head stagnations. 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 screedand shutter vibrators at site.

3.10 STRENGTH REQUIREMENTS OF CONCRETE

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	
	7 days	28 days
1:1:2	210	315
1:1:5:3	175	265
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	150
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 CGEWHO 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 at floor level.

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 1.7-kg/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 CGEWHO and results submitted to them.

In case of ordinary concrete the maximum value of water cement ratio shall be 0.50 and in the case of controlled concrete the water cement ratio 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 CGEWHO, it shall be maintained throughout the corresponding part of works. Approved tests shall be undertaken periodically by the contractor to satisfy the CGEWHO of the maintenance of the consistency .Howeverthe 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 CGEWHO 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 CGEWHO 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 CGEWHO 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 CGEWHO 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 labouratory as approved by CGEWHO.

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 labouratory at the site itself and the results shall be submitted promptly by the contractor to the CGEWHO.

All expenses for setting up the labouratory and conducting tests at site or in an approved labouratory 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 CGEWHO.

In addition the contractor shall at his own expense take such actions as the CGEWHO 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 CGEWHO 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 CGEWHO 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 CGEWHO.

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 discharges 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 CGEWHO 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 CGEWHO 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 CGEWHO.

Concreting shall be carried out continuously between contraction or expansion joints shown on the drawings or agreed by CGEWHO 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 CGEWHO.

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 CGEWHO 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 CGEWHO. 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 CGEWHO 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 CGEWHO.

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 CGEWHO 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 CGEWHO.

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 CGEWHOs 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 CGEWHO/ 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, 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.

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 CGEWHO.

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 CGEWHO, 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 CGEWHO 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 CGEWHO, 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 CGEWHOhave suffered damage either in appearance or stability owing to such cracks.
The repair work shall be carried out to the satisfaction of the CGEWHO. The decision of the CGEWHO 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 CGEWHO 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 CGEWHO.

Honey combed or damaged concrete which in the opinion of the CGEWHO is weak and will adversely affected 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 CGEWHO 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 CGEWHO. Such tests should be carried out only after expiry of minimum 28 days or such longer period as directed by the CGEWHO.

The structure should be subjected to a super imposed load equal to 1.25 times the specified super imposed 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 deflect-o-meters capable of reading up to 1/500 of a cm and located suitably under the structure as directed by the CGEWHO. 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 CGEWHO/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 cutout 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 CGEWHO. 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 Architect/CGEWHO 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 CGEWHO. 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 onthe 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 CGEWHO or their representatives, the contractor shall be fully responsible for the entire work.

3.29 QUALITY CONTROL

The CGEWHO/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 o 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 / LABOURATORY

A testing room of not less than 10 sqm equipped with the following apparatus and qualified concrete technician, labour 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 Cones _____ 2 Nos.
4) 15 cmmoulds _____ 18 Nos.
5) Electric/Kerosene Heater.
6) Plants etc. as directed by the CGEWHO.
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) Labouratory Sink
11) Work benches, shelves, desks and any other furniture and lighting as required by the CGEWHO.
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.
    e) 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.

3.32 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 bulkage.

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. CGEWHO 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 CGEWHO. 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 CGEWHO for the approval if required by the CGEWHO. 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.

D) Hard drawn steel wire fabric conforming to IS: 1566

E) 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 andIS: 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 or the best quality approved by the CGEWHO.

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 CGEWHO.

All reinforcement shall be bent cold using appropriate pin sizes. Bars may be preheated only on approval of the CGEWHO. 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 CGEWHO. 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 CGEWHO.

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 Architect/CGEWHO.

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 CGEWHO/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 CGEWHO/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 CGEWHO.

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 CGEWHO 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 CGEWHO. 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 CGEWHO. 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, labour 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. The cost of binding wire shall be included in the quoted rates.

(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

NOTE: Formwork from foundation to Stilt roof (1st floor level) shall be in Plywood/steel and above 1st floor level only Aluminium Shuttering shall be used.

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 CGEWHO.

5.2.2 DESIGN OF FORMS

Before fabricating of forms, the contractor shall submit design calculations for proposed formwork to the Architect/CGEWHO 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 CGEWHO for his approval.

5.3 MATERIALS

5.3.1 FORMWORK

Formwork shall be of approved timber, plywood, steel, aluminium 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 CGEWHO.

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 CGEWHO.

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.

5.3.5 ALUMINIUM

Aluminium form work for monolithic construction on RCC members with repetitive usage made up of aluninium sheets/plates of minimum 4mm thickness and grade 6061 (Type-6).

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 CGEWHO.

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 CGEWHO 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 CGEWHO 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 CGEWHO. 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 CGEWHO, the forms shall not be stripped in less than the minimum periods specified in IS: 456. However, the CGEWHO 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 un shored 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 CGEWHO has worn out and has become unfit for formwork.

The CGEWHO 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 FORM WORK 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 and all surface irregularities at matching faces of form material shall be dressed for the specified curvature.

5.11 FORMWORK FOR EXPOSED CONCRETE SURFACES

Upto 1st Floor Level: 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, steel plates or Aluminium shuttering of approved quality and as per directed of the CGEWHO.

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 CGEWHO 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 CGEWHO 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.

Form 1st Floor Level to Terrace and above: It is desired, directed and/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 Aluminium form work for monolithic construction on RCC members with repetitive usage made up of aluminium sheets/plates of minimum 4mm thickness and grade 6061 (Type-6).

The formwork comprises of

(a) wall panel, roccker, kickerand internal soffit corner, external soffit corner, external corner, internal corner etc., (b) beam components i.e, beam side panel prop head for soffit beam, beams soffit panel, beam soffit bulk head and (c) deck components i.e. deck panel, deck prop, prop length, deck mid, soffit length, deck beam bar. The panels are held in position by a simple pin and wedge system that passes thorugh holes in the out side rib of each panel. The tolerance of finished panel shall not be less than (-1 mm) and shall conform to IS 14987-1999. Pins and wedges to be made of high grade hot dipped galvansied mild steel. This form work also comprises of M.S. angle iron, "Z" shaped brackets braced diagonally at 0.90 to 1.00 mtr. centre to centre on extrenal wall face just the level below on which to lay M.S. square tube panels (Challis) and guard railing supports to form working platform and 40 mm dia G.I. telescopic adjustable props to support deck formwork and beam soffit panels including de-shuttering the formwork from odd/even level to be shifted/lifted to next alterante odd/even level before which the points and shuttering surface to be thoroughly cleaned, pins greasing and shuttering surface oiling propoerly before fixing all complete including sealing of gap between kicker plates of wall panel and floors (if any) as per design of formwork as provided by shuttering supplier and as per direction of the Engineer-in-charge including filling and finishing the holes of varied sizes and shapes (left by keys/pins of aluminium form work shuttering while de-shuttering) with GP-2 cementeous polymer compound mixed with water in ratio prescribed by manufacturer to form consistent workable dough for pushing it in the holes upto full depth of wall using appropriate tools and finishing smooth with grinding machine all complete as per directions of the Engineer-in-charge.

6. SPECIFICATIONS FOR BRICK/ BLOCK WORK

6.1 SCOPE

The contractor shall provide within his quoted price all labour, materials, scaffolding operations equipment and incidentals necessary and required for the completion of all brick/block work 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 7.5.The size of the bricks shall be (22.9cm x 11.2cm x7.0cm) 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 CGEWHO for his approval before being used in the work. All subsequent deliveries shall be up to the standard of the sample approved.

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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 pozzolana cement conforming to IS :1489 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 CGEWHO.

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 sprit 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 HALF 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 CGEWHO. The cost of reinforcement shall be included in the quoted rates.

6.4 BLOCK WORK WITH AAC BLOCKS (Aerated Autoclaved Concrete Blocks):-

6.4.1 MATERIAL (AAC BLOCKS):

Aerated Autoclaved Concrete Blocks is to be conforming to IS 2185 (Part 3) -1984. The nominal dimensions should be 600mm(L) x 100/200 (W) mm x 200/225/250mm(H) and may very as per manufacturer. The compressive strength should be as per Table 1 of IS code 2185 (Part 3) -1984 and minimum of Grade 1 with compressive strength of 6 N/sq mm with density 650 Kg/cubic meter +/-5% in oven dried condition. The comprehensive strength shall be tested after due oven drying for 48 hours and shall be tested on 200 KN UTM/CTM machine with digital display. The sample shall be prepared as per and compressive strength shall be determined as per IS :6441 (Part 5) – 1972 and block density to be determined as per IS :6441 (Part 1) – 1972. The AAC blocks should baked at 200 degree centigrade at 12 bar pressure for at least 12 hours before dispatch. The manufacturer shall give documentary proof about same. Tolerance of dimensions shall be +_5mm as per in length and +-2mm in other two dimensions.

Test checks on random samples from each lot of blocks brought at site shall be carried out for compressive strength, density, thermal conductivity and drying shrinkage test as per IS:6441-1972 & IS:3346-1980. Result of these tests duly signed and dated by Contractor, CGEWHO and Project Director shall be recorded in a separate register, which shall be kept with the Project Director.

Each lot of AAC blocks shall be suitably marked with the following information:
The identification of the manufacturer,
The grade and block density of the unit.
The month and year of manufacture.
Each block may also be marked with the ISI certification mark.

The general requirement of storage of autoclaved aerated concrete blocks shall be as described in as per IS:4082-1977. The blocks shall be stored in such a way as to avoid any contact with moisture on the site. They shall be stocked piled on planks or other supports free from contact with the ground and covered to protect against wetting. The blocks shall be handled with care and damaged units shall be rejected.

WORKMANSHIP – MASONRY MORTARS

6.4.2 Wetting of Blocks - These blocks need not be wetted before or during the laying in the walls; in case the climatic condition so required, the top and the sides of the blocks may be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar.

6.4.3 Mortar: These AAC blocks are to be affixed with readymade polymer modified adhesive mortar as per IS -15477:2004 in 3mm thickness.
The mortar shall be freshly mixed for immediate use. Any mortar, which has commenced to set shall be discarded and removed from the site.

6.4.4 BOND

All block work shall be built in Stretcher bond, unless otherwise indicated.

Overlap in stretcher bond is usually half block and is obtained by commencing each alternate course with a half block.

6.4.5 CURING

The surface of block work touching the RCC band shall be constantly kept moist for a minimum period of seven days. Block work done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

6.4.6 100MM THICK BLOCK WORK WALLS

The blocks shall be laid in stretcher bond with readymade polymer modified adhesive mortar or as indicated. The reinforcement shall be provided as 2 Nos. 6mm dia M.S. bar at every third course of masonry work. The bars shall be properly anchored at their ends where these walls join with other walls. The in-laid steel reinforcement shall be completely embedded in mortar. Overlap in reinforcement if any shall not be less than 300 mm. The thickness of joint with reinforcement shall be minimum as much as possible. The cost of reinforcement shall be included in the quoted rates.

6.4.7 RCC BAND

Minimum 100mm thick RCC band with two 8mm steel bars shall be laid at 1000 mm level and lintel level from FFL. 100mm thick band shall also be laid over parapet wall. The cost of reinforcement shall be included in the quoted rates.

6.4.8 CC BLOCKS

Precast blocks of minimum size of 200X250X100/200mm (wall thickness) in CC 1:3:6 shall be provided at the time executing the of block masonry at locations where dash fasteners/anchor fasteners have to fixed instead of holdfasts. Hold fasts may also be provided as per specifications. Nothing extra shall be paid on this account.

6.5 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.

6.6 SCAFFOLDING

Unless otherwise instructed by the CGEWHO 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.

6.7 OPENING

Openings in brick/block work for air conditioning ducts, grills, pipes etc. shall be provided at the time of laying brick/block work 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.

6.8 CO-ORDINATION OF WORK

The contractor shall fully coordinate with all other agencies for ensuring completion of their work so that brick/block work does not need to be dismantled at a later stage for executing work pertaining to other related agencies. If the brick/block work 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 form 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 CGEWHO. 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 approsite 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 he rubble stones and shall have uniform chisel

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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 joins 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 bed, 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 us 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 CGEWHO 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 loft 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 CGEWHO 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 CGEWHO as 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/Hard wood or Timber as specified shall be kiln seasoned, the contractor shall get the same done from an approved timber seasoning kiln, by the CGEWHO 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, wanes, 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 CGEWHO 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 TEAK / HARD 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 CGEWHO 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 CGEWHO. 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 CGEWHO. 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 CGEWHO, 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 CGEWHO.

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 fasting 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 CGEWHO

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 CGEWHO/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 WOODEN FRAMES FOR DOOR 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 CGEWHO 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.

Wooden frames for doors 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.

The frames shall be painted with two coats of Black japan bituminitic paint on the surface touching the wall while fixing.

7.8 A) 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, Pre laminated on both faces for internal doors and Pre laminated teak finish on both side of main door shutter, unless otherwise specified in particular specifications or drawings. The thickness of laminate shall be in addition to the thickness of door ie 35mm. The shutters shall conform to Indian Standard Specification IS: 2202 (part-1). Shutter shall be obtained from the manufacturer approved by the CGEWHO.

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.

B) PRELAMINATED FLUSH DOOR SHUTTERS

Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 35 mm.

Width and height of the shutters shall be as shown in the drawings or as indicated by the Architect/CGEWHO. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

Core

The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles. End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

Face Panel

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either Vertical grains or cross-bands and face veneers. The thickness of the cross bands as such or in the hardwood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the 1st class hardwood shall be between 1.0 mm for commercial veneers and for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

Lipping

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm.Opening for glazing shall be provided where specified or shown in the drawing.

Venetian Opening

Where specified the height of the venetian opening shall be 350 mm from the bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

Tolerance

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

Adhesive

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

Tests

Samples of flush door shutters shall be subjected to the following tests:
(a) End Immersion Test
(b) Knife Test
(c) Glue Adhesion Test
One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x 150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter.

Sample Size

Shutters of decorative and non-decorative type from each manufacturer, irrespective of their hickness, shall be grouped separately and each group shall constitute a lot. The number of shutters (sample size) to be selected at random from each lot for testing shall be as specified in Table 1. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the Architect/CGEWHO and in such cases extra payment shall be made for the sample shutter provided the sample does not fail in any of the test specified.
For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of Table below.

TABLE 9.10
Sample Size and Criteria for Conformity

Lot Size	*Sample Size*	*Permissible no. of defective*	*Sub. Sample size*
(1)	(2)	(3)	(4)
Upto 26-50	8	0	1
51-100	13	1	2
101-150	20	1	2

151-300	32	1	3
301-500	50	2	4
501 and above	80	2	5

Criteria for Conformity

All the sample shutters when tested shall satisfy the requirements of the tests. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of Table 1. If the number of sample shutters found unsatisfactory for a test is one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

7.9 DOOR & WINDOWS FRAMES & SHUTTERS: As per drawings, scope of work 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 CGEWHO. 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 uPVC DOOR & WONDOW FRAMES & SHUTTERS

Door frames, window frames & shutters as specified in scope of work, specifications & drawings.

8. SPECIFICATION FOR FLOORING WORK

8.1 CEMENT CONCRETE FLOORING

The contractor shall furnish all labour, materials, tools for operations including fixing devices, equipment and incidentals necessary and required for the completion of all flooring and paving work.

The contactor 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 labour, 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 1:4:8 (I cement: 4 coarse sand: 8 parts aggregate of 20 mm nominal size). Thickness of lean concrete shall be 100mm. This layer shall be laid over soling.

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 CGEWHO. 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 Asbestos 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/marble 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 levelled 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 STONE SLAB KITCHEN COUNTER (TOP & FACIA)

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/ CGEWHO. The thickness of the slabs shall be as per scope of work/shown in drawings. Tolerance ± 2mm 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 stone slab shall be fixed over steel brackets and other raw/rough marble stone as per vendor's details in dwelling units.The counter in other buidings shall be of RCC slab. The contractor shall prepare mockups for counter over steel brackets and RCC slab for approval from CGEWHO. CGEWHO may select any type of counter base & nothing extra shall be paid for this.

The 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/ CGEWHO.
It shall then be removed and laid a side. The top of the mortar shall then by 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 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 15622 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 300 X 300mm, 300x450mm or bigger size as specified. The thickness of the tiles shall be 8 mm or more as specified. The tolerance on facial dimension value shall be ± 1.0 mm and ± 0.5 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 to 15 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 diagnosable 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 we 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 UDAIPUR GREEN STONE/GRANITE 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 hard or machine cut to the requisite thickness along planes parallel to the natural bed or stone and should be of uniform size if required.

8.5.2 Approval of Slabs

Before starting the work, the contractor shall get samples of marble approved by the Engineer-inCharge. Approved samples shall be kept in the custody of the Engineer-in-Charge and the marble/Granite supplied and used on the work shall conform to samples with regard to soundness, colour, veining and general texture

The thickness of the slabs 18 mm or as specified in the description of the item with a permissible tolerance of ± 3 %.

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 the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top,pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey likeconsistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble/granite slabs as given in the description of the item.

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 CGEWHO.

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 Curing, Polishing and Finishing

The day after the stone are laid all joints shall be cleaned of the grey cement grout with a wire brushor trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shape of the topping of the wearing layer of the stone. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat with a view to protect the surface from abrasive damage and fill the pin holes that may exist on the surface.

The floor shall then be kept wet for a minimum period of 7 days. In case of marble,The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No. 120).

The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor,as requird by CGEWHO.

For small areas or where circumstances so require, hand grinding/polishing with hand grinder maybe permitted in lieu of machine polishing after laying. For hand polishing the following carborundumtones, shall be used:
1st grinding — coarse grade stone (No. 60)
Second grinding — medium grade (No. 80)
Final grinding — fine grade (No. 120)
In all other respects, the process shall be similar as for machine polishing.

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a ‘namdah’ block (pad of woollen rags).
The granite stone shall be prepolished and shall be cleaned properly after fixing.

The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any stone is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished.The finished floor shall not sound hollow when tapped with a wooden mallet.

8.6 UDAIPUR GREEN STONE/GRANITE IN TREADS, RISER OR STEPS, SKIRTING ETC.

The relevant specification of item mentioned above shall be followed except that the stone shall fixed for treads &risers of steps of full width of stairacse, dado or skirting in C.M. 1:3 and the polishing shall be done hand grinding machine in case of marble.

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. 13006, 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/ KITCHENS/ BALCONIES / PODIUM / STILT/PLANTERS ETC

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 1st course of applying cement slurry @ 0.488 kg/sq m mixed with water proofing compound tapecrete or equivalent @ 0.253 kg/sqm conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.

(f) 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.

(g) 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.

(h) 4th course of 10 mm cement plaster 1:4 (1 cement : 4 coarse sand) mixed with water proofing compound in recommendedproportion including rounding off junction of vertical and horizontal surface.

(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 (i) shall be repeated.

(j) All plumbing pipes laid in sunken portion, if required, shall be covered with 50 mm thick P.C.C. 1:3:6 around

(k) Filling with P.C.C. 1:5:10 as specified.

(l) One 50 mm dia uPVC pipe spout 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. slab/ beam/facias.

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 CGEWHO.

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 CGEWHO 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 CGEWHO 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 CGEWHO.However uPVC Door/windows shall be fixed after plastering is over.

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 racked 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 CGEWHO. 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 CGEWHO. The Chicken mesh on AAC block work all the wall surfaces along with the junction of RCC and block work shall be fixed with mortar/nails to avoid the temperature cracks. 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 CGEWHO.

10.8 MORTAR

The mortar of the specified “Ready Mix Plaster” 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 CGEWHO /CGEWHO.

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 CGEWHO 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 2.5mm 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 CGEWHO.

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 CGEWHO, 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 sqmsmooth 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 CGEWHO, 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 CGEWHO.

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 CGEWHO.

10.16 PLASTER OF PARIS PUNNING

10.16.1 SCOPE

The Contractor shall furnish all labour 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 CGEWHO/ CGEWHO.

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 CGEWHO 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 WATERPROOF CEMENT 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 CGEWHO. 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 CGEWHO/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 authracene oil.

PREPARATION OF SURFACE

Painting shall be done when the surface id 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 PLASTIC EMULSION PAINT / ACRYLIC DISTEMPER

MATERIALS

Plastic Emulsion (see IS-5411) or Acrylic Distemper (see IS: 428-1969) of approved brand and manufacture shall be used. The primer where used as on new work shall be as specified. These shall be of the same manufacture as emulsion/distemper paint. The emulsion/distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of emulsion/distemper required for days work shall be prepared.

The emulsion/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 CGEWHO.

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 parts 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 colorto be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the emulsion/distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of emulsion/distemper is applied.In the preparation of wall for plastic emulsion/distemper painting, no oil base putties shall be used in filling cracks, holes etc.

APPLICATION

The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces. The thinning of emulsion/distemper is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions. The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

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 CGEWHO 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.

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 CGEWHO, 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 CGEWHO/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 CGEWHO on production of valid official receipts.

14. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTOR 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 CGEWHO which shall include all freight and transportation, excise duty, sales tax, octroi, import duty, GST etc. or the actual cost given by the CGEWHO 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 CGEWHO

16.1 The Contractor shall verify that all materials supplied by the CGEWHO conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the CGEWHO/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 CGEWHO/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 CGEWHO/Architect, materials of makes and specifications mentioned with tender shall be used.

18. 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.

19. 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 foe 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.

20. 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 handling over. At the time of handling 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.

21. 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.

22. COMPLETION DRAWINGS

22.1 On completion of work contractor shall submit one complete set of original tracings and two prints of “As Built” drawings for the CGEWHO/Architect. These drawings shall have the following information.

GARG & ASSOCIATES
48, REGAL BUILDING
CONNAUGHT PLACE
NEW DELHI-110001
GAGAN GARG
CA-No.-98/26499

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.

22.2 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.

22.3 All "Warranty / Guarantee" cards / certificates in original issued by the manufacturers shall be handed over to the CGEWHO/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 CGEWHO.

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 CGEWHO/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 dual flush flushing cistern or 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 CGEWHO.

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 CGEWHO. 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 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 CGEWHO.

6.3 Supply fittings for sinks shall be mixing fittings or C.P. Censor 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 & Aluminium moulding fixed with C.P. brass semi-round headed screws and cup Washers or C.P. Brass Clamps as specified or instructed by CGEWHO.

8.0 SHOWER SET

8.1 Shower set shall comprise of single lever mixer with two C.P. brass concealed stop cocks, or four way diverter 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 CGEWHO, 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 CGEWHO.

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 CGEWHO.

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 confirm 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/inspection chambers & 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 CGEWHO.

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 CGEWHO.

3.0 CLAMPS

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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 CGEWHO.

4. TRAPS

4.1 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.

4.2 **Urinal Traps**

Urinal traps shall be SCI/uPVC trap with or without Vent and set in cement concrete block specified in Para above without extra charge.

4.3 **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 toSCI 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.

4.4 **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.

5.0 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.

6. WASTE PIPE FROM APPLIANCES

6.1 Waste pipe from appliances e.g. wash basins, sinks, urinals shall be of galvanized steel/uPVC as given in the Scope of work or as shown on the drawings.

6.2 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/uPVC pipes	300 cms	240 cms

6.3 **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.

7.0 CEMENT CONCRETE

7.1 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 CGEWHO. Where pipes are running at ceiling level a suitable gradient and required supports of structural clamps shall be provided.

8.0 PAINTING

8.1 Wherever CI/GI 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.

8.2 Paint shall be of approved quality and shade; pipes shall be painted in accordance with approved pipe color code.

8.3 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.

8.4 C.I./GI pipes below ground and covered in cement concrete shall not be painted.

9.0 CUTTING AND MAKING GOOD

9.1 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.

10.0 INSPECTION & TESTING

10.1 **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.

10.2 **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 CGEWHO.

(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 CGEWHO.

10.3 A test register shall be maintained and all entries shall be signed and dated by Contractors and CGEWHO.

SOIL, WASTE, VENT AND RAIN WATER PIPES AND FITTINGS

(uPVC PIPES)

11.0 SCOPE OF WORK

The scope of this section comprises the supply, installation, testing and commissioning of internal soil, waste, vent and rain water disposal pipes.

12.0 BASIC PIPING SYSTEM

Soil, waste, vent and rain water pipes of 75 / 90 / 110 / 160 mm dia in shafts, ducts, suspended and in concealed areas i.e. sunken slab etc. shall consist of UV stabilized uPVC SWR pipes as per type B of IS:13592 & fittings as per IS:14735. The pipes and fittings shall be suitable for rubber ring joint for vertical pipes and solvent cement joint for horizontal pipe work in toilets. All fittings shall be of injection moulded type. The rubber rings shall confirm to IS : 5382. The waste pipes of 65 mm and smaller dia shall be of rigid uPVC as per IS:4985 of min 6 kg / sq cm, suitable for solvent cement joints.

The wall thickness of Pipes shall be as follows –

75 mm diameter	-	wall thickness 3.2 to 3.8 mm
90 mm diameter	-	wall thickness 3.2 to 3.8 mm
110 mm diameter	-	wall thickness 3.2 to 3.8 mm

160 mm diameter - wall thickness 4.0 to 4.6 mm

Pipes shall be fixed by means of clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Engineer. All bends, branches, swan neck and other parts shall conform to the requirement and standards as described for the pipes. Pipes shall be rested against the walls on suitable wooden cradles. Local authority regulations applicable to the installations shall be strictly followed.

Where indicated, the soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the height shown in the drawings. The soil / waste pipes shall be covered on top with cowl as directed and approved. All vertical soil pipes shall be firmly fixed to the walls with properly fixed clamps on MS angle frame, and shall as far as possible be kept 50mm clear of wall.

Every waste pipe shall connected to the floor trap / P trap through the PVC hopper pipe / Tee / height raiser and branch saddle strip or to a multi floor trap. No waste pipe shall be discharged over the grating. The contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided, it shall be ensured that at least one wash is connected to such floor traps to avoid drying of water seal in the trap. Ventilating pipes shall be of UPVC SWR pipes, conforming to the requirements laid down earlier.

Where soil, waste and ventilating pipes are accommodated in shafts ducts, adequate access to cleaning eyes shall be provided.

The internal and external pipe surfaces shall be smooth and clean. They shall be free from grooves, obstructions or other defects. All pipe ends shall be cut cleanly and shall be perpendicular to the axis of pipes.

All fittings used in UPVC piping systems shall be of similar characteristic and same make as those of the pipes. All uPVC fittings shall be factory fabricated suitable for jointing to pipes with rubber rings for 75 / 90 / 110 / 160 mm dia and with solvent cement for 65 mm dia and below. Appropriate solvents as recommended by the pipe manufacturer shall be used for installing the pipes at site. Solvents shall be supplied to site in original manufacturer's container.

All Water closets shall be connected through WC connectors of suitable type as per site requirements.

The water seal of all floor traps which are connected into the pipe and manholes shall be minimum 50 mm as per IS : 5329. For other traps used as branch connections may have lesser water seal.

All pipes and fittings shall be stored, handled, cut, laid and installed in position strictly as per manufacturer's recommendations.

As soon as uPVC pipes and fittings are received at site, they shall be examined for their wall thickness and pressure rating. Only pipes and fittings and solvents of approved manufacture shall be used.

UPVC pipes require supports at close intervals. Recommended support spacing for PVC pipes is maximum 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers

and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

13.0 INSTALLATION OF SOIL, WASTE& VENT PIPES

All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for. The pipes shall be laid in uniform slope and proper levels. The Pipes will be supported by either rubber lined G.I. U strap clamps on 50x50x5 mm MS slotted angle duly painted (for a group of pipes) or G.I. rubber lined split clamp (for independent pipes). The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc.

Use WC connectors for the connection of WC to the soil pipes. Apply rubber lubricant on WC connector ring as well as on the outer side of WC pan.

14.0 JOINTING

(a) Make sure the spigot end and inside of socket is clean and the sealing ring is placed evenly in the socket.

(b) When cutting pipes, make sure they are cut square. Chamfer the end cut to angle of 15° with a medium file.

(c) A correct depth of entry of the spigot into the socket is required to allow thermal movement. To achieve this, push spigot fully into the socket (remove sealing ring at this time) and make a mark on the spigot. Withdraw the spigot by 10 mm & mark the spigot with a bold line. This bold mark indicates the correct depth of entry to allow the necessary expansion gap.

(d) Smear rubber lubricant evenly on the chamfered spigot and the sealing ring. Then insert the spigot into socket with light twisting motion. Pull out the pipe to allow 10mm expansion gap.

(e) The joint is now complete and required no additional mastics, tape or cement or any other jointing sealants.

15.0 CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as building proceeds. The 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 (1cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement : 2 coarse sand) Cured and the surface restored to original condition.

Since, the toilets are not sunken, hence, all pipes will be suspended from the toilet floor and will be taken out to the plumbing shaft below the beam. The cut out in toilet floor will be made through core cutting after marking exact dimensions of fixtures and type of WC. The core cutting is suggested to be done at a later stage during plumbing works. Or, the necessary

cutouts should be left in RCC slab during the casting. Nothing extra shall be paid for core cutting and deemed to be included in the quoted rates.

For Sunk Toilets and Kitchens, 110 / 125 / 160 mm dia PVC sleeve should be left in beams before its casting for passing of soil / waste pipe / AC piping. The contractor should prepare shop drawing for the exact location of sleeve and get it approved from the consultant. Cutting of structural member will not be permitted at later stage

For Sunk Kitchens, a 160 / 125 mm dia PVC sleeve (as per the drawings) will be provided for crossing of waste pipe before the casting of beam (wherever required).200mm dia sleeve with cap for himney in kitchen shall also be provided.

16.0 PIPE PROTECTION

Where pipes are embedded in floors, slabs, columns, beams etc., they shall be given a protection by encasing them with 75 mm thick 1:2:4 cement concrete all round the pipes and fittings as specified.

17.0 SOIL, WASTE AND RAIN WATER PIPES AND FITTINGS

(uPVC PIPES – Main Headers - Suspended from basement/Stilt Ceiling)

The scope of this section comprises the supply, installation, testing and commissioning of PVC pipes for soil, waste and rain water disposal, which are suspended from basement ceiling.

(Note : This section refers to only main / branch header pipes including the terminal bend / Tees of the vertical pipe. The other branch connections from the toilets just above the basement will be covered separately where uPVC SWR pipes shall be as per type B of IS:13592 & fittings as per IS:14735.)

Soil, waste, vent and rain water pipes of 110 / 160 / 200 / 250 mm dia shall consist of –

(1) uPVC pressure pipes as per IS:4985 and fittings as per IS:7834 (moulded type) and IS:10124 (fabricated type). The pressure class will be as mentioned in the scope of work. The pipes and fittings shall be suitable for solvent cement joint as required by the engineer in charge and as per the scope of work.

(2) uPVC SWR grade pipe Type-B as per IS : 13592 suitable for rubber ring joints, fittings confirming to IS:14735. The rubber ring shall confirm to IS:5382.

All pipes and fittings shall be stored, handled, cut, laid and installed in position strictly as per manufacturer's recommendations.

As soon as uPVC pipes and fittings are received at site, they shall be examined for their wall thickness and pressure rating. Only pipes and fittings and solvents of approved manufacture shall be used.

UPVC pipes require supports at close intervals. Recommended support spacing for horizontal PVC pipes is maximum 1400 mm. Pipes shall be aligned properly before fixing them. Piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps

and hangers and be responsible for their structural sufficiency. MS Pipe supports shall be primer coated with rust preventive paint.

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 CGEWHO/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 posses 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 dart 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	23^0 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 CGEWHO/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 CGEWHO/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 CGEWHO/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 CGEWHO/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 CGEWHO/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.

GARG & ASSOCIATES
48, REGAL BUILDING
CONNAUGHT PLACE
NEW DELHI-110001
GAGAN GARG
CA-No.-98/26499

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/cm^2 class. Valves shall be tested at manufacturer's works and the same stamped on it.

11.2 All Valves shall be approved by the CGEWHO/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 CGEWHO/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 cladded 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 alround 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/cm^2 in any case and with the consent of CGEWHO/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

GARG & ASSOCIATES
48, REGAL BUILDING
CONNAUGHT PLACE
NEW DELHI-110001
GAGAN GARG
CA-No.-98/26499

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 CGEWHO.

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 CGEWHO/Architect/CGEWHO before the actual execution of work at site.

2.5 All works shall be executed as directed by CGEWHO.

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 CGEWHO 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 CGEWHO.

4.0 GREASE TRAP

Grease Trap shall be provided on Kitchen waste lines beforedischarging the waste into the main sewer line, if shown in the drgs. Grease Trap shall be built in brick masonry and shall be similar inconstruction to manholes. The grease trap shall be constructed to size as shownat the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanised wrought ironsediment 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".

5.0 ECO DRAIN Pipes and Fittings

5.1 Eco-drain pipes are not solid wall pipes but have a unique wall structure i.e. with a number of “holes”in the wall thickness in longitudinal direction. It is a “Profile” wall pipe using I-beam construction. As a result, the Eco-drain pipes are noticeably lighter.
Because of unique design of joints with fixed click ring and sealing ring, the system is completely leak-proof. Joints are stable, watertight and can accommodate angular deflection and axial displacement. Joints are designed to resist loads from horizontal and vertical forces. These joints can accommodate 3° angular deflection in any direction and hence offer good flexibility against lateral or vertical soil movements.
These pipes are made as per IS:16098 and meets all the test requirements of European and International standards for “Structured-wall pipes and fittings” for Underground Drainage and Sewerage. These pipes have equivalent stiffness and flexibility in combination with a weight reduction from 10 to 35%, depending on size. The pipes are plain ended and are available in 110 to 400mm sizes. The pipes are available in different stiffness classes as given in the table. These pipes are interchangeable with solid wall pipes and are compatible with regular PVC fittings.
Dimensions and Stiffness Class of Eco-Drain Pipes as per IS:16098

Pipe size OD (mm)	Pipe ring Stiffness (Kn/M2)						
	SN2		SN4		SN8		
	Wall thickness (mm)						
110	-	-	-	-	3.50	4.10	
160	-	-	4.30	4.90	5.10	5.90	
200	-	-	5.60	6.50	6.30	7.20	
250	-	-	6.50	7.50	7.90	9.10	
315	6.60	7.60	8.00	9.20	9.80	11.30	
400	8.50	9.80	10.60	12.20	12.00	13.80	

5.2 Laying and Jointing of Pipes :For all sewers, Eco drain pipes shall be used as far as possible in preference to other types of pipes. These are suitable, particularly where acid effluents or acid sub-soil conditions are likely to be encountered.

(i) *Trenches:* Specifications described in 19.2.2.1of CPWD specifications shall apply, as far as possible.

The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under a roadway, a minimum cover of 90 cm is recommended for adoption, but it may be modified to suit local conditions. The trench shall be excavated only so far in advance of pipe laying as specified by the Engineer-in-Charge. The trench shall be so shored and drained that the workmen may work therein safely and efficiently. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains.

The excavation shall be carried out with manual labour or with suitable mechanical equipment as approved by the Engineer-in-Charge.

Unless otherwise specified by the Engineer-in-Charge, the width at bottom of trenches for different diameters of pipes laid at different depths shall be as given below:—

(a) For all diameters, up to an average depth of 120 cm, width of trench in cm = diameter of pipe + 30 cm.

(b) For all diameters for depths above 120 cm, width of trench in cm = diameter of pipe + 40 cm.

(c) Notwithstanding (a) and (b) the total width of trench shall not be less than 75 cm for depths exceeding 90 cm.

The width of trench in the upper reaches shall be increased as described in sub-head 'Earthwork' of CPWD Specifications.

(ii) *Laying* : Where the pipes are laid on soft soil with maximum water table lying at invert level of the pipe, the pipes shall be bedded in hard moorum with 150 thickness and mix as specified, projecting on each side of the pipe to the specified width of the trench (Fig. 19.11(i)of CPWD Specifications).
The pipe shall be carefully laid to the alignments, levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. The pipes shall be laid with socket ends facing upstream. The body of the pipe shall for its entire length rest on an even bed of moorum.

(iii) *Jointing* : As per manufacturers details.

(iv) *Testing of Joints :*The pipes used for sewers shall be subjected to a test pressure of 2.5head of water at the highest point of the section under test. Before commencing test, the pipeline shall be filled with water and maintained full for 24 hours under head of 0.6 m of water. The test shall be carried out by suitably plugging the lower end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head, or the top may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation. The tolerance of two liters per centimeter of diameter per kilometer may be allowed during a period of 10 minutes.

If any leakage is visible, the defective part of the work shall 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.

(v) *Refilling :*The pipes shall be embedded with moorum. special care shall be taken in refilling trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe, and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe continued up to 15 cm above the top of pipe so as not to disturb the pipe.

No tamping should be done within 15 cm of the top of pipe. A layer of jhamma bricks shall be laid over the moorum to keep this safe during any excavation in future.

5.3 ***Fixing Gully Trap /inspection chamber***

(i) *Excavation :*The excavation for gully traps shall be done true to dimensions and levels asindicated on plans or as directed by the Engineer-in-Charge.

(ii) *Fixing :*The gully traps shall be fixed on cement concrete foundation nd not lessthan 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of pipes described above.

The GRP/SFRC cover with frame shall then be fixed on the top of the chamber with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth.

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 CGEWHO.

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 CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC

7.1 **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.

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 then 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 then 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 CGEWHO/Architect/CGEWHO before use.

7.2 **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 CGEWHO. 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.

7.3 **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.

7.4 **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 CGEWHO cement concrete for bed, all round or in haunches shall be laid as follows:-

Description	***Upto 3 M depth***
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.

8.0 MANHOLES AND CHAMBERS

8.1 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.

8.2 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)

8.3 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 cost of neat cement.

8.4 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.

8.5 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.

8.6 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 CGEWHO. Weight of cover, frame and thickness of slab shall be as specified in the Scope of work or as given above.

8.7 All catch basins shall be having SFRC precast Gully Grating as per instructions of CGEWHO. The grating along with frame shall be of approved design and quality as per instruction of CGEWHO/Architect.

9.0 Deep Ultra Inspection Chambers and Manholes (Ultra 600/Ultra 1000/Ultra 1200)

9.1 General

	Ultra 600	Ultra 1000	Ultra 1200
Diameter	ID-Ø600mm	ID-Ø1000mm	ID-Ø1200mm
Material	PE	PE	PE
Color	Black / Golden brown	Black	Black
Chemical resistance	High resistance to almost all acids and alkalis, including resistance to Hydrogen Sulfide and Sulphuric Acid	High resistance to almost all acids and alkalis, including resistance to Hydrogen Sulfide and Sulphuric Acid	High resistance to almost all acids and alkalis, including resistance to Hydrogen Sulfide and Sulphuric Acid
Load bearing capacity	Heavy traffic	Heavy traffic	Heavy traffic
Covers	SFRC / GRP – LD / MD / HD (10T, 20T,40T) or Non-traffic bearing polymer cover	SFRC / GRP – LD / MD / HD (10T, 20T,40T) or Non-traffic bearing polymer cover	SFRC / GRP – LD / MD / HD (10T, 20T,40T) or Non-traffic bearing polymer cover

a) Ultra 600

The Ultra 600 Inspection Chamber consists of base, corrugated single-wall transition shaft and cover. Ultra 600 chambers recommended for installation depth minimum 0.8m to maximum 5.00m. The shaft provides excellent resistance to ground movement and heavy traffic loads. Cover solution is available in plastic, SFRC and GRP, in different load class as per loading requirements.

The Ultra 600 base is available in 6 different configurations with 200 / 250mm diameter of inlet(s) and outlet. By using eccentric reducers, it is suitable for pipe diameter 110 mm to 315 mm. All flow profiles have connectivity to pipe by specially design EPDM rubber ring. Flexible swivel adapter is provided for 250 mm diameter inlet(s) / outlet to accumulate the angular deflection of 7.5° in each direction by which we can avoid extra fittings while alignment.

Simple and reliable “in-situ” connections can easily be made in the shaft to create additional pipe connections

Recommended depth for installation -

a. For manual cleaning -0.8 m to 2,00 m
b. For mechanical cleaning – Up to 5 meter.

b) Ultra 1000

The Ultra 1000 Manhole consists of three parts: base, shaft and cone (top). The shaft is available in different heights, ranging from 0.4m to 1.1m effective height. Shafts can be placed on top of each other to increase the depth of installation. Installation depths can range from minimum 1.2m to maximum 6.0m with a maximum ground water level up to 5.0m. The advanced design of the ribs and corrugated structure and shape of the cone gives the required strength and stability against heavy traffic load and soil movement. The Ultra 1000 has a spacious entrance of 0.64m and nominal inner diameter of 1.00 m. The Manhole is supplied with an in-build ladder. Shaft can be easily cut on site on center of exterior corrugation section to achieve required depth. Extra “in-situ” pipe connections can easily be made with in-situ adapter.

The Ultra 1000 Manhole base is available in 6 different flow profiles and suitable for pipe connections from 160mm to 315mm.

Recommended depth for installation -

a. In general condition -From 1.2 m to 6.00 m
b. In water logged area – Up to maximum 5.00 meter.

c) Ultra 1200

The Ultra 1200 Manhole consists of three parts: base, shaft and cone (top). The shaft is available in different heights (0.4 m to 1.0m effective). Shaft can be placed on top of each other to increase the depth of installation. Installation depths can range from 1.3m to 6.0m with a maximum ground water level up to 5.0m. The advanced design of the ribs structure and shape of the cone gives the required strength and stability against heavy traffic load and soil movement. The Ultra 1200 also have an entrance of 0.64m and approx. 1.20m inside diameter. The Manhole is supplied with in-build ladder. Shaft can be easily cut at bottom of the ribs to achieve required depth as per site condition. Extra pipe connections can easily be made with the help of in-situ adaptor.

The Ultra 1200 Manhole base is available in 7 different flow profiles and suitable for pipe connections from 160mm to 400mm.

Recommended depth for installation -

a. In general condition -From 1.2 m to 6.00 m
b. In water logged area – Up to maximum 5.00 meter.

Components-

- Base with different configurations and inlet(s) / outlet of different diameters.
- Cone

- Shaft pipe
- Eccentric reducers
- In-situ adapter
- Cover (Plastic / SFRC / GRP)
- In-build ladder

Note- for Ultra 600, ladder and cone are not required as man entry in inspection chambers is not allowed.

9.2 Technical specification

Ultra Inspection chambers and manholes suitable for all type of sewer / rain water and industrial effluent underground drainage system made up with PE material selected from the list given in standard EN13476-2 and EN13476-3 suitable for rotational molding procedure with proper compounding within the permissible limit as per the standard guidelines with black color for inside and outside layers.

Ultra manholes are manufacture and test in strict compliance of consistently meeting or exceeding the quality assurance test requirement of standard EN13598 with regards to material, dimensions, construction, shape, workmanship, performance requirements, inspection and testing with service temperature 23°C

9.3 Designed parameters - These products are designed to resist different loading conditions, i.e.

1. Uplift force
2. Lateral thrust
3. Internal water pressure
4. Traffic load
5. Negative pressure

9.4 Resistance against Flotation (Uplift force)

Ultra Inspection Chambers / Manholes do not float when installed correctly, at an installation depth of 5m and with ground water up to surface level. Statistical calculations and practical tests have proved this. The toughness of the Ultra Inspection Chambers / Manholes has been tested in an appropriate long-term test situation. Rigorous testing and quality control throughout the entire production process and continuous long-term measurements ensure a high and long-lasting quality of the products.

9.5 Load Bearing Capacity (Traffic load)

The Ultra Inspection Chambers and Manholes are suitable both for non-traffic and traffic areas. Through extensive testing the high load bearing capacity has been proven, especially by heavy traffic load. On top of this the inspection chambers have passed full-scale field trials that tested the real behavior during extreme static and dynamic loads. When correctly installed with a cover of equal or higher rating, the load bearing capacities of the Ultra units are up to 40 MT wheel load. Covers should be selected taking into account the required traffic load at the location of installation.

9.6 Quality Assurance

All Ultra Inspection Chambers and Manholes are subjected to double quality checks. Rigorous testing and quality control are throughout the entire production process, according to the requirements of the ISO 9001 Quality Management System. Supreme Ultra chambers / Manhole have been designed and developed to fulfill all functional requirements of sewer systems as laid down in EN 476 and EN 1610.

Supreme have developed a testing station to conduct different tests as per the guidelines of standardEN-13598.

Testing parameters as per standard EN 13598

THE SUPREME INDUSTRIES LTD., Gadegaon				
QL/QA/2 PAGE : 01 OF 01	QUALITY PLAN FOR ROTOMOULDED MANHOLE			Revision: 00 Effective Date: 01.07.2013
Sr. no.	**Name of tests**	**Samples size**	**Test Method**	**Remark**
1	Material a) Density of Raw Material 27°C b) Melt Flow Rate 190°C/5 kg. load	One sample per lot	EN 13598-2 clause 4.1.1	≥ 920.0 kg/m^3 3.0 ≥ to ≤ 16.0 gm/10 min @ 190°/5 kg.
2	Visual Appearance	Each product	EN 13598-2-Cl. 5.1	The internal and external surfaces of manholes and its component shall be smooth, clean and free from defects, ends shall be cut, cleanly and square with the axis
3	Colour	5 samples in 100 nos. lot	EN 13598 -2-Cl. 5.2	All components of manhole shall be uniform in colour (Black)
4	Dimensions- a) Socket and spigot diameters b) Wall thickness c) Length of engagement d) Length of spigot e) Frame and cover dimensions f) Manhole steps dimensions - a) Distance from wall b) Between two step	Three samples per lot	EN 13598-2-Cl.6.1.2 6.2.1 6.2.2	As per drawing ---do--- ---do--- ---do--- ---do--- ---do--- ---do--- ---do--- ---do---
5	Impact resistance	One sample per lot	EN 13598-2 Cl.7.0	No cracks or other damages impairing the function of the base
6	Riser – ring stiffness	One sample per	EN 13598-2	Riser stiffness shall be
		lot	Cl.7.0	more than or equal to 2KN/m^2

7	Manhole step and ladder strength a) Vertical strength b) Horizontal pull out force	One sample per lot	EN 13598-2 Cl.7.0	2KN- deformation ≤ 10mm under load and remaining deformation ≤ 5mm. 1KN – No pull out
8	Tightness of joint between base and pipe	One sample per lot	EN 13598-2- Cl. 9.1 & EN 1277- Condition A and D	No leakage
9	Water tightness between base and shaft	One sample per lot	EN 13598-2 Cl .9.1	No leakage
10	Water tightness between shaft and cone	One sample per lot	EN 13598-2 Cl .9.1	No leakage
11	Load bearing capacity of cone	One sample per lot	EN 13598-2 Cl .9.1 Load – Class E	No collapse, no cracking
12	Wight of product	Three samples per lot	EN 13598-2 Cl. 9.2	As per drawing/ standard weight within allowable tolerance

9.7 Rubber ring Seal

All the rubber rings and sealing rings are made up of EPDM rubber. The rubber ring seal for the shaft / coneconnection must be placed between two ribs. This ensures a completely tight and reliable connection.

9.8 Ladder

Ladder provision is in-build with manholes, as per EN 13101:2002 made up of Aluminum / GRP sections, ofwidth 350 mm, spaced at 250mm (center to center) at horizontal distance of 120mm (min.) from wall of manhole as per the standard guidelines.

9.9 Cover

As per the loading condition and customer requirement, we are providing different cover solutions i.e. plastic, SFRC and GRP. Our SFRC covers manufactured and tested as per IS 12592:2002 and GRP covers manufactured as per functional requirements and test as per EN124.

Load classification for top covers:-

Pedestrian load - Plastic

Light weight -10MT (GRP /SFRC)

Medium duty -20MT (GRP / SFRC)

Heavy duty - 40MT (GRP / SFRC)

9.10 **Standard Installation Procedures:**

- Installation procedure for Ultra Manhole
- Excavate 60 cm wider and 15 cm deeper than the size of manhole base.
- Prepare 15 cm thick bed of suitable material and compact to 95%.

- Place the manhole base in position on a compacted bed, adjust and align to the correct level.
- Apply lubricant on sealing ring of inlet(s)/outlet and make the connection with pipe by pushing the base to the spigot of pipe.
- Backfill the surrounding with suitable material in 30 cm layers with proper compaction. This should be repeated for all the manhole components up to ground level for entire depth of installation.
- Clean and place the rubber sealing ring on the exterior face of manhole base.
- Apply lubricant evenly on the rubber seal around the base and on the socket of the shaft.
- Bring the shaft to the correct position and see that the ladder aligns well with the benching. Push and place the shaft on the base uniformly for full insertion depth.Repeat the procedure in case of more than one shaft. Pipe can be cut on site as per requirement
- Bring the cone in the right position and install the cone by pushing it evenly on the shaft fitted with rubber seal. Ensure proper alignment of ladder while placing the cone.
- Provide 150 mm PCC (M20) at the top and embed frame considering finish level.
- Place the cover of suitable load class and finish off with road top.

9.11 Assembly of 'in-situ' pipe connections

- Drill a hole with a hole-cutter at the desired point of connection to the required size. Remove burrs after drilling.
- Install the 'in-situ' rubber seal in the hole. Do not use lubricant.
- Apply lubricant to the inside of the seal for ease of assembly of the socket. Insert the socket into the rubber seal and the extra pipe-inlet is ready.
- Apply lubricant on rubber ring and push the pipe into the in-situ connection.

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.

10.1 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.

10.2 **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.

10.3 **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.

10.4 **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.

SECTION – C INTERNAL ELECTRICAL WORK

SECTION-I : ELECTRIC POWER DISTRIBUTION AND WIRING

1.0 Introduction

The electric power will be received and distributed in a building, through following means:-

(i) Cabling and switchgear to receive power.

The building is divided into convenient number of parts, each part served by a

submain wiring system to distribute power vertically/horizontally.

(ii) Power flows from meter panels to final DBs and then to wiring.

(iii) Dedicated circuit for different loads such asl ighting,HVAC, power plug loads shall be provided, wherever possible.

(iv) Submain wiring, which takes care of general lighting and power outlet load of the building, should have independent wires for lighting as well as power, wherever possible. Other loads like lifts, water pump sets, other motor loads are fed by independent cables of suitable capacity fed from properly designed essential/non- essential LT power panels with suitably designed switchgear having necessary control and safely features.

(v) Therefore the distribution/wiring system essentially consists of provision of cables, switchgear, sub main wiring, earthing, laying of pipes/ conduits etc. (in surface or recess) based on proper detailed designing to decide on various sizes/ capacities of these components and various controls and safeties involved, to provide an efficient, reliable, safe and adequate electrical distribution and wiring system.

(vi) A typical schematic diagram of power distribution of a building is enclosed

2.0 System of Distribution and Wiring

(i) The wiring shall be done from a distribution system through main and/or branch distribution boards. The system design and location of boards will be properly worked out.

(ii) Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker/linked switch with fuse. Each outgoing circuit shall be controlled by a circuit breaker/switch withfuse.

(iii) For non-residential buildings as far as possible DBs shall be separate for light and power.

(iv) Only MCCB/MCB/HRC fuse type DBs shall be used. Rewirable type fuses shall not be used.

(v) 'Power' wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e., beyond the branch distribution boards. Conduits for light/power wiring shall be separate.

(vi) Essential/non-essential/UPS distribution each will have a completely independent and separate distribution system starting from the main, switchboard upto final wiring for each system.As for example,conduit carrying non-essential wiring shall not have essential or UPS wiring. Wiring for essential and UPS supply will have their own conduit system. No mixing of wiring is allowed.

(vii) Generally, no switchboard will have more than one source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at atime.

(viii) Each MDB/DB/Switch Board will have reasonable spare outgoing ways for future expansion.

(ix) Balancing of 3-phase circuit shall bedone.

3.0 Wiring

Submain & CircuitWiring

(a) SubmainWiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

(b) CircuitWiring

Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where point wiring starts.

Measurement of Submain and Circuit Wiring

(i) Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit or channel as the case may be, exclusive of interconnections inside the switchboard etc.The increase on account of diversion or slackness shall not be included in the measurement.

(ii) The length of circuit wiring with two wires shall be measured from the distribution board to the nearest switch box from which the point wiring starts. Looping of switch boxes also will be counted towards circuit wiring, measured along the length of conduit/channel.

(iii) When wires of different circuits are grouped in a single conduit/channel, the same shall be measured on linear basis depending on the actual number and sizes of wires run.

(iv) Protective (loop earthing) conductors, which are run along the circuit wiring and the submain wiring, shall be measured on linear basis and paid forseparately.

Note: Conduit carrying submain will not carry circuit/point wiring. Similarly conduit carrying circuit wiring will not carry submain/point wiring. Conduit carrying point wiring will not carry submain/circuitwiring.

Measurement of Other Wiring Work

Except as specified above for point wiring, circuit wiring and submain wiring, other types of wiring shall be measured separately on linear basis along the run of wiring depending on the actual number and sizes of wires run.

4.0 PointWiring

4.1 **Definition**

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB.

(a) Ceiling rose or connector (in the case of points for ceiling/exhaust fan points, prewired light fittings, and call bells).

(b) Ceiling rose (in case of pendants except stiff pendants).

(c) Back plate (in the case of stiffpendants).

(d) Lamp holder (in the case of goose neck type wall brackets, batten holders and fittings which are notprewired).

4.2 **Scope**

Following shall be deemed to be included in point wiring:

(a) Conduit/channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan/ light fixture.

(b) All fixing accessories such as clips, screws, Phil plug, rawl plug etc. as required.

(c) Metal or PVC switch boxes for control switches, regulators, sockets etc, recessed or surface type, and phenolic laminated sheet covers over thesame.

(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switchboards for loose wires/conduit terminations.

(e) Control switch or MCB, asspecified.

(f) 3 pin or 6pin socket,ceiling rose or connector as required.(2pin and 5pin socket

outlet shall not be permitted.)

(g) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.

(h) Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

(**Note***:* In areas where false ceiling are provided, termination of wires should be at the fittings. Flexible conduits from ceiling junction box to the fittings shall be provided duly coupled at both ends.This shall be included with in the scope of point wiring.)

(i) Interconnecting wiring between switches with in the switch box on the same circuit.

4.3 **Measurement**

(a) Point Wiring (other than socket outletpoints)

(i) Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points,exhaust fan points and call bell points. These shall be measured on unit basis by counting, and classified as laid down in classification.

5.0 **Classification**

Points measured on unit basis shall be classified as under according to the type of building:

(a) Residential Buildings

(i) Group 'A', for point wiring for type I, type II and type III residential quarters and hostels.

(ii) Group 'B', for point wiring for type IV and above type of residential quarters and barracks.

(b) Non-residential Buildings

Group 'C' for all types of non-residential buildings such as offices, hospitals, laboratories, educational institutions, libraries etc.

(c) For any Other Type ofBuilding

The group under which the points are to be classified shall be decided by the concerned Chief Engineer (Elect.).

Point Wiring for Socket OutletPoints

(i) The light plug (6A)point and power(16A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely, switch box, another socket outlet point, or the sub-distribution board as the case may be, up to the socket outlet.

(ii) The metal/PVC box with cover, switch/MCB, socket outlet and other accessories

shall be measured and paid as a separate item.

Note: There shall normally be no “on the board” light plug point.

(iii) The power point outlet may be16A/6Asixpinsocketoutlet,wheresospecifiedin the tender documents.

6.0 **Group Control Point Wiring**

(i) In the case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified according to 5.0, and (b) for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point(s) and classified according to 5.0.

(ii) No recovery shall be made for non-provision of more than one switch in such cases.

Twin Control Light PointWiring

(i) A light point controlled by two numbers of two way switches shall be measuredas twopointsfromthefittingtotheswitchesoneithersideandclassifiedaccordingto 5.0.

(ii) No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

Multiple Controlled Call Bell PointWiring

(i) In the case of call bell points with a single call bell outlet,controlled from more than one place, the points shall be measured in parts i.e.

(a) From the call bell outlet to one of the nearest ceiling roses meant for connection to bell push, treated as one point and classified according to 5.0,and

(b) From that ceiling rose to the next one and soon,shall be treated as separate point(s) and classified according to 5.0.

(ii) No recovery shall be made for non-provision of more than one ceiling rose or connector for connection to call bell in suchcases.

7.0 Wiring System

(i) Wiring shall be done only by the looping system. Phase/live conductors shall be looped at the switch box. For point wiring, neutral wire/earth wire looping for the 1st point shall be done in the switch box; and neutral/earth looping of subsequent points will be made from pointoutlets.

(ii) In wiring, no joints in wiring will be permitted any where, except in switch box or

point outlets,where jointing of wires will be allowed with use of suitable connector.

(iii) The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.

(iv) Light, fans and call bells shall be wired in the 'lighting' circuits. 15A/16A socket outlets and other power outlets shall be wired in the 'power' circuits. 5A/6Asocket outlets shall also be wired in the 'power' circuit both in residential as well as non-residential buildings.

(v) ColourCoding

Following colour coding shall be followed inwiring:

Phase	:	Red/Yellow/Blue.(Three phasewiring)
Live	:	Red (Single phasewiring)
Neutral	:	Black
Earth	:	Yellow/Green.

(vi) Termination of Circuit intoSwitchboard

Circuit will consist of phase/neutral/earth wire. Circuit will terminate in a switch board (first tapping point, where from point wiring starts) in following manner:

Phase wire terminated in phase connector.

Neutral wire terminated in neutral connector.

Earth wire terminated in earth connector.

The switchboard will have phase, neutral and earth terminal connector blocks to receive phase/ neutral/ earth wire.

8.0 Run ofWiring

(i) The type of wiring shall be as specified in the tender documents namely, surface conduit/recessed conduit, steel/PVC,channel.

(ii) Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible forinspection.

(iii) Above false ceiling, in no case,open wiring shall be allowed. Wiring will be done in recessed conduit or surface steel conduit.

(iv) In recessed conduit system, routes of conduit will be planned, so that various inspection boxes provided don't present a shabby look. Such boxes canbe provided 5 mm above plaster level, and they can be covered with plaster of paris with marking of junction boxes.

(v) Where number of electrical services like electrical wiring, telephone wiring,

computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminium/PVC channels duly covered by a false ceiling, so that subsequently such service can be maintained and additional cables can be provided.

(vi) Generally conduits for wiring will not be taken in floor slabs.When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance. Alternatively false flooring can be provided.

9.0 Passing through Walls orFloors

(i) When wiring cables are to pass through a wall, these shall be taken through a protection (steel/ PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either porcelain, PVC or other approved material.

(ii) All floor openings for carrying any wiring shall be suitably sealed after installation.

10.0Joints inWiring

(i) No bare conductor in phase and/or neutral or twisted joints in phase, neutral,and/ or protective conductors in wiring shall be permitted.

(ii) There shall be no joints in the through-runs of cables.If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.

(iii) Termination of multistranded conductors shall be done using suitable crimping type thimbles.

11.0 Ratings of Outlets

(to be adopted for design).

(i) Incandescent lamps in residential and non-residential buildings shall be rated at 60W and 100W respectively.

(ii) Ceiling fans shall be rated at 60W. Exhaust fans, fluorescent tubes, compact fluorescent tubes, HPMV lamps,HPSV lamps etc.shall be rated according to their capacity. Control gear loses shall be also considered as applicable.

(iii) 6A and 16A socket outlet points shall be rated at 100W and 1000W respectively, unless the actual values of loads arespecified.

12.0 Capacity of Circuits

(i) Lighting circuit shall feed light/fan/call bell points. Each circuit shall not have more than 800 Watt connected load or more than 10 points whichever is less. However, in case of CFL points where load per point may be less, number of points may be suitably increased.

(ii) Power circuit in non-residential building will have only one outlet percircuit.

(iii) Each power circuit in residential building can feed followingoutlets:

(a) Not more than 2 Nos. 16Aoutlets.

(b) Not more than 3 Nos. 6Aoutlets.

(c) Not more than 1 No.16A and 2 Nos. 6Aoutlets.

(iv) Load more than 1 KW shall be controlled by suitably rated MCB and cable size shall be decided as percalculations.

(v) Power Wiring with Bus Trunking

It is permitted to meet large-scale power requirement in a hall, or floor, with use of single phase or 3 phase bus bars running inside a metal enclosure. Thiswill beprovided with careful design and use of factory fabricated bus-trunking of reputed make, conforming to relevant BIS standards and with standard accessories like End feed unit, tap off with necessary safety features like overcurrent,short-circuit and earth fault protection. Such trunking will be of specified breaking KArating.

13.0 Socket Outlets

(i) Socket outlets modular type shall be 6A 3 pin, 16 Amp 3 pin or 16/6 Amp 6 pin. 5 pin socket outlets will not be permitted.

The third pin shall be connected to earth through protective (loop earthing) conductor. 2 pin or 5 pin sockets shall not be permitted to be used.

(ii) Conductors connecting electrical appliances with socket outlets shall be of flexible type with an earthing conductor for connection to the earth terminal of plug and the metallic body of the electrical appliance.

(iii) Sockets for the power outlets of rating above 1KW shall be of industrial type with associated plug top and controlling MCB.

(iv) Where specified, shutter type (interlocking type) of sockets shall be used.

(v) Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on the 'live' side of theline.

(vi) 5A/6A and 15A/16A socket outlets shall be installed at the following positions, unless otherwise specified.

(a) *Non-residential buildings* – 23 cm above floorlevel.

(b) *Kitchen* – 23 cm above working platform and away from the likely positions of stove and sink.

(c) *Bathroom*–No socket outlet is permitted for connecting a portable appliance thereto.MCB/IC switch may be provided above 2m for fixed appliances,and at least 1 m away from shower.

(d) *Rooms in residences* – 23 cm above floor level, or any other level in special cases as desired by theEngineer-in-charge.

(vii) Unless and otherwise specified, the control switches for the 6A and 16A socket outlets shall be kept along with the socket outlets.

14.0 Cables

(i) Copper conductor cable only will be used for submain/ circuit/ pointwiring.

(ii) Minimum size ofwiring:

LightWiring	:	1.5sq.mm.
PowerWiring	:	4.0 sq.mm.
Powercircuit rated	:	More than 1 KW, Size as percalculation.

(iii) Insulation : Copper conductor cable shall be PVC insulated conforming to BIS Specification.

(iv) Multistranded : Cables are permitted to be used.

15.0 Flexible Cable

(i) Conductor of flexible cables shall be of copper. The cross sectional area of conductor for flexible cable shall be as per design.

(ii) Only 3 core flexible cables shall be used for connecting single-phase appliances.

(iii) Unless the flexible cables are mechanically protected by armour, or tough rubber, or PVC sheath,these shall not be used in workshops and other places where they are liable to mechanical damage.

(iv) Flexible cable connection to bell push from ceiling rose shall be taken through steel conduit/metallic casing andcapping.

16.0 WiringAccessories

(a) Control Switches for Point

(i) Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be 'On' when the knob is down.

(ii) It is recommended to provide double pole MCB in proper enclosure as power outlet for window type AC units, geysers etc.

(b) Switch Box

(i) Switch box shall be hot dip galvanized, factory fabricated, suitable in size for surface/ recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for applications other then modular switches/sockets).

(ii) Switch box also can be of non-metallic material. The technical sanctioning authority will approve specified makes of reputed quality andspecifications.

(c) Switch Box Covers (for application other than modular type)

Phenolic laminated sheets of approved shade shall be used for switch box covers. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conforming to grade P- I of IS 2036 :1974.

Note: Specification for switch boxes is covered in the chapters on the various types of wiring.

(d) Ceiling Rose

(i) A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.

(ii) Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.

(iii) A ceiling rose shall not embody fuse terminal as an integral part ofit.

(e) Lamp Holders

(i) Lamp holders may be batten, angle, pendant or bracket holder type as required. The holder shall be made of brass and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so thatthey do not open out during attention to the lamp orshade.

(ii) Lamp holders for use on brackets and the like shall have not less than 1.3cm nipple, and all those for use with flexible pendant shall be provided with cord grips.

(iii) All lamp holders shall be provided with shade carriers.

(iv) Where center contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the 'middlewire',or the neutral conductor of the circuit.

(f) Fittings

Types **:**The type of fittings shall be as specified in tender documents.

Indoor Type Fittings

(i) Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permit looping back.

(ii) Wires used within prewired fittings shall be flexible with PVC insulation and 14/0.193 mm (minimum) copper conductors. The leads shall be terminated on built-in-terminal block, ceiling rose or connector, asrequired.

(iii) Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting for dischargelamps.

(iv) Fittings shall be installed such that the lamp is at a height of 2.4m above floor level, unless otherwise directed by the Engineer-in-charge.

(v) Fittings made of CRCA shall be phosphatized and powder/epoxy painted. For coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel etc. should be used.

OutdoorFittings

Outdoor fittings shall have suitable IP protection. It is preferable that street light fittings are of cast aluminium body of IP 65, for reducing recurring maintenance cost and improved performance.Where required IP66 fittings also can be provided for reducing maintenance frequency and cost.

Other fittings, which are not available with tested IP 65/54 protection, can be properly fabricated with weatherproof features, proper gasketing etc. As far as possible corrosion free material like cast aluminium, stainless steel, engineering plastics may be used for fabrication of such fittings, to prolong life of such fittings. There should not be any exposed wiring in such outdoor fittings.

17.0 Attachment of Fittings andAccessories

(a) Conduit WiringSystem

(i) All accessories like switches, socket outlets, call bell pushes and regulators shall be fixed in flush pattern inside the switch/regulator boxes. Accessories like ceiling roses,brackets,batten holders etc.shall be fixed on outlet boxes. The fan regulators may also be fixed on outlet boxes, if so directed by the Engineer-in-charge.

(ii) Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases.

(iii) The switch box/regulator box shall normally be mounted with their bottom 1.25 m from floor level, unless otherwise directed by the Engineer-in-charge.

(b) Fixing to Walls andCeiling

(i) Wooden plugs for fixing to wall/ceiling will not be allowed. Fixing will be done with the help of PVC sleeves/Rowel plugs/ dash fasteners as required.

(ii) Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

18.0 Fans, Regulators and Clamps

(a) Ceiling Fans

(i) Ceiling fans including their suspension shall conform to relevant Indian Standards.

(ii) The capacity of a ceiling fan to meet the requirement of a room with the longer dimension D meters should be about 55 Dm^3/min.

(iii) The height of fan blades above the floor should be (3H+W)/4,where H is the height of the room, and W is the height of the work plane.

(iv) The minimum distance between fan blades and the ceiling should be about 0.3 meters.

(v) When actual ventilated zone does not cover the entire room area, then optimum size of ceiling fan should be chosen based on the actual usable area of the room, rather than the total floor area of theroom.

(vi) The number of fans and the optimum sizes for rooms of different dimensions are given in the following table:

19.0 Optimum Size/Number of Fans for Rooms of Different Sizes

Room Width	*Room Length*										
m	*4m*	*5m*	*6m*	*7m*	*8m*	*9m*	*10m*	*11m*	*12m*	*14m*	*16m*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
3	1200/1	1400/1	1500/1	1050/2	1200/2	1400/2	1400/2	1400/2	1200/3	1400/3	1400/3
4	1200/1	1400/1	1200/2	1200/2	1200/2	1400/2	1400/2	1500/2	1200/3	1400/3	1500/3
5	1400/1	1400/1	1400/2	1400/2	1400/2	1400/2	1400/2	1500/2	1400/3	1400/3	1500/3
6	1200/2	1400/2	900/4	1050/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
7	1200/2	1400/2	1050/4	1050/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
8	1200/	1400/	1200/	1200/	1200/	1400/	1400/	1500/	1200/	1400/	1500/

	2	2	4	4	4	4	4	4	6	6	6
9	1400/2	1400/2	1400/4	1400/4	1400/4	1400/4	1400/4	1500/4	1400/6	1400/6	1500/6
10	1400/2	1400/2	1400/4	1400/4	1400/4	1400/4	1400/4	1500/4	1400/6	1400/6	1500/6
11	1500/2	1500/2	1500/4	1500/4	1500/4	1500/4	1500/4	1500/4	1500/6	1500/6	1500/6
12	1200/3	1400/3	1200/6	1200/6	1200/6	1400/6	1400/6	1500/6	1200/7	1400/9	1400/9
13	1400/3	1400/3	1200/6	1200/6	1200/6	1400/6	1400/6	1500/6	1400/9	1400/9	1500/9
14	1400/3	1400/3	1400/6	1400/6	1400/6	1400/6	1400/6	1500/6	1400/9	1400/9	1500/9

Note: This table is indicative only. Case specific design should be done by field officers based on site conditions & constraints.

(vii) Energy Efficient fans with BEE 3-5 star rating or complying with IS374:1979, shall be used. The minimum service value of fans shall be 3.5m^3/min/Wand air delivery 200m^3/min.

The values of service factor and air delivery for ceiling fans with 1200 mm sweep are given in the table below:

Star Rating Index Calculation for Ceiling Fans (1200 mm sweep)

Star Rating	*Service Value for Ceiling Fans**
1 Star	≤ 3.2 to < 3.4
2 Star	≤ 3.4 to < 3.6
3 Star	≤ 3.6 to < 3.8
4 Star	≤ 3.8 to < 4.0
5 Star	> 4.0

* Where x is the base service value as per IS 374 : 1979. BEE has proposed a base service value of 3.2 at present and would upgrade it to higher value once the BIS value is finalised.

* The BIS has proposed from the year 2010 the service value of 3.5.

* All ceiling fans covered under this standard shall comply with minimum air Delivery of 210m^3/min.

For other fan size (mm) the following table may be considered

Standard Power with Air Delivery of Fan as per the IS 374 Code

Fan Size	*Type*		*Minimum Air Delivery*	*Minimum Service Value*	*Maximum Power Input*
(mm)			*m^3/min*	*m^3/min/ W*	*W*
900	Capacitor	AC	130	3.1	42
		DC	130	3.4	38
1050	Capacitor	AC	150	3.1	48
		DC	150	3.4	44
1200	Capacitor	AC	200	4	50
		DC	200	4.6	44
1400	Capacitor	AC	245	4.1	60
		DC	245	4.8	51
1500	Capacitor	AC	270	4.3	63
		DC	270	5.1	53

Note: Air delivery values are on the basis of air velocity measurements up to 15m/ min.

(viii) Step Type Electronic regulators should be used instead of resistance type regulators for controlling speed of fans.

(ix) All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulators between hooks and suspension rods. There shall be no joint in the suspension rod.

(x) For wooden or steel joists and beams, the suspension shall consist of GI flat of size not less than 40 mm x 6 mm, secured on the sides of the joists or beams by means of two coach screws of size not less than 5 cm for each flat. Where there is space above the beam, a through-bolt of size not less than 1.5 cm dia, shall be placed above the beam from which the flats are suspended. In the latter case, the flats shall be secured from movements by means of another bolt and nut at the bottom of the beam.A hook consisting of MS rod of size not less than 1.5cm dia shall be inserted between the MSflat through oval holes on their sides. Alternatively, the flats may be bent inwards to hold tightly between them by means of a bolt and nut, a hook of 'S'form.In the case of 'I' beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of a long bolt andnut.

(xi) For concrete roofs, a12mm dia. MS rod in the shape of 'U' with their vertical legs bent horizontally at the top at least 19 cm on either side, and bound to the top reinforcement of the roof shall be used.

(xii) In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub-clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box shall be used.

(xiii) Canopies on top of suspension rod shall effectively hide the suspension.

(xiv) The leading in wire shall be of nominal cross section alarea not less than1.5 sq. mm. and shall be protected from abrasion.

(xv) Unless otherwise specified, all ceiling fans shall be hung 2.75 m above the floor.

(xvi) In the case of measurement of extradown rod for ceiling fan including wiring, the same shall be measured in units of 10cm. Any length less than 5cm shall be ignored.

(xvii) The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

(b) Exhaust Fans

(i) Exhaust fans shall conform to relevant IndianStandards.

(ii) Exhaust fans shall be erected at the places indicated by the Engineer-in-charge. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The hole shall be neatly plastered to theoriginal finish of the wall. The exhaust fan shall be connected to the exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.

(iii) Exhaust fans for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.

(iv) Installation of exhaust fans in kitchens, dark rooms and such other special locations need careful consideration; any special provisions needed shall be specified.

(c) Regulators

The metallic body of regulators of ceiling fans/exhaust fans shall be connected to earth by protective conductor.

20.0 Marking of Switch Boards

(i) Schematic Diagram First a comprehensive schematic diagram for each building is to be prepared, starting from Main Panel, sub main, submain boards, DBs, etc. and the manner in which they are connected. This will include essential, non-essential and UPS systems. Sizes of interconnecting main/submain cables shall be indicated.

(ii) Marking of each Main Board

Each main board/submain board shall be marked indicating rating of each incoming/outgoing switch and the details of load/area it feeds. Detail/size of incoming and outgoing cable also shall be marked indicating from where the incoming cable has originated.

(iii) Marking of Distribution Board

Each Distribution Board shall be marked indicating detail of incoming switch(Size of cable and from where it is fed) and marking of each outgoing MCB indicating the area it feeds.Suitable marking sticker will be suitably fixed to indicate such details.

(iv) Marking of Power/Light DBs

Power/light DBs shall be marked 'P' and 'L' respectively.

(v) Marking for Non-essential/Essential/UPS/Switch Boards

Each switchboard shall be marked essential/non-essential/UPS to indicate the nature of such switchboards.

(vi) Marking of Main EarthingTerminal

Main earthing terminals in main/submain switch board shall be permanently marked, as "Safety Earth – Don't Remove".

21.0 LT DistributionSwitchgear

Only following type switch boards will be used:

(a) Main/Submain switchboard of cubicle type.

(b) DBs – Conventional DBs of reputed makes can also be used with the approval of technical sanctioning authority in addition to prewired DB.

(c) Specially designedswitchboards.

Also specially designed switchboards can be used with detailed specification and fabrication drawings approved by the technical sanctioning authority.

(d) Specifications of cubicle panel and pre-wired DB are given in Clause 7.1.2 of Chapter 7 of CPWD Specifications.

22.0 Location of Switchboards shall be strictly as per Drgs.

(i) Switch boards are to be located in common areas like corridors, lobby etc. and not to be located in locked room.

(ii) Switchboard shall be located only in dry situation and in well-ventilated space. They shall not be placed in the vicinity of storage battery or exposed to chemical fume.

(iii) Switchboards shall not be erected above gas stove, or sinks or within 2.5 meter of any washing unit in washing rooms of launderings or in the bath rooms, toilets, or kitchen.

(iv) As far as possible main boards shall not be located in basement.Such main boards can be located in ground floor.

(v) Similarly DBs can be in suitable nitches in corridor walls having doors.

(vi) Locating main boards under staircase or standing open in corridor is not a desirable practice, besides being highly unaesthetic.

(vii) The main switchboard, which receives power to the building, should be invariably located in a switchroom, having round the clock access,for emergency attendance to the switchboard.

23.0 Guidelines for Planning Residential Areas

(i) U.G. System of Power Distribution, Street Lighting, Telephone Cabling and TV Cabling

For long-term economical maintenance, better reliability of service, safety, protection against heavy rains, storm, wind etc. and aesthetics, under ground cable system will be generally followed. Also considering the high cost of land, under ground system results in better economic utilization of land area, otherwise substantial land route has to be earmarked for overhead lines.

(ii) Efficient working of streetlights and staircase lighting is required for security of the colony and safety and convenience of the residents. Therefore adequate street lighting, staircase lighting is to be provided. Generally back lanes of residential blocks remain dark. Such areas are also to be covered by basic street lighting for security.

(iii) Kitchen

(i) Exhaust fans opening with one point outlet to be provided irrespective of yardstick of provision of exhaust fans.

(ii) In addition to one16A6-pin power outlet for kitchen,one 3pin 6Amp.outlet to be provided for water filter.

(iv) WashingMachine

Location to be finalized in consultation with the Architect. A power outlet plus water supply/drainage to be coordinated with Architect/CGEWHO.

(v) Stair Case Lighting

Stair case lighting is to be treated as an extension of street lighting, for security and convenience of the residents.CFL(1x11Watt) type staircase lighting may be provided to reduce load.As for example,need of 200 quarters can be met with100 CFL fitting (each of 11watt), with connected load of 1.5KW only.In can descent stair case lighting and bulk head fittings should not be provided, in view of excessive energy consumption and low burning hours.

(vi) Emergency Electric Supply

For ensuring essential water supply and security lighting, a D.G.set to be provided for each block to take care of water supply pump set, street lighting and essential load requirement of buildings like Club etc.

(vii) Fittings

Subject to limit of yardstick of fittings for various types of quarters following guidelines to be provided:

(i) Every room to be provided with one fluorescent fitting for energysaving.

(ii) Kitchen to be provided with a fluorescent fitting, tapped from a batten holder (through an adopter), so that in case of need batten holder can be used with bulbs.

(iii) Incandescent bulkhead fittings not to beused.

(iv) Quality fittings of reputed make to beused.

(viii) Main Board of Each Quarter

It shall be MCB type with provision of ELCB with the incoming MCB. It shall be located in a nitch with ventilated door cover, in the room connecting to the entryof the quarter. MCB DB shall be pre-wired type, for trouble free service.

(ix) Corrosion Free Fittings

Coastal areas and humid areas like kitchen, toilet are subject to corrosion, which substantially reduces the useful life of such fittings, besides giving an ugly look on account of rusting.

Therefore for coastal areas, and other humid areas corrosion free type of fittings (like aluminium, stainless steel, engineering plastic) should be used, for ensuring long life of such fittings and to achieve life cycle economy,after taking in to account recurring expenditure on account of painting offittings.

(x) Telephone Wiring

Telephone wiring is to be provided for each quarter. Such telephone wiring to be brought to a tag-block at a suitable point in ground floor. Provisions shall be kept for suitable entry-pipe for laying incoming telephone cable.

(xi) TV Cabling

Internal TV cabling shall be provided, with number of outlets as per BOQ.Similarly,from suitable point at ground floor, TV cabling shall be provided. With use of suitable splitters, such TV cabling to be connected to each quarter.

(xii) Lighting for Parks

Colonies are provided with parks. Such parks should be provided with adequate lights to include area lights, pathway lights etc.so that the parks can be effectively used by the residents and they remain secure during night time.

(xiii) External Pipe Network for Laying Telephone and TV Cabling for the Colony

Starting from a suitable room, pipe network may be provided to lay telephones/TV cables for the colony. Suitable road cross pipe and manholes to be provided for drawing such cables and their maintenance.

(xiv) Preliminary Estimate to Take Care of Telephone/TV Cabling in a Colony

At present, such services are provided in a very crude manner making use of existing poles and hanging cables. Apart from making colonies shabby, such services are subject to damages and unsatisfactory service.Therefore preliminary estimate should provide for such TV/Telephone cabling for the colony.

(xv) Other AlliedServices

Modern residential colonies require support services like CCTV (for Gate and house security), intercom system, basic security system etc. for the safety and convenience of the residents. Therefore, preliminary estimate should provide for basic provisions for such safety/security systems. Most of these services pay for themselves within 3 / 4 years of installation, besides providing security, which sometimes amount to life saving instances.

24.0 Guidelines for Planning Other Buildings

(i) The main objective is to avoid possible fire hazards,which calls for sound detailed designing and use of quality equipments and materials executed with sound workmanship and supervision.

(ii) All control LTPanels, controlling power supply to the entire building will be located in a centralized room, from where centralized control and monitoring of the entire power supply system can be made.

(iii) Earth fault protection shall be provided for each individual building at the LT receiving point i.e. Main LT Panel. ELCB shall not be provided as a matter of routine in distribution boards. These can be provided, if required, by the Chief Engineer (E), incharge.

(iv) Office buildings are prone to fire hazard during night hours. Therefore, after office hours, all the LT Panels should be switched off. Based on need of the building,

only the specified LT panel to be kept 'ON' which feed the loads during nighthours. Such panel, called common service panel, may feed following loads, which are normally used after officehours:-

(a) Some specified lifts.

(b) Staircase/ Corridor/ Compoundlight.

(c) Fire protection loads.

(d) Pump Sets.

(e) Other loads which are kept 'ON' after officehours.

(v) Reliability of Power Supply

Minimum two transformers to be provided to provide certain redundancy. Also a smaller size transformer may be provided to take care of reduced load during 'after office' hours to have energy saving of transformer, after proper technical evaluation.

(vi) It is preferable to plan for a separate service building, to combine all electrical and mechanical services of the building, so that the services can be maintained comprehensively at a lower cost and also reducing the overall area requirement. Such service building can combine electric sub-station, DG Sets, UPS, Air-conditioning Plant, water supply pump sets,etc.

(vii) While planning, maintainability of various services to be ensured, like providing facilities like access, approachability of various equipments, maintenance space etc.

SECTION-II :METALLIC CONDUIT WIRING SYSTEM

1.0 Scope

This chapter covers the detailed requirements for wiring work in metallic conduits. This chapter covers both surface and recessed types of works.

2.0 Application

(i) Recessed conduit is suitable generally for all applications. Surface conduit work may be adopted in places like workshops, plant rooms, pumprooms, wiring above false ceiling/below false flooring, and at locations where recessed work may not be possible to be done. The type of work, viz. surface or recessed, shall be as specified in the respective works.

(ii) Flexible conduits may only be permitted for interconnections between switchgear, DBs and conduit terminations in wall.

3.0 Material

3.1 Conduits

(i) All rigid conduit pipes shall be of steel and be ISI marked. The wall thick- ness shall be not less than 1.6 mm (16 SWG) for conduits upto 32 mm dia and notless than 2mm (14SWG) for conduits above 32 mm dia.These shall be solid drawn or reamed by welding, and finished with galvanized or stove enameled surface.

(ii) The maximum number of PVC insulated cables conforming to IS 694 : 1990 that can be drawn in one conduit is given sizewise in Tablel,and the number of cables per conduit shall not be exceeded. Conduit sizes shall be selected accordingly in each run.

(iii) No steel conduit less than 20 mm in diameter shall beused.

3.2 Conduit Accessories

(i) The conduit wiring system shall be complete in all respects, including their accessories.

(ii) All conduit accessories shall be of threaded type, and under no circumstancespin grip type or clamp grip type accessories shall beused.

(iii) Bends, couplers etc. shall be solid type inrecessed type of works and may be solid or inspection type as required, in surface type ofworks.

(iv) (a) Saddles for surface conduit work on wall shall not be less than 0.55 mm (24 gauges) for conduits upto 25 mm dia and not less than 0.9 mm (20 gauges) for larger diameter. The corresponding widths shall be 19 mm & 25mm.

(b) The minimum width and the thickness of girder clips used for fixing conduits to steel joists, and clamps shall be as per Table II.

3.3 Outlets

(i) The switch box or regulator box shall be made of metal on all sides, except on the front. In the case of cast boxes, the wall thickness shall be at least 3mm and in case of welded mild steel sheet boxes,the wall thickness shall not be less than 1.2 mm (18 gauge) for boxes upto a size of 20 cm x 30 cm, and above this size1.6mm(16gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection as per chapter 15 of these Specifications.

(ii) (a) Outlet boxes shall be of one of the size, covered in the Schedule of Rates (Elect.), 2012

(b) Where a large number of control switches and/or fan regulators are required to be installed at one place, these shall be installed in more than one outlet box adjacent to each other for ease ofmaintenance.

(iii) An earth terminal with stud and 2 metal washers and terminal block shall be provided in each MS box for termination of protective conductors and for connection to socket outlet/metallic body of fan regulator etc.

(iv) A metal strip shall be welded/screwed, to the metal box as support if tumbler type of control switches, sockets and/or fan regulators in flush pattern.

(v) Clear depth of the box shall not be less than 60 mm and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

(vi) The fan regulators can also be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer-in-charge.

(vii) Except where otherwise stated, 3 mm thick phenolic laminated sheets as per clause 3.14(c) shall be fixed on the front with brass screws, or aluminium alloy/ cadmium plated iron screws as approved by the Engineer-in-charge.

3.4 Installation

Common Aspects for Recessed and Surface ConduitWorks

(i) Conduit Joints

(a) The conduit work of each circuit or section shall be completed before the cables are drawn in.

(b) Conduit pipes shall be joined by means of screwed couplers and screwed accessoriesonly.Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories.

(c) Cut ends of conduit pipes shall have no sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

(d) The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc., after they have been prepared, shall be submitted for inspection before being fixed.

(e) No bare threaded portion of conduit pipe shall be allowed, unless such bare threaded portion is treated with anticorrosive preservative or covered with approved plastic compound.

(ii) Bends in Conduit

(a) All necessary bends in the system, including diversion, shall be done either by neatly bending the pipes without cracking with a bending radius of not less than 7.5 cm, or alternatively, by inserting suitable solid or inspection type normal bends, elbows or similar fittings, or by fixing cast iron inspection boxes, whichever is most suitable.

(b) No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.

(c) Conduit fittings shall be avoided as far as possible on conduit system exposed to weather. Where necessary, solid type fittings shall be used.

(iii) Outlets

(a) All outlets such as switches, wall sockets etc. may be either flush mounting type,or of surface mounting type,as specified in the Additional Specifications.

(b) All switches (except piano type switches), socket outlets and fan regulators shall be fixed on metal strips which shall be screwed / welded to the box. Piano type switches and accessories shall be fixed on the phenolic laminated sheet covers in flush pattern.

(iv) Painting after Erection

After installation, all accessible surfaces of conduit pipes, fittings, switch and regulator boxes etc.shall be painted in compliance with the clauses under Chapter 15 “Painting”.

Additional Requirements for Surface ConduitWork

(i) Painting before Erection

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of the conduit system, shall be adequately protected against rust when such system is exposed to weather, by being painted with 2 coats of red oxide paint applied before they are fixed.

(ii) Fixing Conduit onSurface

(a) Conduit pipes shall be fixed by saddles, secured to suitable approved plugs with screws in an approved manner at an interval of not more than one meter, but on either side of the couplers or bends or similar fittings,saddles shall be fixed at a distance of 30 cm from the center of suchfittings.

(b) Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by theEngineer-in-charge.

(c) In long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided.

(iii) Fixing Outlet Boxes

Only portion of the switch box shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

Additional Requirements for Recessed ConduitWork

(i) Making Chase

(a) The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired.

(b) In the case of buildings under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

(c) In case of exposed brick / rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

(ii) Fixing Conduits inChase

(a) The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddles, not more than 60 cm apart or by any other approved means of fixing.

(b) All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection agains trust.

(iii) Fixing Conduits in RCCWork

(a) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of thesame.

(b) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in ofconductors.

(c) Location of inspection / junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

(iv) Fixing Inspection Boxes

(a) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection and to facilitate replacement of wires, ifnecessary.

(b) These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS 2667 :1988.

(c) Suitable ventilating holes shall be provided in the inspection boxcovers.

(v) Fixing Switch Boxes andAccessories

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlets etc. shall be flush mounting type, unless otherwise specified in the Additional Specifications.

(vi) FishWire

To facilitate subsequent drawing of wires in the conduit, GI fish wire of

1.6 mm/1.2 mm (16/18 SWG) shall be provided along with the laying of the recessed conduit.

(vii) Bunching of Cables

(a) Cables carrying Direct Current may, if desired, be bunched whatever their polarity, but cables carrying alternating current, if installed in metal conduit shall always be bunched so that the outgoing and return cables are drawn into the same conduit.

(b) Where the distribution is for single phase loads only, conductors for these phases shall be drawn in oneconduit.

(c) In case of three phase loads, separate conduits shall be run fromthe distribution boards to the load points, or outlets as the case maybe.

Earthing Requirements

(i) The entire system of metallic conduit work, including the outlet boxes and other metallic accessories, shall be mechanically and electrically continuous by proper screwed joints, or by double check nuts at terminations. The conduit shall be continuous when passing through walls orfloors.

(ii) A protective (loop earthing) conductor(s) shall be laid inside the conduit between the metallics witch boxes and distribution switch boards and terminated with proper earth lugs/terminals. Only PVC insulated copper conductor cable of specified size green in colour shall be allowed.

(iii) The protective conductors shall be terminated properly using earth studs, earth terminal block etc. as the case maybe.

(iv) Gas or water pipe shall not be used as protective conductor (earthmedium).

TABLE I

Maximum Number of PVC Insulated 650/1100 V grade Aluminium / Copper Conductor Cable conforming to IS 694 :1990

[Clause 4.2.1 (ii)]

Nominalcross sectional area of conductor in sq.mm	*20 mm*		*25 mm*		*32 mm*		*38 mm*		*51 mm*		*64 mm*	
	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
50	–	–	–	–	–	–	–	–	5	3	6	5
70	–	–	–	–	–	–	–	–	4	3	5	4

Note:

(1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

(2) The column sheaded ‘S’ apply to runs of conduits which have distance not exceeding 4.25 m 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 sizes are the nominal external diameters.

TABLE II

Girder Clips or Clamps

[Clause 4.2.2 (iv) b]

Size of Conduit	*Width*	*Thickness*
(i) 20 mm	19 mm	0.9 mm (20 SWG)
(ii) 25 mm	19 mm	0.9 mm (20 SWG)
(iii) 32 mm & above	25 mm	1.2 mm (18 SWG)

SECTION-III :NON-METALLIC CONDUIT WIRING SYSTEM

1.0 Scope

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recessed types of wiring work.

2.0 Application

Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places like workshops etc. and where recessed work may not be possible to be done. The type of work shall be as specified in individualworks.

Flexible non-metallic conduits shall be used only at terminations, whereverspecified.

(i) Special Precautions

(ii) If the pipes are liable to mechanical damages,they should be adequately protected.

(iii) Non-metallic conduit shall not be used for the following applications:-

(a) Inconcealed / inaccessible places of combustible construction where ambient temperature exceeds 60 degreesC.

(b) In places where ambient temperature is less than 5 degrees C.

(c) For suspension of fluorescent fittings and other fixtures.

(d) In areas exposed to sunlight.

3.0 Materials

3.1 Conduits

(i) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 2509 : 1973 and IS 3419 : 1989 for rigid conduits and IS 9537 (Part 5) : 2000 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.

(ii) The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in Table III.

(iii) No non-metallic conduit less than 20 mm in diameter shall beused.

(iv) Wiring Capacity

The maximum number of PVC insulated aluminium/copper conductor cables of 650/1100 V grade conforming to IS 694 : 1990 that can be drawn in one conduit of various sizes is given in Table I under clause 4.2.1 (ii). Conduit sizes shall be selectedaccordingly.

3.2 Conduit Accessories

(i) The conduit wiring system shall be complete in all respect includingaccessories.

(ii) Rigid conduit accessories shall be normally of griptype.

(iii) Flexible conduit accessories shall be of threadedtype.

(iv) Bends, couplers etc. shall be solid type in recessed type of works, and may be solid or inspection type as required, in surface type ofworks.

(v) Saddles for fixing conduits shall be heavy gauge non-metallic type withbase.

(vi) The minimum width and the thickness of the ordinary clips or girder clips shall be as per TableIV.

(vii) For all sizes of conduit, the size of clamping rod shall be 4.5mm (7SWG) diameter.

3.3 Outlets

(i) The switch box shall be made of either rigid PVC molding, or mild steel, or cast iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron.

(ii) PVC boxes shall comply with the requirements laid down in IS14772:2000. These boxes shall be free from burrs, fins and internal roughness.

The thickness of the walls and base of PVC boxes shall not be less than 2 mm. The clear depth of PVC boxes shall not be less than 60 m.

(iii) The specifications for metallic boxes shall be as per requirements of clause 4.2.3.

(iv) 3 mm thick phenolic laminated sheet covers for all types of boxes shall be as per requirements of clause3.14(c).

3.4 Installation

Common Aspects for Both Recessed and Surface Conduit Works

(i) The erection of conduits of each circuit shall be completed before the cables are drawn in.

(ii) Conduit Joints

(a) All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through suchpipes.

(b) The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

(iii) Bends in Conduit

(a) All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.

(b) Radius of bends in conduit pipes shall not be less than 7.5 cm. No length of conduitshallhavemorethantheequivalentoffourquarterbendsfromoutlet to outlet.

(c) Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectivelyreduced.

(iv) Outlets

All switches, plugs, fan regulators etc. shall be fitted in flush pattern. The fan regulators can be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer-in-charge.

(v) Painting

After installation, all accessible surfaces of metallic accessories shall be painted in compliance with clauses under Chapter 15“Painting”.

Additional Requirements for Surface Conduit Work

(i) Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings. Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.

(ii) Where the conduit pipes are to be laid along the trusses, steel joists etc.the same shall be secured by means of saddles or girder clips as required by the Engineer-in-charge.Where it is not possible to use these for fixing,suitable clamps with bolts and nuts shall be used.

(iii) If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

Additional Requirements for Recessed Conduit Work

(i) Making Chase

Requirements under ralevent clause in Metallic Conduit work shall be complied with.

(ii) Fixing Conduits in Chase

(a) The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles, placed at not more than 60 cm apart, or shall be fixed by any other approved means offixing.

(b) At either side of the bends, saddles/staples shall be fixed at a distance of15 cm from the centre of thebends.

(iii) Erection in RCC Work

Requirements under ralevent clause in Metallic Conduit work shall be complied with.

(iv) Fixing Inspection Boxes

Requirements under ralevent clause in Metallic Conduit work shall be complied with.

(v) Fixing Switch Boxes andAccessories

Requirements under raleventclause in Metallic Conduit workshall be complied with.

(vi) FishWire

Requirements under ralevent clause in Metallic Conduit work shall be complied with.

(vii) Bunching of Cables

For ease of maintenance,cables carrying direct current or alternating current shall always be bunched so that the outgoing and return cables are drawn in the same conduits.

Earthing Requirements

(i) A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes, and/or earth terminal blocks at theDBs.

(ii) Gas or water pipe shall not be used as protective conductors (earthmedium).

TABLE III

Dimensional Details of Rigid Non-metallic Conduits

[Clause 5.2.1(ii)]

(All dimensions in mm)

S. No.	*Nominal Outside Diameter (in mm)*	*Maximum Outside Diameter (in mm)*	*Minimum Inside Diameter (in mm)*	*Maximum Permissible Eccentricity (in mm)*	*Minimum Permissible Ovality (inmm)*
1.	20	20 + 0.3	17.2	0.2	0.5
2.	25	25 + 0.3	21.6	0.2	0.5
3.	32	32 + 0.3	28.2	0.2	0.5
4.	40	40 + 0.3	35.8	0.2	0.5
5.	50	50 + 0.3	45.0	0.4	0.6

TABLE IV

Ordinary Clips or Girder Clips

[Clause 5.2.2(vi]

Size of Conduit	*Width*	*Thickness*
(1) 20 mm & 25 mm	19 mm	20 SWG (0.9144 mm)
(2) 32 mm & above	25 mm	18 SWG (1.219 mm)

SECTION-IV :M.V. PANEL, D.B. ETC.

1.0 Scope

This covers supply/erection/testing and commissioning of the equipments suitable for 415 Volt, 3 Phase, 50 HZ 4 wire system.

2.0 Requirements

(i) For each equipment, required IP rating and short circuit rating capacity will be specified. Governing BIS also will be specified.

(ii) All the equipments will be factory fabricated in an approved factory having modern fabrication and testing process. It shall have seven tank pre-treatment process comprising of degreasing, rinsing, de-rusting, rinsing, phosphatising, rinsing and passivation followed by powder coat painting having a paint thickness of 60microns or as specified. The powder paint will be subjected to oven-heated process. All panels will be provided with suitable gasket to make it dust/ verminproof.

Specification of LT Cubicle Panel

(i) Cubicle panel shall be floor mounted (on a base frame) totally enclosed and extensible type.The general construction shall conform to IS8623:93.The design shall include all provisions for safety of operating and maintenance personnel. Degree of IP protection shall be IP-42 for indoor application and IP-54 for outdoors, unless otherwise specified.

(ii) The panel shall be compartmentalized type having space and arrangement for incoming cable/ bus ducting, incoming switchgear/ switchgears, buscoupler, insulated and properly supported compartmentalized bus bars, outgoing compartmentalized switchgear, bus bar supports, joint shrouds, cable alleys of suitable size for cabling routing, support and terminations, inter-connection between bus bars and switchgear with auxiliary bus bars/ insulated conductors/ strips etc. Also the panel will be provided with necessary instrumentation likeCTs, PTs, Ammeters, Voltmeters, phase indicating lamps, other required instruments, wiring, fuses etc.

(iii) It shall be fabricated out of CRCA sheet not less than 2.0 mm thick for loadbearing members and 1.6 mm for doors of LT panels. The framework may be Angle Iron/Channel/Bolted type construction. General constructions shall employ the principle of compartmentalization and segregation of each circuit.Unless otherwise

approved, incomer and bus section panels shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type board shall have hinged access door at the rear. Operating handle of the highest unit shall be at a height not more than 1.7 mt. Overall height of the board shall not exceed 2.3metre.

(iv) Arrangement for Incoming/Outgoing CableTermination

Cable entries shall be provided either from the rear or from the front through cable alleys of suitable size. Removable gland plate to be provided for each cableentry. Cable support arrangement to be provided inside cable alley so that cables are neatly arranged and fixed. From each outgoing switch, insulated strip/ conductor of suitable size to be provided up to suitable terminal block, which will receive incoming / outgoing cable termination. It is desirable that cables are not terminated directly to switchgear, but terminated through proper terminal blocks.

(v) Specification of Cable Terminal Block

Terminal block of reputed make shall be used. The housing material shall be poly amide having unbreakable and fire-retardant characteristic. All the metal parts shall be made up of copper alloy including the screws. Mounting shall be 'Din' or 'G-rail'type. Screws shall be self captive type.No protection cover is required,and the block should be touchproof.

(vi) Bus bars/ Supports/ Clearances

The bus bar system may comprise of a system of main/ auxiliary bus bars run in bus bar alleys.

For bus bar material, ratings, current density, insulation, supports, bus bar clearances and joints see para 7.2 (iii) of CPWD specifications.

(vii) Earthing

2 Nos. 20 x 3 mm copper strip for LT panelupto 400 Amp. capacity or 2 Nos. 20x5mm copper strip for LT panel of higher capacity shall be fixed all around the panel connected to 2 Nos. earth bus copper strips connected to incoming earth conductors.

(viii) Commissioning

After erection, the LT panel will be commissioned after:

(a) Tightening of all nuts and bolts.

(b) Closing any left out holes to ensure the entire panel is insectproof.

(c) Megger testing.

(d) Earth testing.

Specification of Prewired DB

As a general practice only prewired MCB/HRC type DBs shall be used, on account of their superior technical features, compared to conventional DBs, which don't allow for proper wiring space and wiring termination. Rewirable fuse type DBs shall not be used.

Prewired DBs shall have following features:

(i) Recess/ Surface type with integral loose wirebox.

(ii) Phase/neutral/earth terminal blocks for termination of incoming & outgoing wires.

(iii) Din Channel for mounting MCBs.

(iv) Arrangement for mounting incomer MCB/ RCCB/ RCBO/ MCCB as required.

(v) Copper Bus bar.

(vi) Earthing terminals.

(vii) Wiring from MCBs to phase terminalblock.

(viii) Interconnection between terminal block/incoming switch/busbar/neutral terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/thimbles.

(ix) Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq.mm.

(x) Terminal block shall be made of flame retardant polymidematerial.

(xi) Colour terminal blocks and FRLS wires for easy identification of RYB Phases, Neutral and Earth.

(xii) Prewired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits. (This is an optional feature.)

(xiii) The prewired DB shall have peelable poly layer on the cover for protection from cement, plaster, paints etc. during the constructionperiod.

(xiv) Detachable plate with Knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6mm sheet steel, properly pre-treated, phosphatized with powder coated finish.

Where specified it shall be of double door construction provided with hinged cover in the front.

Note: Prewired DB will be factory manufactured by reputed manufacturer of MCB DBs.

SECTION-V :EARTHING

1.0 Scope

This chapter covers the essential requirements of earthing system components and their installation. This shall be read with Appendix F of CPWD specifications,which lays down criteria for their design. For details not covered in these specifications IS code of Practice onEarthing (IS 3043 : 1987) shall be referred to.

2.0 Application

(i) The electrical distribution system in the Department is with earthed neutral (i.e. neutral earthed at the transformer / generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipments and non-current carrying metallic components in the sub-station, as well as in the internal/ external electrical installations.

(ii) Earthing requirements are laid down in Indian Electricity Rules,1956,as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

(iii) Application for Internal E.I.

(a) Every sub-main will have earth continuity conductor to run along with sub-main wiring. In case of 3-phase sub-main wiring two earth continuity conductors shall be provided.

(b) Every circuit will have its earth continuity conductor to run alongwith circuit wiring. In case of 3-phase circuit two earth continuity conductors shall be provided.

(c) Looping of earth is allowed only in case of point wiring.

(d) When 2/3 power outlets are looped to one circuit, earth looping of these outlets is permissible.

Types of Electrodes &Material

Earth Electrodes

Types

The type of earth electrode shall be any of the following, as specified. (For selection criteria in designs, Appendix F may be referred to).

(a) Pipe earth electrode.

(b) Plate earth electrode.

(c) Strip or conductor earth electrode.

Electrode Materials andDimensions

(i) The materials and minimum sizes of earth electrodes shall be as per Table IX (revised).

(ii) GI pipe electrodes shall be cut tapered at the bottom, and provided with holes of 12mmdia,drilled not less than 7.5 cm from each other up to 2 m of length from the bottom.

(iii) The length of the buried strip or conductor earth electrode shall be not less than 15 m. This length shall suitably be increased if necessary, on the basis of the information available about soil resistance, so that the required earth resistance is obtained. Prior approval of the Engineer-in-charge shall be taken for any such increase in length.

(iv) All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes, and forged tinned brass in case of copper plateelectrodes.

Earthing Conductor & Sizes

(i) The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper, and in the form of wire or strip as specified.

(ii) The size of earthing conductor shall be specified, but this shall not be less than the following (For calculating the size of the earthing conductor in design, Appendix F para 3.5.1).

(a) 4 mm dia. (8 SWG) copperwire,

(b) 25 mm x 4 mm in the case of GI strip,or

(c) 20 mm x 3 mm in the case of copper strip.

(iii) Earthing conductor larger than the following sectional areas need not be used, unless otherwise specified.

(a) 150 sq.mm. in case of GI,or

(b) 100 sq.mm. in case ofcopper.

Earth Continuity / Loop Earthing Conductor & Sizes

(i) The material and size of protective conductors shall be as specified below (for criteria in design of these Appendix F may be referredto):

Size of phase conductor	*Sizeofprotectiveconductorofthesame material as phaseconductor*
Upto 4 sq.mm.	Same size as that of phase conductor
Above 4 sq.mm. up to 16 sq.mm.	Same size as that of phase conductor
Above 16 sq.mm. up to 35 sq.mm.	16 sq.mm.
Above 35 sq.mm.	Half of the phase conductor

3.0 Location for Earth Electrodes

(i) Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases, electrodes may be located further away from the building, with the prior approval of the Engineer-in-charge.

(ii) The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, pavements and roadways, should be avoided for locating earth electrodes.

4.0 Installation

Electrodes

Various Types ofElectrodes

(i) (a) Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in Fig. 11 (revised) of CPWD specifications.

(b) In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table,hard soil or rock,the electrode may be of reduced length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the Engineer-in-charge. Pipe electrodes may also be installed in horizontal formation in such exceptional cases.

(ii) Plate electrode shall be burieding round with its faces vertical,and it stop not less than 3.0 m below the ground level. The installation shall be carried out as shown in Fig. 12 (revised) of CPWD specifications.

(iii) When more than one electrode (plate/pipe) is to be installed, a separation of not less than 2 m shall be maintained between two adjacentelectrodes.

(iv) (a) The strip or conductor electrode shall be buried in trench not less than 0.5m deep.

(b) If conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point.

(c) If the electrode cannot be laid in a straight length, it may be laid in a zigzag manner with adeviation upto 45 degreesfromtheaxisofthestrip.Itcanalso be laid in the form of an arc with curvature more than 1 m or apolygon.

Artificial Treatment of Soil

When artificial treatment of soil is to be resorted to, the same shall be specified in the schedule of work. The electrode shall be surrounded by charcoal / coke and salt as indicated in Fig. 11 and 12of CPWD specifications. In such cases, excavation for earth electrode shall be increased as per the dimensions indicated in thesefigures.

Watering Arrangement

(i) In the case of plate earth electrodes, a watering pipe 20 mm dia. Medium class pipe shall be provided and attached to the electrodes as shown in Fig. 11 and 12of CPWD specifications. A funnel with mesh shall be provided on the top of this pipe for watering the earth.

(ii) In the case of pipe electrodes, a 40 mm x 20 mm reducer shall be used for fixing the funnel with mesh.

(iii) The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm x 30 cm x 30cm.

(iv) A cast iron/MS frame with MS cover,6 mm thick,and having locking arrangement shall be suitably embedded in the masonry enclosure.

Earthing Conductor (Main Earthing Lead)

(i) In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

(ii) In the case of pipe earth electrode, wire type earthing conductor shall be secured as indicated in Fig. 11of CPWD specificationsusing a through bolt, nuts and washers and terminating socket.

(iii) A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanized “C” shaped strips, bolts, washers, nuts and check nuts of adequate size shall be used for the purpose.

(iv) The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class,15mm dia.GI pipe in the case of wire, and by 40 mm dia, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case

of road crossing and pavements).The portion with in the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.

(v) The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by:

(a) Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and

(b) Bolt, nut and washer in case of strip conductor.

In the case of sub-stations or alternators, the termination shall be made on the earthing terminal of the neutral point on the equipment and/or the earth bus,as the case may be.

Loop Earthing/ Earth Continuity Conductor

(i) Earth terminal of every switch board in the distribution system shall be bonded to the earth bar/ terminal of the upstream switch board by protective conductor(s).

(ii) Two protective conductors shall be provided for a switchboard carrying a 3-phase switchgear thereon.

(iii) Loop earthing of individual units will not be however necessary in the case of cubicle type switch boards.

(iv) The earth connector in every distribution board (DB) shall be securely connected to the earth stud/ earth bar of the corresponding switch board by a protective conductor.

(v) The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to the earth stud in switch boxes by protective conductor. Where the switch boxes are of non-metallic type, these shall be looped at the socket earth terminals, or at an independent screwed connector inside the switch box. Twisted earth connections shall not be accepted in anycase.

5.0 Earth Resistance

(i) The earth resistance at each electrode shall be measured.No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.

(ii) Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc.,as may be directed by the Engineer-in-charge.

6.0 Marking

(i) Earth bars/terminals at all switch boards shall be marked permanently, either as "E" or as

(ii) Main earthing terminal shall be marked"SAFETYEARTH–DONOTDISCONNECT".

7.0 Use of Residual Current Devices(RCDs)

An extract on selection and application of RCDs (also known as RCCBs) from IS 12640: 1988 is given at Appendix G. Provision of RCD shall be specified in individual cases keeping in view the type, use, importance, system of earthing and nature of electrical in stallations to be protected by the RCCBs,requirements of the local electric supply company, etc. The sensitivity shall be 30 mA, 100 mA, 300 mA, or 500 mA, as specified.

TABLE IX (Revised)

Materials and Sizes of Earth Electrodes

[Clause 8.2.1.2(i)]

Type of Electrodes	*Material*	*Size*
Pipe	GI medium class	40 mm dia 4.50 m long (without any joint)
Plate	(i) GI (ii) Copper	60 cm x 60 cm x 6 mmthick 60 cm x 60 cm x 3 mmthick
Strip	(i) GI (ii) Copper	100 sq. mm section 40 sq. mm section
Conductor	(i) Copper	4 mm dia (8 SWG)

Note : Galvanisation of GI items shall conform to Class IV of IS 4736 : 1986.

EARTHING PIT SCHEDULE

S.No.	Description	GI Earthing		Size of Earthing Strip (GI)			Copper Earthing	Size of Earthing Strip (Cu)	
		600 x 600 x 6mm	40mm Dia Pipe	50x6	25x6	25x3	600 x 600 x 3mm	50x6	25x3
1	11 KV HT METER BOARD	2	-	25	-	-	-	-	-
2	11KV HT PANEL -1	2	-	25	-	-	-	-	-
3	11/0.433KV 2000KVA CSS-1	2	-	25	-	-	2	-	-
4	11/0.433KV 2000KVA CSS-2	2	-	25	-	-	2	25	-
5	500KVA DG SET-1	2	-	25	-	-	2	25	-
6	500KVA DG SET-2	2	-	25	-	-	2	25	-
7	500KVA DG SET-3	2	-	25	-	-	2	25	-
8	MAIN LT PANEL	2	-	35	-	-	-	-	-
9	DG SYNCHRONOUS PANEL	2	-	50	-	-	-	-	-
10	COMMON LOAD PANEL FOR BLOCK-1	-	1	-	100	-	-	-	-
11	METERING PANEL-1 & 2 FOR BLOCK-1	-	2	-	100	-	-	-	-
12	COMMON LOAD PANEL FOR BLOCK-2	-	1	-	100	-	-	-	-
13	METERING PANEL-1 & 2 FOR BLOCK-2	-	2	-	100	-	-	-	-
14	COMMON LOAD PANEL FOR BLOCK-3	-	1	-	100	-	-	-	-
15	METERING PANEL-1 & 2 FOR BLOCK-3	-	2	-	100	-	-	-	-
16	COMMON LOAD PANEL FOR BLOCK-4		1		100				
17	METERING PANEL-1 & 2 FOR BLOCK-4		2		100				
18	COMMON LOAD PANEL FOR BLOCK-5		1		100				
19	METERING PANEL-1 & 2 FOR BLOCK-5		2		100				

GARG & ASSOCIATES
48, REGAL BUILDING
CONNAUGHT PLACE
NEW DELHI-110001
GAGAN GARG
CA-No.-98/26499

20	CAPACITOR PANEL-1 & 2		2		70				
21	COMMON SERVICE PANEL	-	2	-	50	-	-	-	-
22	SEWAGE TREATMENT PLANT	-	2	-	35	-	-	-	-
23	FEEDER PILLAR-1 FOR STREET LIGHT	-	2	-	-	30	-	-	-
24	FEEDER PILLAR-2 FOR STREET LIGHT	-	2	-	-	30	-	-	-
25	FEEDER PILLAR-3 FOR STREET LIGHT	-	2	-	-	30	-	-	-
26	WATER SUPPLY PUMP	-	2	-	-	30	-	-	-
27	IN CABLE TRENCH	-	-	100	-	-	-	-	-
28	FOR GRID	-	-	-	200	-	-	-	-
	TOTAL	**18**	**29**	**360**	**1355**	**120**	**10**	**100**	**0**

SECTION-VI :ENERGY CONSERVATION

Energy is very costly. Guidelines for energy conservation:

1.0 Lighting and Controls

Lighting Design

Lighting design to be done in such a way that it achieves the required visual comfort at working plane and is energy efficient. Visual comfort can be defined in terms of lux level at the working plane and energy efficiency can be defined in terms of lighting power density (Watt/m^2). The recommended lux levels and lighting power densities have been specified in Chapter 2 Section 2.9.

Wherever possible,a combination of task lighting and general lighting shall be provided to get desired lighting levels. In addition to general lighting, local task luminaires shall be provided for adequate lighting level and quality in the task areas.

For general lighting, lux levels required for circulation and other non-critical applications should be maintained.

Efficient Lamp Selection

Selection of lamp is the most important criterion for lighting design.The lamp selection should be on the basis of efficacy and good colour rendering index(CRI).

Lamps used for general lighting scheme should comply to the following:

- *Point Light Source* – All the point light sources installed in the building for general lighting should be CFL or LED based with minimum lamp efficacy of 50lm/W.
- *LinearLightSource*–All the linear light sources installed in the building for general lighting should be T-5 or at least 5 Star BEE rated TFLs.

Table 9 lists the Wattage, luminous flux, efficacy and CRI of different types of lamps.

Incandescent lamps should not be used at all.

New high frequency electronic ballasts should be used instead of traditional magnetic ballasts.

Lighting Controls

Automatic LightingShutoff

Interior lighting systems in buildings larger than 500 m^2 (5000 ft^2) shall be equipped with an automatic control device. Within these buildings, all office areas less than 30m^2 (300ft^2) enclosed by walls or ceiling-height partitions,all meeting and conference rooms,all school classrooms,and all storage spaces shall be equipped with occupancy sensors.

For other spaces, this automatic control device shall function on either :

- A scheduled basis at specific programmed times. An independent program schedule shall be provided for areas of no more than 2500 m^2 (25000 ft^2) and not more than one floor,

  Or

- Occupancy sensor that shall turn the lighting off within 3 minutes of an occupant leaving the space.Light fixtures controlled by occupancy sensors shall have a wall mounted, manual switch capable to turning off lights when the space is occupied.

  Exception to above: Lighting systems designed for 24-hour use.

Space Control

Each space enclosed by ceiling-height partitions shall have at least one control device to independently control the general lighting with in the space. Each control device shall be activated either manually by an occupant or automatically by sensing an occupant. The maximum coverage area for each control device is given in the table below:

Space Area and Lighting Control

Sl. No.	*Space Area (m^2)*	*Maximum Coverage Area for each Control Device (m^2)*
1	⩽ 1000	250
2	> 1000	1000

Each control device shall be capable of overriding the required shut off control for no more than 2 hours. It should be readily accessible and located such that theoccupant can see the control.

Exception to above: The required control device may be remotely installed if required for reasons of safety or security. A remotely located device shall have a pilot light indicator as part of or next to the control device and shall be clearly labeled toidentify the controlled lighting.

Day-lighting Controls

Luminaires in day lighted areas greater than 25 m^2 (250 ft^2) shall be equipped with either a manual or automatic lighting control device that is capable of reducing lighting output of the luminaires in the day lighted areas by at least 50% and controls only the luminaires located entirely within the day lighted area.

Exterior Lighting Control

Lighting for exterior applications shall be controlled by a photo sensor or astronomical times witch that is capable of automatically turning off the exterior lighting when day light is available or the lighting is not required.

Lighting Control Devices

Following is a description of different types of control devices available for controlling the lighting:

Timers: These are the simplest type of controls and are most popular. Some areas in buildings may require lighting for specific durations like security lighting, landscape lighting or building flood lighting. Timers allow this type of control by switching 'on'and 'off'as per preset times.These can have one setting (sametime) for the whole year or several (seasonal/ weekly/daily) settings to take care of the changing sunset times.

Photocell Lighting Control: These measure the amount of natural light available and suitable for both indoor and outdoor applications. When available light falls below a specified level,a control unit switches the lights on (or adjusts a driver to provide more light). Photocells can be programmed so that lights do not flip on and off on partially cloudy days.

Occupancy Sensors : These devices – also known as 'motion detectors' – turn lights off and on in response to human presence. Once sensitivity and coverage area is established, sensors are selected from two predominant technology types.

*Passive Infrared Sensors :*These detect the motion or heat between vertical and horizontal detection zones. This technology requires a direct line of sight and is more sensitive to lateral motion, but it requires layer motion as distance from the sensor increases. The coverage pattern and field of view can also be precisely controlled. It typically finds its best application in smaller spaces with a direct line of sight, such as restrooms.

Ultrasonic Sensors: These detect movement by sensing disturbances in high-frequency ultrasonic patterns. Because this technology emits ultrasonic waves that are reflected around the room surfaces, it does not require a direct line of sight. It is more sensitive to motion towards and away from the sensor and its sensitivity decreases relative to its distances from the sensor. It also does not have a definable coverage pattern or field of view. These characteristics make it suitable for use in layer-enclosed areas that may have cabinets, shelving, partitions, or other obstructions. If necessary,these technologies can also be combined into one product to improve detection and reduce the likelihood of triggering a false on or offmode.

2.0 Efficient Motors

Motors shall comply with the following:

- All permanently wired poly-phase motors of 0.375kW or more serving the building and expected to operate more than1500 hours per year and all permanently wired polyphase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a minimum acceptable nominal full load motor efficiency not less than IS 12615 for Energy Efficientmotors.
- Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor. See Table14.
- Motor horse power ratings shall not exceed 20% of the calculated maximum load.
- Motor name plates shall list the nominal full load motor efficiencies and the full load power factor.
- Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.
- Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken so that the core characteristics of the motor is not lost due to thermal and mechanical stress during removal of damaged parts. After rewinding, a new efficiency test shall be performed and similar records shall be maintained.
- Motors should be installed with soft start energy savers and Variable Speed drives based on the application required.

3.0 Metering

- Services exceeding 1000 KVA shall have permanently installed electrical metering to record demand (kVA), energy (kWh), and total power factor. The metering shall also display current (in each phase and the neutral), voltage (between phases and between each phase and neutral), and total harmonic distortion (THD) as a percentage of total current.
- Services not exceeding 100 kVA but over 65 kVA shall have permanently installed electric metering to record demand (kW), energy (kWh), and total power factor(or kVARh).
- Services not exceeding 65 kVA shall have permanently installed electrical metering to record energy (kWh).
- Electrical meters shall be installed to measure the energy units generated on site through DG/ GG sets.
- Separate electrical sub-meters shall be installed to measure energy consumption

by HVAC plant, AHU fans and indoorlighting.

- BTU meters* shall be installed for each chiller at the entry and leaving points to measure the cooling generated bychillers.
- BTU meter* shall be installed on the chilled water loop to measure the building's total cooling demand.

***BTUMeter:** BTU is the acronym for BritishThermal Unit,which is a traditional unit of energy. BTU meters are used for thermometric billing as they measure heat in terms of BTU. These meters are used for measuring energy consumption of heating and cooling systems. By installing BTU meters at individual chillers, cooling generated by individual chillers can be measured and by installing the BTU meter on the chilled water loop, building's total cooling demand can be measured.*

SECTION-VII : SELECTION AND APPLICATION OF RCCBs (RCDs)

1.0 General

IS 732 : 1989 recognizes two forms of shock hazard, 'Indirect contact' and 'Direct contact'. The objective is to achieve safety to personnel and property through the best possible means in the most economicmanner.

The most commonly used protective measure against indirect contact is termed "main equi-potential bonding and automatic disconnection of supply". Irrespective of the type of protective device used, the aim is to prevent dangerous 'touch voltages' persisting on accessible conductive parts which become live under earth fault conditions. Use of RCCBs is only one of the means that would provide automatic disconnection of supply in the event of shock hazard. The use of RCCB is not considered, as a sole means of protection and it does not obviate the need to apply other protective measures. Some broad guidelines are provided in this Appendix on these issues.

2.0 Residual Current Operated Circuit Breaker(RCCB)

In general, every circuit is provided with a means of over current protection. If the earth fault loop impedance is low enough to cause these devices to operate with in the specified times, such devices can be relied upon to give the requisite automatic disconnection of supply. Where the earth fault loop impedance is too large,efforts are required to make it low enough. Guidelines are available in IS 3043 : 1987. When protection against indirect contact is decided to be provided by RCCB, IS732:1989 prescribe that the product of its rated residual current (ratedtripping current) in amperes and the earth loop impedance in ohms should not exceed the value50.

Fault voltage operated circuit breakers voltage operated ELCB are not preferred devices against shock protection.This Appendix covers only truly current-operated devices. These are of different types. The following are the two main types:

(a) Residual current devices not dependent on line voltage,and

(b) Residual current devices dependent on linevoltage.

3.0 Choice of RCCBs

Where RCCBs are required to be used for affording shock protection; there are several broad parameters that are required to be carefully chosen. These are described in the followingclauses.

Location

RCCB can be used as a protective measure to the entire installation, or part, or to an item of equipment.This is determined by the security of supply desired in

Certain parts of the same installation when RCCB operates.Where only one RCCB is being employed to protect the entire installation, it is necessary that it is located at the main distribution board, at the origin of the installation.

Type of RCCB

RCCBs are suitable in general for various applications. However, devices suitable for household applications are to be verified for additional requirements as given in this Appendix. RCCB that has its automatic opening intentionally delayed may be preferred under certain circumstances. Portable RCCBs may be necessary especially in situations where portable/mobile equipment pose a shock hazard against which other suitable means of protection are not available. Portable RCCBs are required to be tested (using the test button) each time they are used.

Rated Current

The IS restricts the rated current of the device to an order of magnitude of 125 A. Use of RCCB in circuits of higher rated currents is not envisaged for the time being.

Rated TrippingCurrent

(i) The preferred rated currents of RCCBs are10,30,100 and 300mA. RCCBs having minimum operating currents of 30mA are intended to give protection against 'indirect contact'. RCCB having minimum operating currents of 30mA and below are generally referred to as having'highsensitivity' and can give protection against 'direct contact' in case of failure of other protective measures. It is essential that an RCCB is not used as a sole means for protection against direct contact.

(ii) It is emphasized that the value of leakage current that can flow before the RCCB has operated can be higher than the rated tripping current, theactual value being determined by the impedance of the circuit on which the fault occurs. The rated tripping current is a value assigned by the manufacturer at which the RCCB opens under specified conditions. While the speed of operation will not be significantly affected by the value of leakage current, RCCB can open at any value between 50 to100 percent of the rated tripping current.

(iii) The RCCB should be so chosen as to have the lowest suitable tripping current. Lower the tripping current, the greater is the degree of protection afforded.Nevertheless,it would introduce the possibility of nuisance tripping and may also become unnecessarily expensive. The minimum operating current will, therefore, have to be above any standing leakage that may be unavoidable in the installation.

Discrimination

When more than one RCCB is required to be used by grading the sensitivities, it is possible to achieve discrimination amongst RCCB in the same circuit. Discrimination may also be achieved by selectively employing devices having their tripping times intentionally delayed.

Type of System Earthing

The choice of right sensitivity of RCCB would also be determined by the type of earthing system adopted in the installation. The vectoral sum of leakage currents of equipment supplied by an installation or part of an installation by an RCCB shall be less than one half of the rated residual operating current of the device and it may be necessary to sub-divide the earthing arrangement for this reason. Reference is also invited to IS3043:1987“ Code ofpractice for earthing”,which gives guidelines on the use of RCCB for different types of system earthing.

Breaking Capacity

(i) When using RCCBs, it is necessary to assess the prospective current value in the location where it is likely to be installed and ensure that where higher withstanding or breaking capacities are desirable,suitable back-up protection is available in the system. This could be by means of a fuse or another circuit breaker (MCB), which is in series with the RCCB. The over current/ short circuit protective device is then said to provide back-up protection for the RCCB. Alternately, RCCBs with integral over current/short circuit protection could beemployed.

(ii) In practice, the functions of RCCB and that of the over current/ short circuit protective device in series may tend to overlap and under certain conditions both may attempt to clear the fault. This may occur, for example, when a severe earth fault produces a current of similar magnitude to that under short circuit conditions, or when an earth fault and short circuit occur simultaneously. Another possible cause is the inherent out of balance in the primary windings of the balance transformer causing the RCCB to trip. Care is, therefore, necessary to be exercised in ensuring that RCCB is coordinated with over current devices.

Neutral Grounding or Failure

Use of RCCBs assumes adequate care in wiring and earthing design. Use of RCCB is not a sole means of affording shock protection. Attention should be given to bonding and choosing the right cross-sectional area of the conductors, specially the protective conductor. Different types of RCCBs in different circuits may react differently to the presence of a neutral to earth fault on the load side. Such a fault together with the earthing of the supply at the neutral point will constitute a shunt across the neutral winding on the RCCB transformer. Consequently a part of the neutral load current will be shunted away and this may result in the device tripping. On the other hand, the shunting may result in reduced sensitivity and prevent its tripping in general. Therefore, care should be taken to avoid neutral to ground fault when RCCBs are in use.In the event of the neutral failure on the supply side, the RCCB should either open automatically, or is of such a design that it remains functional.

4.0 Guidelines for Specific Occupancies orLocations

Household and Similar Installations

The rated tripping current of RCCBs for use in household and similar installation shall not exceed 30 mA. Use of devices with intentional time delay is not recommended.

Locations containing Bath Tub/Shower Basin and SwimmingPools

Where socket outlets and other appliances are to be protected by RCCB,the rated tripping current shall not exceed 30mA.

Where individual socket outlets are required to be protected by RCCB, the rated tripping current shall not exceed 30mA.

Industrial Installations

For industrial installations,use of RCCB would be dependent upon already available devices capable of offering protection against harmful earth leakages.For example, use of a separate RCCB may not be necessary for installations equipped with protective devices with inbuilt releases initiating trip signals due to harmful earth leakages. Similarly, individual or group of motors otherwise adequately protected need not be provided additional protection throughRCCBs.

DataProcessingInstallations/IndustrialControl/Telecommunication Equipment

Radio frequency interference suppression filters fitted to these equipments may produce high earth leakages. Failure of the protective earth connection may cause a dangerous touch voltage. Use of RCCBs under such circumstances should be carefully considered owing to their frequent tripping, besides capacitor charging currents at switching on shall have to be considered. Under such circumstances, where leakages exceed 10 mA, one of the three measures given below may be necessary:

(a) Use of high integrity protective earth circuits by robust or duplicate conductors,

(b) Earth continuity monitoring, or provision for automatic disconnection when earth continuity fails,or

(c) Use of double wound transformers to enable localization of path of leakage and minimize the possibility of breakages.

The presence of generating sets within an installation may change the conditions of application of RCCB.The contribution to the prospective short circuit current by the generating set should be taken into account.

Medical Establishment and Electrical Installations in Hazardous Locations

The use of RCCB and their selection in such installations has to be carefully considered. Reference is invited to SP 30:1985, “National Electrical Code”.

SECTION-VIII : SELECTION AND APPLICATION OF MINIATURE CIRCUIT BREAKERS (MCB)

Based on the tripping characteristics, MCBs are available in 'B' and 'C' curve to suit different types of applications.

'B' Curve: For protection of electric circuits with equipment that does not cause surge current (lighting and socket outlet circuits)

Short circuit release is set to 3 - 5 I_n

'C' Curve: For protection of electric circuits with equipment that cause surge current (inductive and motor circuits)

Short circuit release is set to 5 - 10 I_n

'D' Curve: For protection of electric circuits which cause high in rush current when they are switched ON, typically 15 times the normal running current (Transformers, Heavy Start Motors, 2 PoleMotors)

Short circuit release is set to 10 - 20 I_n

Miniature Circuit Breakers (MCBs) are to be used in final power distribution and branch circuits, as well as control circuits for effective protection against overload and short-circuit protection. These shall conform to latest Indian and / or International Standards,

IS : 8828-1996, IEC : 60898-1995

Miniature circuit breakers shall be quick make and break type for 240/415 V AC, 50 Hz application with magnetic thermal release for over current and short circuit protection.

The breaking capacity shall not be less than 10kA at 415V AC.

MCBs shall be C-curve type and DIN mounted.

The offered MCBs should be 'ISI' marked. 'ISI' marking on the MCB should be clearly displayed (printed) on the MCB. It should not be displayed by pasting stickers or printing. Name of the manufacturer shall also be printed clearly on body of MCB. Also make and brand shall be clearly identified on each MCB.

Technical Features

- **Isolation** : to ensure complete electrical Isolation of downstream circuit or equipment , when the MCB is switched OFF (to be marked on the MCB in symbolic form)
- **IP 20 Degree of Protection** : to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

- **Positive Contact Indication** : In accordance with IEC-60947-2, MCBs for this characteristic shall have positive contact indication, so that in the event of accidental contact welding during faults, MCB knob does not show OFF position. This is essential to prevent any serious accidents during maintenance.

- **Energy Limitation Class-3** : to ensure minimum let through energy in the event of a fault, for safety of downstream circuit equipment. (to be mentioned on the MCB as per standards)

- **Low Power Loss** : MCBs should have low power loss, in any case not more than prescribed limits of standards. Energy efficient MCBs having lesser power loss than prescribed in relevant standards will be preferred.

- **Line-Load Reversibility** : to allow line or load connections from top or bottom terminals without any risk of unsafe operation or protection performance of MCB.

- **Ease of Installation**: MCBs should have design to help easy & fast installation on DIN rail, with provision of dual position bistable clips for secured mounting.

- **Large Terminal Design** : MCBs to have minimum 25 sq.mm. terminals for ratings below 32A, and 35 sq.mm. for ratings of 32A and above, to ensure perfect termination of connections. Terminals of MCBs shall have captive screws.

- **Ease of Identification** : Basic technical parameters, rating, operating voltage, etc. shall be printed on front face of MCB for ease of identification.

- Mechanical Life shall be 20000 operations and Service life at rated load for In below 32A shall be 20000 and for In above 32A shall be 10000 operations.

SECTION-IX :UNINTERRUPTIBLE POWER SYSTEMS (UPS)

S.No.	Features	Specifications
1	Capacity	As per BOQ
2	Battery VDC	12V
	Input	
3	Voltage range	Single Phase input 230V (- 20% to + 20%)
4	Frequency range	50 Hz ± 10%
5	Supply	From Electrical Mains/DG set supply
	Output	
6	Voltage	230V + 1%
7	Frequency	50HZ +/- 0.1Hz
8	Overload Protection	105% Constant
9	Short circuit Protection	Fuse /MCB in mains mode and electronics protection in inverter mode
10	Output Wave form	Pure Sine Wave
11	Transfer time	< 5 msec
12	voltage THD	3% on linear load
13	Inverter efficiency	> 90%
14	Load PF	0.8 Lag
	Battery	
16	Digital Charger	02-10 A charging current
17	Battery type	Sealed Maintenance Free - SMF
18	Back-up time	20 Min.
19	Inbuilt Over Temperature Protection	Yes
20	Over Voltege Cut off device	Yes

21	Over charging protection	Yes
	Display /Indications and alarm	
22	LED indication	Mains ON, Inverter ON, Battery Low, Over load, Battery Charging, Inverter fault, BatteryMode,
	Physical Characteristics	
23	Audible Noise	<55 dB at 1 mtr distance
24	Temperature Range	0°C to 45°C
25	Relative Humidity	0-95% RH non-condensing
26	Enclosure	UPS will be installed in indoor with minimumIP20.
27	Safety Standards	IS 16242 (Part 1) : 2014 IEC 60240-1 : 2008

SECTION-X : 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

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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.

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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.

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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 CGEWHO. 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 CGEWHO 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, sh ...vided to facilitate of adequate strength feeding/drawing in of cables and to provide working space fo... Suitable m... covers with frame of proper design shall cover Manholes.

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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 sulpharic 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.

PERFORATED CABLE TRAYS

Standard Technical details of perforated cable tray shall be as follows:

S. No.	SIZE OF TRAY (Width)	THICKNESS & COLLAR (Height)
1.	150mm to 300mm width	1.6mm thick
2.	450mm to 750mm width	2mm thick

Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray.

a. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as pe ent of IS: 209-1992.

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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.

9. 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 CGEWHO'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 CGEWHO / CGEWHO representative.

10. 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 Cl[illegible] narked with "DANGER 1.1 kV CABLE" with 1 meter long GI angle iron grouting bracket including 1:[illegible]ement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by E[illegible]ly Compan[illegible]

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SECTION-XI :FIRE DETECTION AND ALARM SYSTEM (CONVENTIONAL)

1.1 INTRODUCTION :

Fire safety is very important consideration in building construction and maintenance. Now a days due to constraint of availability of land, construction of high rise buildings is coming up very fast hence fire safety measures have greater importance. Even buildings of lesser heights where fire protection measures are essential by virtue of type of occupancy and contents such as archival records, museums with rare art pieces, super computer, computer installations, libraries, auditoria, telephone exchanges etc. Even in normal office building fire risk is high due to a large quantity of papers, files furniture & curtains etc.

The aim of providing fire safety measures is to provide protection to life of occupants and property in the event of fire. The details of fire safety measures are provided in National Building Code 2016 and in Local Fire bylaws.

It is not sufficient to provide fire safety measures but more important is to take timely action by the personnel responsible for fire safety measures in the buildings. This would include locating the fire, evacuating the occupants quickly in organized manner, calling the fire brigade and in the meantime using the first hand fire fighting appliances to control the fire. Such personnel should have necessary training to perform the above activities. These activities should therefore be coordinated with the client department who is occupant of the building as they have to keep watch & ward & up keep of the premises. The security personnel should also be trained to take action in case of fire.

1.2 Role of Fire Alarm System:

Fire Alarm system is required to provide the following functions:

(i). Protection of life

(ii). Protection of property.

1.2.1 Protection of life:

Fire can kill by asphyxiation, poisoning, irradiation or burning. Smoke density, ambient temperature and/or carbon monoxide concentration beyond certain limits can endanger human life. Over-riding priority is to be given for detection of smoke due to the following factors:

(i) Main threat to life in fire emergency emanates from smoke and toxic fumes.

Smoke and lethal gases travel rapidly to areas far from fire due to strong convection currents.

(ii) Detectable quantity of smoke from a hostile fire precedes detectable heat level and development of lethal atmosphere.

(iv) Smoke brings down the visibility and may cause loss of visibility on escape routes. Where the visibility is low, say less than 10 meters, the inmates may feel reluctant to walk through smoke. In life safety installations, it is therefore essential to:

(i) Give primary attention to detect fire in the incipient stages and to protect escape routes.

(ii) Ensure operation of detectors on escape routes before visibility falls below 20 mts.

(iii) Ensure provision of pressurization system, smoke extraction system, smoke control etc. on escape routes wherever required as per National Building Code 2016.

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1.2.2 Protection of Property:

People may not always be present, mobile or alert in all parts of premises, housing property even during normal occupancy hours. Premises may remain unattended or unsupervised for long and short periods. When fire starts in such areas it gets time to grow to a stage where it cannot be easily extinguished. Installation of fire detectors enables early detection and extinction by reducing delay between ignition and start of fire fighting measures. As rapid and extensive loss of property is caused by flaming combustion. Detectors should be efficient in detecting flaming fire to keep losses to a minimum. It is important to minimize incidence of false alarms particularly when detectors are hooked to actuate means of automatic extinguishing. Automatic extinguishing should generally be initiated only on confirmation of two detecting signals to avoid possibility of false actuation:

1. Computer/ Electronic Data Processing (EDP) Centre/Electronic equipment which have a very high value should be protected by smoke detectors.
2. Archives, high value libraries, and museums with high value combustibles should be protected by combination of heat, flame, smoke detectors. The heat detectors should be used on the racks and cupboards and smoke detectors in open space on the ceiling, flame detectors may be used where height of the ceiling is more than 9 meters.
3. Flammable liquid in small quantities stored in confined spaces where ambient temperature is high or where chances of rapid heat built up exist (such as garage, repair shops, store areas. etc.), heat or flame detectors should be provided.

1.3 GENERAL

1.3.1 Scope:

These general specification cover the details of equipment to be supplied, inspected as may be necessary before dispatch, delivery at site, installation, testing, commissioning and handing over in working condition of Fire Alarm System and Automatic Fire Alarm System (called FAS and AFAS).

1.3.2 Related documents:

These technical specifications shall be read in conjunction with the standard conditions of contract with all correction slips as are relevant for commercial aspects, as well as schedules and drawings and requirements under these specifications. In the event of any discrepancy between these specifications and tender specifications the latter shall be followed and deemed to be having over-riding value.

1.3.3 Definition of terms:

The definitions of terms used in these general specifications are given in Appendix-II (Terminology).

1.4 System Engineering:

1.4.1 General

FAS/ AFAS installation comprises of trigger devices, automatic as well as manual indicating panels, sounders, power supply equipments including stand by battery unit, system wiring and mimic diagrams.

1.4.2 Scope of work:

The scope of FAS / AFAS installation work shall generally comprise the supply, installation, testing and commissioning of th g. The scope shall also include the engineering design of the system, using the t offered.

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(i) Trigger devices viz. automatic fire detector of the required types and/or manual call boxes.

(ii) Sounders of low intensity and high intensity types.

(iii) Control and indicating panels including repeater panels, if any.

(iv) Standby battery and charging unit.

(v) Mimic diagram (s)

(vi) P.A. System.

(vii) System wiring.

1.5 Conformity to Statutory Acts, Rules, Regulations, Standards & Safety Codes.

1.5.1 Indian Electricity Act and Rules :

All electrical works in connection with installation of FAS and AFAS shall be carried out in accordance with the provision of Indian Electricity Act, 2003 and the Indian. Electricity Rules 1956, both amended upto date.

1.5.2 CPWD Specification :

The electrical installation work shall conform to CPWD General Specifications for electrical works Part I (Internal) 2013 and Part-II (External) 1994, both amended upto date.

1.5.3 Indian Standards:

The system/components shall conform to relevant Indian Standards and National Building Code 2016 amended up to date.

1.5.4 International Standard:

Conformity to International Standards is required only in the case of imported fire detectors. The standards applicable shall be indicated by the tenderer in their offer.

1.5.5 Fire regulations:

The installation shall be carried out in conformity with the local Fire Regulations & Rules there under wherever they are in force and the provisions in local bye-laws, if any.

1.5.6 Safety Codes and Labour Regulations:

In respect of all labour employed directly or indirectly on the work, the successful tenderer (herein after called the contractor) at his own expense will arrange for the safety provisions to comply with the statutory regulations, B.I.S. recommendations and CPWD Codes. In case of default, the department shall be at a liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.

The contractor shall provide necessary barriers, warning signals and other safety measures to avoid any accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect.

Nothing in these specifications shall be construed to relieve the contractor of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with applicable Statutory Regulations and Safety Codes in force from the safety angle.

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1.6 Component performance:

All components of FAS /AFAS shall be new and suitable for the environment of installation at site. These shall be satisfactory in operation at voltage deviated by ±10 % from the nominal value.

1.7 Information and drawings to be supplied by the Department:

1.7.1 Schedule of work :

The schedule of work along with other relevant information, as per format in Appendix-I, shall be supplied with the tender papers along with the detailing of the equipment and materials required and the estimated quantum of work required to be executed.

1.7.2 Drawings :

All drawings specified and issued with the tender specifications are for the purpose of tendering only.

1.8 Works to be arranged by the Department:

Unless otherwise mentioned in the tender specifications, the following works shall be carried out by the Department.

(i) Electric Power Supply for testing and operation, single phase 230 V 50 Hz A. C. at the C&I Panel, alongwith main earth lead.

(ii) Frame-work in false ceiling if the low intensity sounder is to be recessed therein.

1.9 Works to be done by the Contractor:

In addition to supply, installation, testing and commissioning of all the equipments and materials as per the schedule of work, the following works shall be deemed to be included within the scope of work to be executed by the contractor, whether or not indicated in the schedule of work.

(i) Extension of the conduit ends upto the FAS / AFAS Equipments and loop earthling as required.

(ii) All minor building work such as cutting and making good the damages.

(iii) Necessary testing equipments.

(iv) Watch and ward of the equipments, materials and installation, till their handing over to the department duly installed and commissioned.

(v) Approval from the concerned fire authorities as may be required as per the local Fire Regulations and byelaws.

1.10 Inspection of site and collection of data:

The tenderer shall be deemed to have examined the tender documents, detailed specifications, data etc. and to have visited the site or ascertained all relevant details for offering suitable equipment and for the installation work.

1.10.1 Inspection and testing

(a) Initial inspection and testing

(i) Initial inspection of materials &equipments at manufacturer works may be done by the Engineer-in-Charge or his representative. For item/equipment requiring initial inspection at manufacturer works, the [illegible]r will intimate the date of testing of the equipments at the manufacturer's work[illegible] dispatch. [illegible]ntractor shall give sufficient advance notice regarding the date [illegible]ed for such [illegible] to the department representative(s) to facilitate his presence during testing. The [illegible]er-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. The cost of Engineer's visit to the manufacturer/ authorized dealer premises will be borne by the department.

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

(iii) The materials shall be dispatched to site of work by the contractor after getting duly inspected by Engineer-in-Charge or his authorized representative.

(b) Final Inspection & Testing

Final inspection & testing will be done by the Engineer-in-Charge or his representative as per details indicated in Appendix-IV & VI under "Installation, testing & commissioning".

The installation will be offered for inspection to local body (Chief Fire Officer), The contractor will extend all help including test facilities to the representative of Chief Fire Officer. In case contractor fails to make desired facilities available during inspection, the department reserves the right to provide the same at the risk & cost of the contractor. The observation of Chief Fire Officer which are a part of agreement shall be promptly attended by the contractor. The installation will be accepted by the department only after receiving clearance from Chief Fire Officer.

(c) Safety Measure:

All equipments shall incorporate suitable safety provisions to ensure safety of the operating personnel at all times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment.

1.11 Rates

(a) The rates quoted by the tenderer shall be firm and inclusive of all taxes, duties, levies and all charges for packing, forwarding, insurance, freight, delivery, installation, testing and commissioning etc. at site including temporary construction of storage, risks, over head charges, general liabilities/obligations and clearance from local bodies and State Fire Services, as applicable. However, the fee for these inspections shall be borne by the department.

(b) Storage and Custody of Material

Watch and ward of the stores and their safe custody shall be the responsibility of contractor till the final taking over of the installation by the department.

1.11.1 Information to be supplied by the tenderer:

The following schedules in the proforma given in Appendix-I shall be submitted with the tender:-

(i)	Schedule of technical particulars	-	Schedule 'A'
(ii)	Schedule of addresses of manufacturers	-	Schedule 'B'
(iii)	Schedule of programme of work	-	Schedule - 'C'
(iv)	Schedule of departure from specifications	-	Schedule - 'D'

The tenderer shall furnish data and technical particulars, printed pamphlets, etc. for proper evaluation of their offers.

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1.12 Extent of Work:

The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation to the entire satisfaction of the Engineer-in-Charge. The term complete installation shall mean; not only major items of equipment covered by these specifications, but also incidental sundry components necessary for complete execution and satisfactory performance of the installation, with all labour charges, whether or not these have been mentioned in detail in the tender documents.

1.13 Completeness of tender:

All fittings, unit assemblies, accessories, hardware, foundation bolts, terminal blocks for connections, cable glands, miscellaneous materials and accessories necessary for efficient assembly and working of the equipment shall be deemed to have been included within the scope of work in the tender and within the overall details for complete items whether they have been specifically mentioned or not.

1.14 Certificate of compliance with or departure from specifications:

(a) The tenderers who wish to depart from the provisions in these specifications or system engineering or the detailed requirements in Appendix-I, should list out such departure in the proforma indicated in Schedule 'D' of Appendix-I supported with complete particulars, technical reasons for departure and standards and test certificates. They should, however, quote rates strictly in accordance with the schedule of work in the documents and indicate separately changes in the quoted price due to their proposed departure.

(b) The tenderer shall certify while submitting the offer that except the departure specifically mentioned by him, the work tendered by him shall comply in all respects with the tender specification. Unless this is done, the system shall be considered to comply in every respect with these specifications.

1.15 Drawings and manual to be furnished by the Contractor:

(a) The contractor shall submit in duplicate the following drawings within a fortnight of the award of work for approval by the department:

(i) Layout of detectors, manual call boxes and all other accessories.

(ii) Wiring diagram including connection topology for the complete system.

(iii) Circuit diagram of individual panels, P.A. system and detectors.

(iv) Constructional details of the various control and indicating panels and mimic diagram(s).

(b) Before commencement of the installation:

The above drawings, with observations of the Department duly incorporated, shall be submitted to the Engineer-in-Charge in triplicate along with any special instructions, with regard to handling, storage and installation.

(c) Documents to be furnished on completion of installation:

Three sets of the following documents shall be furnished to the department by the contractor on completion of work:-

(i) Completion drawings as per 1.16.

(ii) Manufacturer's technical catalogues of all equipments and accessories.

(iii) Operation and maintenance manual of all major equipments, detailing all adjustments, operation and maintenance procedures.

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(d) Before commencement of the installation:

The above drawings, with observations of the Department duly incorporated, shall be submitted to the Engineer-in-Charge in triplicate along with any special instructions, with regard to handling, storage and installation.

(e) Documents to be furnished on completion of installation:

Three sets of the following documents shall be furnished to the department by the contractor on completion of work:-

(i) Completion drawings as per 1.16.

(ii) Manufacturer's technical catalogues of all equipments and accessories.

(iii) Operation and maintenance manual of all major equipments, detailing all adjustments, operation and maintenance procedures.

1.16 Completion drawings:

Three sets of following laminated drawings shall be submitted by the contractor while handing over the installations to the Department. Out of this one of the sets shall be laminated on a hard base for display in the fire control room. In addition one soft copy shall also be furnished.

(a) Installation drawings giving complete details of all the components/items such as detectors, call boxes etc.

(b) Line diagram and layout of all electrical control panels and work station.

Control wiring drawings with all control components and sequence of operation to explain the operation of control circuits.

1.17 Coordination with other agencies:

The contractor shall coordinate and cooperate with other agencies by exchange of all technical information as required, like details of weight, over all dimensions clearance and other technical data required for successful and proper completion of his portion of the work in relation to the work of others without any reservation. No remuneration should be claimed from the Department for such technical cooperation. Care shall be taken not to damage any structure. If any unreasonable hindrance is caused to other agencies and any completed portion of the works has to be dismantled and redone for want of the cooperation and coordination by the contractor during the course of work, suchexpenditure incurred will be recovered from the contractor. If the restoration work is not carried out to the satisfaction of the Engineer-in-Charge the same shall be got done at his risk and cost.

1.18 Care of building:

Care shall be taken while handling and installing the equipment to avoid damage to the building. On completion of the installation, the contractor shall arrange to repair all damages to the building caused during installation so as to bring to the original condition.

1.19 Painting and protection:

Metal work of all equipment to be supplied (except the detectors) shall be given the final coat of paint over the primer after necessary treatment at the works before dispatch. All damages to painting during transport and installation shall be set right or repainted to the entire satisfaction of the Engineer-in-Charge before handing over.

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1.20 Guarantee:

The contractor shall guarantee the entire FAS/ AFAS installation as per specifications both for components and for system as a whole. All equipments shall be guaranteed for one year from the date of acceptance against unsatisfactory performance or break down due to defective design, manufacture and/or installation. The installation shall be covered by the condition that the whole installation or any part thereof found defective within one year from the date of taking over shall be replaced or repaired by the contractor free of charge to the entire satisfaction of 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 & cost of the contractor.

The warranty shall cover the following:-

(i) Quality strength and performance of materials used.

(ii) Safe mechanical and electrical stress on all parts under all specified conditions of operation.

(iii) Satisfactory operation during the maintenance period.

(iv) Performance figures and other particulars as specified by the tenderer under schedule of guaranteed technical particulars.

1.21 After sales service:

The contractor shall ensure adequate and prompt after sales services in the form of maintenance personnel and spares as and when required with a view to minimize the break down period. Particular attention shall be given to ensure that all spares are easily available during the normal life of the installation.

1.22 Security Deposit & Performance Guarantee:

As per CPWD Works Manual amended up to date.

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2.0 MANUAL CALL BOXES

2.1 Scope

This section covers the requirements of manual call boxes used in fire alarm system.

2.2 Constructional requirements:

(i) The call box shall be of 1.5mm thick welded sheet steel or 3mm thick cast aluminium. The front face shall have a glass area designed to break by a steady application of pressure or by impact. Suitable arrangement like scratching by a diamond bit shall be incorporated in the frangible element so that when it breaks upon application of pressure by a finger, it does not hurt the finger.

(ii) The frangible element shall keep a push button pressed inside such that in the event of breaking of the frangible element, the push button is released to actuate an alarm in the control panel. The push button shall be partly depressed so as not to hinder breaking of the frangible element.

(iii) The call box shall have suitable knock out for termination of a 20mm conduit. This shall also have suitable provision for being fixed on surface or semi recessed in wall.

(iv) Where sheet steel is used for call box, this shall be thoroughly cleaned off dust, dirt, grease and rust if any and two coats of anti rust primer shall be given both inside and outside followed by two coat of synthetic enamel paint in signal red colour or expoxy or powder coated after seven tank process.

(v) In the case cast aluminium body for a call box, the surface shall be neatly finished with red colour paint as in (iv) above.

(vi) The words 'FIRE' shall be printed on the front of the call box in face of window.

(vii) The glass surface shall be minimum 30 sqcm in area and glass thickness shall not exceed 2 mm.

2.3 Installation requirement:-

(i) Manual call boxes shall be installed at a height of l400mm above the floor level.

(ii) They shall be installed at easily accessible, well illuminated and conspicuous position, preferably in a contrasting background so that they are easily noticed from either direction. They should be semi-recessed so as to project minimum 10mm from wall surface.

(iii) They shall be installed free from obstructions and shall not themselves obstruct exit way.

(iv) It shall be located on escape routes at (inside or outside) each floor to escape stairs preferably near entry to staircases at various level.

(v) It shall be located such a way that, no person in the premises needs to travel more than 30 meters to reach a manual call point to give an alarm.

(vi) Where necessary, the travel distance may be reduced to less than 30 meters e.g. where there is difficulty in access or in potentially dangerous risk areas.

2.4 Functional requirement:

Once the glass is broken the alarm shall sound on the floor as well as on control panel.

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3.0 Automatic Fire Detectors

3.1 Scope:-

This-section covers the requirements of Automatic Fire Detectors of various types used in Automatic Fire Alarm System.

3.2 Choice of Fire Detectors :-

3.2.1 The Fire detectors are designed to detect one or more of following three characteristics of a fire:

(a) Smoke

(b) Heat

(c) Radiation (flame)

3.2.2 No one type of detector is suitable for all applications. It is often useful to use a combination of different types of detectors. Choice of selecting a detector depends on the following:

(i) The speed of response required.

(ii) Need to minimize false alarms

(iii) The nature of the fire hazard

(iv) Other factors such as cost, suitability for environment, maintenance requirement etc..

3.2.3 The detector has to discriminate between a fire and normal environment.

3.2.4 Each type of detector responds to a different kind of fire e.g. with a slowly smoldering fire involving smoke, a smoke detector operate first. A fire that evolves heat rapidly with very less smoke operates heat detector first.

3.3 Types of Detectors:

The detectors shall be one or more of following types:

(A) Heat Detectors:

(i) Fixed Temperature

(ii) Rate of Rise-Cum-fixed temperature Detectors

(iii) Probe type high temperature Bi-Metal Heat Detector

(iv) Linear Heat Sensing Cables

(B) Smoke Detectors:

(i) Ionization typeOptical type

(ii) Air Sampling type (Laser type Detector or high sensitivity detector)

(iii) Multi-criteria Type

(iv) Photo-thermal Type

(v) Beam Detector

(vi) Carbon Monoxide

(C) Spark / Ember Detector

(D) Ultra Violet (UV) Flame Detector

(E) Infra Red (IR) Flame Detector

(F) Thermal Multi-Criteria Detector

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3.4 Governing Specifications:

(i) Heat Detectors shall conform to IS-2175 - 1988 or BS-5445 (EN 54) Part 5 – 1977(VdS/LPCB approved) or NFPA72 (UL/ULC/FM approved) amended upto date.

(ii) Smoke Detectors shall conform to IS-11360-1985 or BS 5446 Part I-1977 & Part VII – 1985 (VdS/LPCB approved) or NFPA72 (UL/ULC/FM approved) amended upto date.

(iii) For other detectors/devices relevant IS or BS (EN 54) (VdS/LPCB approved) or NFPA 72 (UL/ULC/FM approved) amended upto date

3.5 Detectors & Applications:

3.5.1 Fixed Temperature Heat Detector:

The fixed temperature heat detectors are designed to operate when the temperature of detectors exceeds a predetermined value.

Application : Used where the ambient temperature is likely to fluctuate rapidly overshort period e.g. in kitchen, boiler room, D.G. Set room, Non AC. area in building.

3.5.2 Rate of rise-cum-fixed temperature detectors:

These detectors are designed to operate within a given time.

- When the rate of temperature rise at the detector exceeds a predetermined value regardless of the actual temperature.
- When temperature at detector exceeds a predetermined value

Application -

In areas subject to smoke, dust and dirt during normal use, where smoke detectors cannot used.

3.5.3 Probe type High Temperature Bi-Metal Heat Detector:

The detector are reset type and highly suitable to use above 80°C where electronic components cannot be used.
Application: Generator Enclosure, turbine enclosures, oven and furnace area etc.

3.5.4 Linear Heat Sensing Cables:

These can be broadly divided into two categories; digital and analogue, depending upon the principle by which the sensing cable registers a change in temperature.

Digital sensor consists of two core cable in which the conductors are separated by a heat sensitive insulator. When a specified temperature is reached, the cable insulation breaks down and an alarm is activated.

In analogue sensor, cores are separated by a negative temperature co-efficient polymer whose resistance reduces in proportion to temperature increase.

Applications: These cables are used for detecting fire and overheating in followingareas:

(i) Cable tunnels, trays and vaults

(ii) Material conveyors

(iii) Bulk storage mull - racked areas

(iv) Rim seals of floating roof tanks storing hazardous chemicals.

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3.5.5 Ionization smoke Detector

Good for invisible smoke detection. Due to use of radioactive element present in it, the disposal is a great problem and can cause serious health hazard, hence now slowly becoming obsolete, use of this detector may be avoided.

3.5.6 Optical Smoke Detectors

The optical smoke detector is based on Light Scattering principle. The LED (Light Emitting Diode) transmits light to the measuring chamber where it is absorbed. In case of fire, smoke enters the measuring chamber and the smoke particle scatter the light. The amount of light reaching to photo diode is converted into a proportional electrical signal. On operation of detector when the electrical signal reaches a predetermined threshold value it triggers the alarm on control panel.

Use: More suitable for smoldering fire which produces mainly larger particle ofsmoke e.g. burning of PVC, in A.C. area in a building.

3.5.7 Air sampling type detector (High sensitivity smoke detector)

Laser type smoke detectors are used in this type of system. Detector consists of a piping or tubing distribution network that runs from the detector to the areas to be protected. An aspiration fan in the detector housing draws air from the protected area back to the detector through air sampling ports, piping or tubing. At the detector, the air is analyzed for the products by the laser based smoke detector.

Use : Typical application of the system is in places where trace of smoke needs to bedetected and high airflow can make traditional smoke detector inadequate.

3.5.8 Spark / Ember Detector

This detector uses a solid state photodiode or photo transistor to sense the radiant energy emitted by embers typically between 0.5 microns and 2.0 microns in normally dark environments.

These detectors can be made extremely sensitive (microwatts) and their response times can be made very short (microseconds).

Applications :

The detectors are primarily installed to detect sparks and embers that could, if allowed to continue to burn, can cause a much larger fire or explosion.

The detector is mounted on some form of duct or conveyor, monitoring the fuel as it passes by. It is necessary to enclose the portion of the conveyor where the detectors are located, as these devices generally require a dark environment.

3.5.9 Ultra-Violet (UV) Flame Detector:

It makes use of ultra violet sensitive photocathode for detecting flame. It has very high sensitivity and low false alarm rate and is suitable for indoor application.

The detector is not suitable for high ceiling as the radiation from fire is attenuated by smoke. The random UV radiation from sources such as lighting, the Arc welding etc. can cause false alarms hence usage in such areas to be avoided.

3.5.10 Infra-red flame detector:

Almost all the materials that participate in the flaming combustion emit ultraviolet radiation to some degree during flaming combustion wl nly carbon containing fuels emit significant radiation at 4.35 micron (Carbon dio d used by many detectors to detect a flame. This detector senses wave length in the spectrum

Application:

(i) High-ceiling, open-spaced buildings such as ware-houses and aircraft hangers

(ii) Outdoor or semi outdoor areas where winds or draughts can prevent smoke from reaching a heat or smoke detector.

(iii) Where rapidly developing flaming fire can occur such as in petrochemical production areas, storage areas, natural gas installations, paint shops or solvent areas.

Some of the extraneous sources of radiant emissions that have been identified as interfering with the stability of flame detectors include the following:

(a) Sun Light

(b) Lightning

(c) X-rays

(d) Gamma Rays

(e) Cosmic Rays

(f) Ultraviolet radiation from welding

(g) Electromagnetic interference

(h) Hot objects

(i) Artificial lighting

3.5.11 Photo - Thermal Multi-criteria detector

This detector combines optical smoke and heat detection and is capable of being used as a smoke and heat detector both. The multi criteria detector shall be able to discriminate between non-threatening deceptive phenomenon such as cigarette smoke and actual fire hazards. This avoids nuisance alarm.

Application: This is good for smoldering and fast flaming fires, optically dense smokeand can be used in buildings for AC and Non-AC area.

4.0 CONTROL AND INDICATING PANELS & PA SYSTEM

4.1 SCOPE:

This section covers the requirements of the various Control and indicating panels used in Fire Alarm System and Public Address System.

4.2 Type of control and indicating panels:

Following are the types of control indicating panels in a FAS/AFAS. These shall be provided as specified in the schedule of work.

(i) Main control and indicating panel (C & I Panel) including Public Address System.

(ii) Sector Panel.

(iii) Zonal Panel.

(iv) Repeater Panel.

4.3 Functional requirements:

4.3.1 General:

The trigger devices shall be connected to the respective zonal panels. Where the zoning design in any work provides of areas as sector and further sub-division as zones, the trigger devices shall be connected to the sector panels, since no zonal panel is required in such a case. The sector/zonal panels shall in turn be connected to the C&I Panel. The C&I panel shall provide necessary audio-visual alarm and actuate the sounders. This shall also initiate signals for any other operation specified in tender specification. Electric power supply to the entire FAS/ AFAS shall be fed through this panel.

4.3.2 C& I Panel including Public Address System

(i) All the sectors/zones connected to this panel shall be continuously monitored.

(ii) Audio-visual alarm shall be provided in this panel to show the ZONE affected by fault in its wiring system or by fire. Such an alarm should be separate for fault and fire conditions. (See also 4.4.2)

(iii) This shall be complete with necessary circuitry for providing power supply to the entire FAS/AFAS drawing power from the mains/standby battery.

(iv) This shall transmit to its repeater panel if any, signal of alarm of fault and of fire.

(v) This shall be so designed that the audio alarm activation and silencing shall be as indicated in Section-5 (Part-A).

(vi) Public Address System shall be provided to enable transmission of announcements and instructions to the occupants in each zone in the event of a fire.

(vii) Fire alarm sounders in the premises shall be designed to function as loud speakers for the purpose. The microphone, necessary amplification equipment and control switches shall be provided as a part of the C&I panel.

(viii) The power rating and frequency response shall be as per the requirement of the individual installation.

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CONNAUGHT PLACE
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4.3.3 Sector/zonal Panel:

(i) A sector panel shall be provided where there is more than one zone in a floor under the control of a C&I panel, and zonal panel is not required in that floor. A zonal panel shall be provided where there is only one zone in that floor.

(ii) The sector/Zonal panel shall provide visual indication of the ZONE where a fault or fire has occurred. (See also 4.4.3) Audio alarm in this panel shall be provided, where specified in tender specifications.

(iii) This panels shall transmit to the C&I panel, alarm signals from any of the trigger devices and the wiring connected to it.

4.3.4 Spot Indicator:

This shall provide only a visual indication whenever any of the detectors connected to it triggers a fire alarm.

4.3.5 Repeater panel:

A repeater panel where provided shall duplicate the alarm indications (audio as well as visual) of the C&I Panel.

4.4 Constructional requirements:

4.4.1 General design & fabrication:

(i) The various control and indicating panels shall be totally enclosed, dust and vermin proof and shall be suitable for the environmental conditions at the site of their installation.

(ii) These shall be fabricated out of sheet steel of 1.6mm thickness and designed for wall or floor mounting. They shall be front openable type with hinged cover and lock.

(iii) The C & I Panel shall be designed such that the equipment for power supply, battery charging and P.A system for FAS/AFAS are housed in independent compartments. Maintenance free batteries shall however not be accommodated inside the panel to avoid problems due to corrosion.

(iv) Suitable knock outs shall be provided for the entry of cables and wiring into the panels.

(v) The panels after fabrication shall be cleaned to remove any dust/dirt/grease/rust and phosphated. After two coats of anti-rust primer, the panels shall be finished with powder coating of fire red colour.

(vi) All components and their wiring shall be arranged so as to be conveniently attended to from the front of the panels.

(vii) All indicating lamps, control switches and buttons and fuses shall be located in the front of the panels. These shall be suitable and unambiguously labeled.

(viii) The indicating lamps should consist of LED confirming to relevant Indian standards, connected in parallel, of following colours:

(a) Red to indicate FIRE condition - Two LED

(b) Amber to indicate FAULT condition - only one LED i.e. for open & short circuit separately.

(c) Green to indicate HEALTHY condition.

(ix) Test buttons to test the indicating lamps shall be provided.

(x) All control and indicating panels can be of either electro-mechanical type or of electronic type.

(xi) Any printed circuit boards (PCBs) used in the panels shall be plug in type. The PCBs shall be suitably protected against atmospheric corrosion.

(xii) If required, the panel should have additional capacity to operate auxiliary equipment like fire dampers, fire closers, ventilation and/or pressurizing fans, smoke exhaust fans etc.

4.4.2 C & I Panels.

(i) Audio-visual indication shall be provided in this panel for the following:

(a) Fire in any zone

(b) Fault in any zone including fault in wiring to the sector/zonal panels and removal of any fire detector/disconnection of leads to detectors.

(c) Fault in this panel itself.

(d) Mains supply failure.

(e) Low battery voltage.

(f) A.C. Fuse blowout.

(g) D.C. fuse blow out.

(ii) Only visual indication shall be provided in this panel for the following:

(a) A.C. Power ON/OFF.

(b) Stand by battery supply ON/OFF.

(c) Battery charger ON/OFF.

(d) Isolation of zone for testing purposes as per (iii) below.

(e) Operation if silencing switch, when there is no alarm condition.

(f) P.A. system ON.

(iii) Facility shall be provided to test the zones individually by simulating fault or fire condition. Each zone shall be capable of isolation for maintenance or test purposes leaving the remaining zones in healthy condition so that fire detection in those zones is not affected. Visual indication of such isolation shall be available on the panel.

(iv) This panel shall also be provided with the following:

(a) Necessary test switches for testing of circuits and C&I panel.

(b) Panel sounder and silencing switch.

(c) Switches to operate the fire alarm sounders zone wise and also collectively at all zones.

(d) Changeover switch to P.A. System.

(e) P.A. System equipment and panel microphone.

(f) Voltmeters with protective fuses for both A.C. and D.C. Supplies.

(g) Battery charger ammeter.

(v) On clearance of a fault or a fire condition, as the case may be the system shall reset automatically.

(vi) Where specified, the following provisions shall be incorporated in the design of the C&I panel:

(a) Provision for automatic connection to Fire Brigade through external public telephone lines.

(b) Provision for operation in conjunction with other Gas based Suppression System.

4.4.3 Sector/Zonal Panel:

(i) This panel shall provide visual indication for the following:

(a) System ON and healthy.

(b) Fault in any zone connected to this panel.

(c) Fire in any zone connected to this panel with double lamp arrangement.

(d) Isolation of a zone for testing purposes from C&I panel.

(ii) Test switch shall be provided to test the lamps on this panel.

(iii) Where audio alarm is specified in tender specifications in any work in this panel, panel sounder and its silencing switch shall be provided.

(iv) The power supply to operate this panel shall be drawn from the C&I panel.

4.4.4 Spot indicator:

(i) The indication given out by these indicators shall be conspicuous under fire conditions. In case of recessed type, the design shall be such that the indicators are spotted easily.

(ii) The cover of the spot indicators may be screwed type or snap-in-type.

4.4.5 Repeater Panel:

(i) All indications, both visual and audio as shown on the C&I panel shall be indicated in the repeater panel, where provided.

(ii) The power supply to operate the repeater panel shall be drawn from the C&I panel.

4.5 Installation requirements:

4.5.1 Location:

(i) No control and indicating panel shall be located outside the building room in severe environmental conditions, unless precaution against the effects of the same have been taken.

(ii) These panels shall not be provided inside any enclosed space and preferably be located somewhere on the ground floor / in fire control room.

(iii) The C&I panel shall be conspicuously located so as to be visible without effort on entering a building.

(iv) The sector/zonal panel shall be located in a conspicuous location at the entrance to a sector/zone, such as a lift lobby or a staircase lobby. This panel shall be in a common lobby or a corridor, which can be approached without passing through an occupied area.

(v) The repeater panel should be provided near the main entrance so that maintenance staff notices the fault condition or isolation if any for rectification.

4.5.2 Installation of control and indicating panels:

(i) The control and indicating panels shall be installed at the locations decided in conformity with 4.5.1 above and shown in the drawings approved by the department. Mimic diagram shall be installed by the side of the C&I panel so as to be integral part of the same.

(ii) Depending on the size and design of these panels, they may be either wall mounting or floor mounting type. Installation shall be done using necessary foundation bolts etc.

(iii) Any supports required for large panels shall be of sufficient strength so that installation is rigid and sturdy.

(iv) Necessary provisions shall be made for conveniently receiving conduits or cables as the case may be.

(v) The panels shall be so installed that all the indicator lamps are easily visible and the switches in the panels are within easy reach for operation.

(vi) A free working space of at least 1 meter shall be available in front of the panels.

4.5.3 Installation of spot indicators:

(i) Spot indicators shall be installed on wall such that its top is at door level and by the side of the entrance to the respective premises.

(ii) Spot indicators for detectors installed over a false ceiling in a corridor shall be installed directly under the false ceiling.

(iii) Spot indicators for detectors installed under a false floor, shall be installed at a height of 1 meter above false floor level. Additionally, a marking or an arrow pointing downwards shall be made by the side of the spot indicator.

(iv) The installation shall be such that the visual indication from the spot indicators are conspicuous and that the affected area is spotted without difficulty.

4.5.4 Silencing of Fire Alarm:

The alarm should operate until silenced manually. The alarm should not be silenced automatically.

5.0 SOUNDERS AND SILENCING SWITCHES

5.1 SCOPE

This section covers the requirements of sounders and silencing switches used in fire Alarm System/Automatic Fire Alarm System.

5.2 Type of Sounders:

Sounders in a FAS/AFAS shall be of the following types:

(i) Panel sounders.

(ii) Fire alarm sounders. These in turn comprise of low intensity and high intensity Sounders. These shall be provided as specified in the schedule of work. The sounders for fire alarm should be electronic hooters/horns/electric bell.

5.3 Functional requirements:

(i) Panel sounder shall be provided in C&I Panels, sector/zonal panel specified and repeater panel if any so as to draw attention of the care taking personnel in a building to a fault in the FAS/AFAS wiring and a fire condition in the protected premises.

(ii) Fire alarm sounder of low intensity type shall be installed to signal to the occupants of the building to evacuate in the event of a fire.

(iii) Fire alarm sounders of high intensity type shall be installed to draw the attention of the fire fighting personnel toward the main entrance of the premises where a fire has erupted.

(iv) Fire alarm sounders shall not be used for any purpose other than for fire operations.

(v) Silencing facility shall be provided, only for panel sounders and not for fire alarm sounders.

5.4 Operation of sounders and silencing:

(i) (a) Panel sounders shall be actuated from the respective panels except in repeater panel, in which this shall be actuated from the C&I Panels.

(b)Fire alarm sounders shall be actuated from the C&I Panel.

(c) The operation of sounders shall be independent of operation of any indication like lamps or flags in the panels.

(ii) The panel sounders in the respective panels shall be actuated automatically as soon as fire alarm signal is initiated from any trigger device connected to them. These shall be sounded when there is a fault alarm signal within their areas of control.

(iii) A silencing switch shall be provided in C&I Panel. Operation of this switch shall mute the audio output from the panel sounder in this panel and in its repeater panel, if any. Silencing switch shall also be provided in repeater panel which when actuated shall mute the audio output in the panel only. Silencing switch shall be provided in sector/zonal panels which may be specified to have audio indication in particular works, to mute the output of the same.

(iv) Fire alarm sounders in a zone affected by a fire shall be actuated automatically as soon as fire alarm signal in initiated from any trigger device in that zone. All other fire alarm sounders shall be actuated only manually from the C&I Panel, individual zone-wise and collectively for the entire installation. (Automatic operation of all the sounders in a building immediately after a fire alarm signal is initiated is likely to create panic). Such a manual operation of Fire alarm sounders be done after operating the silencing switch for the sounder in the C&I Panel, within a preset time.

5.5 Specification requirements:

5.5.1 Sounders:

(i) Hooter shall be provided for both panel sounders and fire alarm sounders. Bell may be provided as low intensity fire alarm sounders, only where so specified.

(ii) The frequency of sound from sounders shall lie in the 500-1000 Hz band. The sound level shall be at least 65dB(A)or 5 dB (A) above any other noise likely persists for a period longer than 30 second at any part of the building. Sounders with a level greater than 120 DB(A) shall not be provided.

(iii) The sound shall be continuous although the frequencies and amplitude may vary and of the same characteristics from the fire alarm sounders in a building. Coded fire alarm signaling from sounders shall not be provided which may cause hearing damage.

(iv) 'Fault alarm' and 'Fire alarm' in a panel sounder shall be distinctly different.

5.6 Silencing switches:

(i) Silencing switch shall be in the form of a switch or push button.

(ii) This shall be located on the panel whose panel sounder is to be silenced.

(iii) Operation of a silencing switch shall not affect any visual indication nor the output of fire alarm sounders in the building.

(iv) Operation of a silencing switch shall not prevent the receipt of alarm from any sector/zone as the case may be, not already in an alarm condition.

5.7 Installation requirements:

(i) Low intensity fire alarm sounders may be installed on surface of ceiling, suspended from ceiling or recessed in flush with the ceiling, depending on the construction of the sounder and ceiling height.

(ii) These shall be installed at a height not lower than 2.4m except when recessed in a false ceiling of lower height. In such cases the sounders shall be recessed at false ceiling level.

(iii) When installed flush with a false ceiling these shall match the ceiling surface. Necessary provisions for frame work to accommodate the sounders shall be made in the ceiling in advance.

(iv) High intensity sounders shall be mounted on substantial supports. Provisions for terminating the electrical wiring cables shall be such as not to permit entry of rain water through the wiring conduits or cable runs.

6.0 MIMIC DIAGRAM

6.1 SCOPE:

This section covers the requirements of mimic diagram to be provided as part of a Fire Alarm system/Automatic Fire Alarm System.

6.2 Mimic Diagram.

(i) A clear indication of the locations of all the ZONES shall be provided in mimic diagram.

(ii) Mimic diagram shall be provided near Main Control Panel and near repeater panels.

(iii) A topographical representation of the premises shall be provided in the mimic diagram for the purpose.

(iv) The construction shall be in a metal frame work wall mounted, with a facia of transparent acrylic sheet with lighted and labeled (or engraved) indications.

(v) The location shall be well lighted so that the mimic diagram is conveniently readable.

7.0 POWER SUPPLY EQUIPMENT AND WIRING

7.1 SCOPE:

This section covers the requirements of power supply equipment for the Fire Alarm System /Automatic Fire Alarm System and the wiring for the system.

7.2 Main Supply

Power supply at 230 V 50 Hz, A C. single phase shall be provided terminating directly into the incoming switch of the C & I panel. Earth wire shall be provided with the power supply. Rectification of the input AC supply into DC and further stabilization of the voltage as may be necessary shall from part of the FAS equipment.

7.3 Standby battery supply

7.3.1 Standby battery shall be provided with C&I Panel.

7.3.2 Battery supply shall be arranged to automatically feed the FAS/Automatic Fire Alarm System in the event of variation of input A.C. voltage beyond preset values on high and low sides.

7.3.3 The battery shall be sealed maintenance free lead acid type or any other rechargeable type. The nominal voltage shall be as suitable for the FAS/AFAS The capacity of the battery Shall be such that it should capable of maintaining the system in normal operation for a Period of not less than 24 Hours after failure of normal supply.

7.3.4 Installation

Battery shall be located in a well ventilated space close to the C & I Panel, so as to be conveniently maintained. This shall be installed in a non corrosive enclosure, such as of wood, PVC or steel coated with epoxy paint

7.4 Battery Charger

7.4.1 The battery shall be provided with a matching battery charger which shall form part of the C&I Panel. The battery shall be in continuous trickle/boost charge.

7.4.2 The charging rate shall be such that after re-charging for a period of 8 hours, the battery shall be capable of feeding load for the capacity specified in the schedule of work.

7.4.3 The charger shall be complete with necessary voltmeter, ammeter, indicating lamps, fuses, etc.

7.5 Wiring for FAS/AFAS

7.5.1 Circuit Design: The design of the System wiring shall match the manufacturer system design.

7.5.2 Wiring/Cables:

(i) The PVC insulated FRLS copper conductor cable having a minimum 1.5 mm^2 cross sectional area confirming to IS-694 to be used.

(ii) Armoured XLPE cables confirming to IS 7098 Part-1, 1988 with upto date amendments shall be used for connection with control panels & other areas wherever required.

(iii) Wiring shall be laid in metallic/rigid conduit.

(iv) Cables connected to detectors should be given 'S' loops on both the sides of the detectors which should be properly clamped to the ceiling. Loop should also be left, where wire/cables connect to sounders & all other accessories in the system. Appropriate glands should be provided where the cables enters the junctions box.

(v) Only 'red colour' wire should be used for laying in conduit.

(vi) No over head lines should be used to connect different building.

(vii) All the wires should be tagged for proper identification, should be identified by ferrules at junction & cable by colour bands at every 3 meters distance.

(viii) Multi-core cables and flexible cords shall not be used.

7.5.3 Installation requirement:

(i) The electrical work connected with a FAS/ AFAS shall be carried out in conformity with CPWD General Specification for electrical work Part-I (Internal) 2013 and Part-II (External) 1994 both amended up to date.

(ii) FAS/AFAS wiring shall be exclusive to the FAS/AFAS and be physically separated from wiring for any other service in the building.

(iii) To minimize possible disruption due to fire or other cause, fire alarm circuits should be separated as much as possible from each other. Where practicable, the different fire alarm circuits shall be run through different routes.

(iv) The metal body of all control and indicating panels shall be loop earthed using 2.5 sqmm copper wire and bonded to the earthing system in the building.

8.0 GENERAL

8.1 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 Labouratories, 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.

8.2 SCOPE:

A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

8.3 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.

8.4 DRAWINGS & TECHNICAL SUBMITTALS

8.4.1 General:

Two copies of all submittals shall be submitted to the Architect/CGEWHO 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.

8.4.2 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.

8.4.3 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.

8.4.4 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.

8.4.5 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.

8.5 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 five (5) year from the date of acceptance. The full cost of maintenance, labour and materials required to correct any defect during this five year period shall be included in the submittal bid.

8.6 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.

8.7 POST CONTRACT EXPANSIONS:

The contractor shall have the ability to provide parts and labour 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 labour 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 labour, and labour to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labour necessary to install this hardware.

Do not include cost of conduit or wire or the cost to install conduit or wire except for labour 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.

8.8 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 Labouratories 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.

8.9 APPROVALS:

The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters LabouratoriesInc**(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.

8.10 PRODUCTS

8.10.1 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.

8.10.2 CONDUIT AND WIRE:

Conduit:

Conduit shall be in accordance with The National Electrical Code (NEC), CPWD, 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.

SECTION-XII : CCTV SYSTEM

1. IP Dome Camera

2.	Image Sensor	:	1/3” 2MP Progressive CMOS
3.	Stream Resolution	:	1920x1080 @ 25 fps
4.	Type of Camera	:	WDR HD Dome Camera (Vandal Resistant)
5.	Video Resolution	:	1920x1080p
6.	Lens	:	3-12 mm Auto Varifocal motorized lens
7.	Shutter speed	:	Min 1/5 sec. or better
8.	Min. Illumination	:	0.1Lux/F1.2(Color) or better
9.	Video Compression	:	H.264/265, MJPEG resolution
10.	Audio Compression	:	G.711/AAC
11.	IR Range	:	30m or better
12.	True Day & Night	:	True ICR Day/Night
13.	Wide Dynamic Range	:	DWDR >75dB
14.	Storage/Memory Card Support	:	Yes, Min. 64 GB Micro SD SDHC/SDXC Slot
15.	ONVIF profile S compliance(Mandatory)	:	Yes
16.	Certifications	:	CE,FCC,EN/UL
17.	Power supply	:	DC 12V/PoE/AC 24V
18.	Security	:	Password Protection/ User Security Authentication

2. IP Bullet Camera

1.	Image Sensor	:	1/3” 2MP Progressive CMOS
2.	Stream Resolution	:	1920x1080 @ 25 fps
3.	Type of Camera	:	WDR HD Bullet Camera
4.	Video Resolution	:	1920x1080p
5.	Lens	:	3-12 mm Auto Varifocal motorized lens
6.	Shutter speed	:	Min 1/5 sec. or better
7.	Min. Illumination	:	0.1Lux/F1.2(Color) or better
8.	Video Compression	:	H.264/265, MJPEG resolution
9.	Audio Compression	:	G.711/AAC
10.	IR Range	:	50m or better
11.	True Day & Night	:	True ICR Day/Night
12.	Wide Dynamic Range	:	DWDR >75dB
13.	Storage/Memory Card Support	:	Yes, Min. 64 GB Micro SD SDHC/SDXC Slot
14.	ONVIF profile S compliance (Mandatory)	:	Yes
15.	Certifications	:	CE,FCC,EN/UL
16.	Power supply	:	DC 12V/PoE/AC 24V
17.	Security	:	Password Protection/ User Security Authentication

3. 32 Channel Network Video Recorder (NVR) Minimum Technical Spec.

Number of IP video ch	32 x 8MP		
Input Band	256Mbps (Str.1: 192Mbps / Str.2: 64Mbps)		
Output Band	256Mbps (5 remote users or more)		
Audio codec	G711A / G711U		
Resolution is recorded	8MP/6MP/5MP/4MP/3MP/1080p/720p/D1/CIF		
Compression	H.264/265		
Recording speed	Do 30 kl./sek.		
LIVE / PB Resolution	8MP/6MP/5MP/4MP/3MP/1080p/720p/D1/CIF		
Display	LIVE:	32 kan.	720p
		16 kan.	1080p (Full HD)
		8 kan.	4MP
		4 kan.	8MP (4K)
		16 kan.	1080p (Full HD)
	PLAYBACK:	8 kan.	4MP
		4 kan.	8MP (4K)
Resolution of the monitor	VGA - 1920 x 1080 / 1280 x 720 (60Hz)		
	HDMI1 - 1920 x 1080 / 1280 x 720 (60Hz)		
	HDMI2 - 3840 x 2160 (4K) / 1920 x 1080 (60Hz)		
HDD support	4 x SATA HDD (4 x 6TB), 1x eSATA		
Storage functions	HOT-SWAP + HDD Group		
Network interface	2 x RJ45 (Base-T 10/100/1000Mbps)		
Network protocols	RTP/RTCP, TCP/UDP, HTTP, DHCP, DNS, NTP		
USB ports	2 x USB 2.0 ; 1 x USB 3.0		
HDMI / VGA outputs	2 x HDMI; 1 x VGA (simultaneous operation)		
Audio I / O	1 x IN; 1 x OUT		
I / O alarm	16 x IN; 4 x OUT		
Other	Reset button, RS-485 interface		
Power	230V AC power supply, max 200W		
Operating temperature	-10° … +45°C		
Moisture max.	90%		

4. 40" Professional/Commercial Monitor

i)	HDMI/VGA Output	:	HDMI X 2, VGA X 1, Video IN X 1, USB X 1, Audio IN X1, Audio Out X 1, SPDIFX 1, RS232C x 1
ii)	Monitor Size	:	40 inch
iii)	Speaker Wattage	:	16W in-built
iv)	LED Display	:	IPS LED Display

SECTION-XIII : BOOM BARRIERS

1. Electromechanical Automatic Barrier

a. The actuator shall operate on 230V 50 Hz single phase AC power supply and shall consume not more than 300 W during any and all operation modes. The control panel shall operate on 230 V 50 Hz single-phase power supply and shall not consume more than 100 mA.

b. The opening time of the system shall not be more than 12 seconds for 6 mtr& above Boom length and not more than 4.5 seconds for 4.5 mtr. & below Boom length.

c. The aluminium bar shall be of hollow rectangular type **(Minimum size 100x70mm)** with reflective stickers. The length of the bar shall be as specified. It should be possible to have an articulated or fenced bar.

d. The system shall incorporate electric limit switches. These shall be housed within the actuator unit and shall be adjustable.

e. The ingress protection for the actuator shall be IP24 and the ingress protection for the control panel shall be IP54.

f. The system shall operate properly in environmental temperatures -5° C to +55° C.

g. The system shall have a quick release key for manual operation during power failure or emergency , fork rest to support during closed position.

h. The system shall be capable of being operated 600 times in 24 hours.

i. The system should be UL/CE approved and shall be manufactured by a reputed manufacturer who shall be certificated under the ISO 9001 series quality procedures.

2. Flap Barriers for pedestrians entry and exit

a. The Automatic Flap barrier shall have UL & CE Certifications.

b. The flap barriers shall be SS finish as approved.

c. The Flap barrier should incorporate photo beam detector for protection.

d. The flap barrier shall have the torque of 3Nm with the protection of IP 54.

e. The flap barrier shall have the opening time of 0.4 Sec with Built in Thermo Protection.

f. Operation through switch and access control reader.

3. READERS

i. Long-Range Reader

a. The card reader shall be a Long Range proximity card/ Prox-Linc WS tag reader.

b. The card reader shall read the encoded data from the access card and/or transponder and transmit the data back to the controller, giving an audible and visual indication of a properly read card.

c. The reader shall not be larger than 12.0" x 12.0" x 1.0".

d. The reader shall have a typical read range of 9 to 11 feet with 1.0A at 6.5V DC, 0.4A at 15V DC.

e. The reader shall be provided with an internal tamper switch that will indicate an alarm condition if an unauthorized attempt is made to disassemble the unit.

f. The card reader shall be sealed to a NEMA rating of 4X, and all internal electronics will have conformal coating to provide a high degree of environmental protection.

g. The reader shall be listed under UL 294 as an access control system accessory, and shall have the following certifications: Canada/UL 294, Canada/UL 1604 (Hazardous Location Model only) FCC, Canada Radio, EU and CB Scheme Electrical Safety, EU – R&TTE Directive, CE Mark, Australia C-Tick, New Zealand.

h. The reader shall have separate terminal control points for the green LED, the red LED, and the audible indicator.

i. The reader shall be fully weatherproof, and shall have an operating temperature of -5 to 55 degrees Celsius, and shall have an operating humidity of 5-95% non-condensing.

j. The reader shall be made from polycarbonate material, and shall be charcoal gray or as approved.

k. The reader shall transmit data at a 125 kHz frequency.

l. The reader shall communicate in a Wiegand protocol interface, and be compatible with all standard access control systems.

m. Reader shall be programmable read repetition rate for one shot or multiple reads prevent.

n. Reader shall utilizes passive tag technology.(Without battery)

o. Reader shall be of industry standard Wiegand and RS-232 data output.

p. Reader shall be compatible with the control module& software as specified.

q. The reader shall have automatic tuning capability to continuously optimize antenna tuning for environmental changes to provide consistent read range.

ii. Standard Card Readers with Wiegand Communications

The card readers with Wiegand Communications shall be provided with or without a keypad. The standard card reader must offer the following features:

a. UL 294, ULC, and CE Certified.
b. Low Power/Surface Mount Card Reader.
c. 600,000 pass read head.
d. Bi-directional card swipe.
e. Weatherized Finishes.
f. LEDs for access and card reader status.
g. Card and PIN data shares same output lines.
h. 12VDC or 5VDC Input Power.

iii. Proximity Cards

a. The access card shall have up to 84 programmable bits of Wiegand formatted information for universal compatibility with all Wiegand interface reader applications.

b. The access card shall be "Passive" (non-battery operated) proximity technology.

c. The access card shall have a permanent ink jet or laser engraved identification number printed onto it. The card numbering options shall be Sequential Matching i.e. The internal identification numbers and the external ink jet numbers shall both be sequential and shall match (i.e. internal numbers 1-100, external ink jet numbers 1-100).

d. The access card shall be slot punched on the short edge of the card for a vertical/ portrait oriented photo, shall be offered with multicolor custom graphics.

e. The access card shall have an operating temperature of -5 to 55 degrees Celsius, and shall have an operating relative humidity of 5-95% non-condensing.

f. The read range of the access card shall be extremely consistent, and not be affected by body shielding or variable environmental conditions

iv. Passive long range cards for the vehicles (wind-screen)

a. Cards shall have the read range of 9 feet to 11 feet when WS tag is attached by self-adhesive to the inside of the vehicle's windshield.
b. Cards shall be Passive proximity at 902-928 MHz Frequency-hopping limits interference and requires no FCC license.
c. Cards shall have Prox-Linc WS tags can be programmed with trillions of unique codes for the security.
d. Cards shall have no battery; capable of an infinite number of reads to assure years of maintenance-free operation.
e. Cards shall have Wiegand format up to 2K user-definable bits; field programming capabilities available.

SECTION-XIV : FTTH SYSTEM

A ACTIVE PART

GPON OLT and ONT

Special Conditions

1. All components shall be from the same OEM
2. The OEM shall be ISO 9001:2000 certified
3. The OEM shall be ISO 14001 accredited

Applicable Documents

The GPON system described in this specification is derived in part from the recommendations made in industry standard documents.

The proposed equipment solutions offered shall comply, but not limited to the following International Standards:

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1. ITU-T G.652: Characteristics of a single-mode optical fiber and cable.
2. ITU-T G.703: Physical/electrical characteristics of hierarchical digital interface.
3. ITU-T G.983.4: A broadband optical access system with increased service capability using dynamic bandwidth assignment.
4. ITU-T G.984.1: GPON General Characteristics.
5. ITU-T G.984.2: GPON Physical Media Dependent (PMD) layer specification.
6. ITU-T G.984.3: GPON Transmission convergence layer spécifications.
7. ITU-T G.984.4: GPON ONT management and control interface specification.
8. IEEE 802.1ad Provider Bridges.
9. IEEE 802.1ag Ethernet OAM.
10. IEEE 802.1D Spanning Tree Protocol.
11. IEEE 802.1p VLAN prioritization.
12. IEEE 802.1Q VLAN tagging.
13. IEEE 802.1w Rapid Spanning Tree Protocol of at least 8 ports, based on port-based, address-based, and round robin.
14. IEEE 802.3 10 Mbps Ethernet.
15. IEEE 802.3u 100 Mbps Fast Ethernet.
16. IEEE 802.3ad Ethernet Link Aggregation.
17. IEEE 802.3ae 10 Gigabit Ethernet.
18. IEEE 802.3z Gigabit Ethernet.
19. IEEE 802.3x Flow Control.
20. IETF RFC 2131: DHCP.
21. IETF RFC 2132: DHCP Options and BOOTP
22. IETF RFC 2236: Internet Group Management Protocol, Version 2.
23. IETF RFC 2933: Internet Group Management Protocol Management Information Base.
24. IETF RFC 3046: DHCP Relay Agent Info Option (Option 82).
25. IETF RFC 3376: Internet Group Management Protocol, Version 3.

Applicable Documents

A GPON system operates on a split fiber infrastructure. The purpose is to provide an ONT in single-dwelling units, such infrastructure is planned to transport Triple Play Services (Data, Voice, Video).

Optical Line Terminal (OLT)	
1.1	Management Module –uplink port available from controller card itself 2 * 1 GE SFP and 2 * 10 GE x FP based module. 2 * GE module can be used either as electrical or optical
1.2	PON Module – OLT chassis must be able to support GPON, Point to Point modules and with xDSL cards. The modules must be able to coexist in a single chassis.
1.3	The OLT must be able to support following standards:
1.53.1	ITU G.984 GPON – The current deployment will be based on GPON for residential subscriber and SMB requiring dedicated bandwidth up to 100 MB or more if it demands for future services like HDTV and 3DTV.
1.4	OLT Mandatory Requirements:
1.4.1	The OLT solution shall provide non-blocking bandwidth path downstream between the transport network and all PONs of the access network.
1.4.2	Chassis
1.4.2.1	Support modular structure where each module is hot-swappable and multiple FTTP technologies may be active in the same chassis. And must be 10 GPON ready for future Bandwidth requirement
1.4.2.1.1	Single Management Module
1.4.2.1.2	Dual Switch Modules supported from controller card itself
1.4.2.1.3	Chassis should support a maximum of 128 PON port.
1.4.2.2	The chassis must contain management interfaces and indicators and power inputs:
1.4.2.2.1	10/100BASE-T Network Management Interface

1.4.2.2.2	Serial Craft Interface – The serial craft interface on the chassis face-plate shall provide access to command line interface to manage the OLT.
1.4.2.2.3	Power A LED
1.4.2.2.15	Dual -48 VDC Power Supply Input or AC input
1.4.2.3	Cooling fans – cooling fans must be individually replaceable and hot-swappable. The fan tray shall have failure LEDs for each individual fan.
1.4.2.4	Backplane – the backplane of the OLT shall be non-blocking in nature, and backplane bandwidth must be in Terabit and the maximum power consumption of each PON port shall be less than 7W.
1.4.3	Management Module
1.4.3.1	The management module must support out-of-band Ethernet and in-band Ethernet.
1.4.3.2	Failure in the management module shall not be service effecting.
1.4.4	Switch Module
1.4.4.1	Dual switch modules are required per OLT chassis for redundancy and increased service network capacity and this shall be supported from the OLT controller card of OLT
1.4.4.2	Between the dual switch modules, at least two (2) 1 GigE uplink and at least two (2) 10 GigE uplink ports need to be supported from each controller card
1.4.4.3	The Gigabit Ethernet network interface connector need to be standard SFP (optical or electrical Small Form-factor Pluggable) based.
1.4.4.4	The switch module shall provide full support for IEEE 802.1q VLANs, VLAN stacking (Q-in-Q),
1.4.4.5	The switch module need to prioritize traffic based on Layer 2 (IEEE 802.1p).
1.4.4.6	The switch module need to support load sharing across modules using high-availability components, near-instantaneous fail-over capabilities, link aggregation (IEEE 802.3ad), and Layer 2 Spanning Tree protocols.
1.4.5	PON Modules
1.4.5.1	All PON must support up to 64 splits with Class B+ SFP and also support 128 splits with Class C+ SFP
1.4.5.2	All access ports need to be SFP based

1.4.5.3	GPON Module
1.4.5.3.1	The GPON ports must be ITU G.984 compliant supporting 1490 nm wavelength downstream and a 1310 nm wavelength upstream for the transmission of the IP optical services, and use a third 1550 nm downstream wavelength for the transmission of overlay video signals.
1.4.5.3.2	The PON port shall support 2488 Mbps downstream data rate and the upstream data rate is 1244 Mbps.
1.4.5.3.3	The GPON module needs to support dynamic bandwidth assignment, supporting both guaranteed and best effort bandwidth allocation.
1.4.5.3.4	The PON interfaces must support 128-bit encryption.
1.4.6	These modules provide connections to point-to-point ONTs and other customer premise Ethernet equipment such as routers and switches.
1.4.7	Each Pt – Pt module need to provide multitude of Gigabit Ethernet (IEEE 802.3z/802.3ah) point-to-point interfaces via optical or copper Small Form-factor Pluggable (SFP) components.
1.4.8	Each PON port needs to operate at wire rate regardless of packet size.
1.4.9	Any port on the module may be used as a mirror port for monitoring traffic on the module, as a network interface to deliver additional uplink capacity, or as a point-to-point link for customer equipment.
1.4.10	Resiliency requirements:
1.4.10.1	Redundant power feeds to OLT;
1.4.10.2	Redundant Switch module in the OLT (for chassis-based OLT);
1.4.10.3	Diverse fiber paths between the central office and OLT;
1.4.10.4	Resilient load-balanced service network interface connections using IEEE 802.3ad Ethernet Link Aggregation support;
1.4.10.5	Link diversity for service network interface connections using Multiple and Rapid Spanning Tree Protocols (IEEE 802.1s and IEEE 802.1w); and
1.4.10.6	OLT must support Link Aggregation Groups (LAGs) between each paired PE switch and OLT switch module. This is requirement for Tier 1 service providers providing service to business customers to provide both resiliency and for increasing the link speed beyond the limits of any one single interface.

1.4.10.7	PON protection to support a redundant OSP per ITU-T G.984.1, 14.2.1, Type B, as may be required for critical services such as cellular backhaul or critical subscribers requesting high-availability or area prone to fibre cuts.
1.5.1	The LD-OLT chassis shall support dual -48V DC power supplies or AC power supply
1.5.2	The LD-OLT shall not require external forced air within the cabinet. If fans are required within the chassis, these fans must be field replaceable and monitored
1.5.3	The Compact OLT may be deployed in a ring architecture connecting multiple devices in a single 1G or 10G Ethernet ring
1.5.4	The Compact OLT chassis shall be no more than 2 RU high and can be placed on table or third party 19” or ETSI standard rack
1.5.5	LD-OLT shall support up to 1024 ONT connections
1.5.6	The LD-OLT shall be network manageable
1.6	PON Protection
1.6.1	Both OLT shall provide automatic protection switching as described in G.984.1 Section 14 and Appendix III.
1.6.2	The OLT shall support a dual PON resiliency with a less than 50 millisecond recovery time.
1.6.3	The level of OLT resiliency shall be selectable between the following:
1.6.3.1	PON ports on the same interface module/card of an OLT
1.6.3.2	PON ports on distinct interface modules/card of an OLT
1.6.3.3	PON ports on interface modules of distinct OLTs
2	ONT Requirements
	ONT requirements are broken down into 3 categories: Single Dwelling Residential ONT, Multi Dwelling Residential ONT and Business ONT.
2.1	Generic ONT Requirements
2.1.1	**GPON ONT**
2.1.1.1	ONT need to be ITU G.984 GPON standards compliant, 32 T-CONTs, 1000 GEM ports
2.1.1.2	Each GPON ONT shall provide an interface to a 2488 Mbps downstream / 1244 Mbps upstream fiber optic link on its network side.
2.1.1.3	Depending on the model, a combination of standards-based Ethernet data ports (10/100/1000BASE-T), analog voice (POTS) ports.
2.1.1.4	ONT shall support the GPON data security strategy with authentication and 128-bit encryption

2.1.2	Broadband: 4096 VLANs, supporting QinQ and stacking VLANs, 4096 MAC Addresses, supporting VMAC, 802.1p, supporting PQ and WRR flow control and ACL
2.1.3	Leased Line Service: Native TDM Clock source recovery of the E1 port Loopback, blocking and unblocking of the E1 port
2.1.4	Multicast: IGMPv2/v3, IGMP proxy & IGMP snooping A maximum of configurable 1024 multicast programs in the system A maximum of 48 multicast users A maximum of 16 concurrent multicast programs for each user
2.1.5	Security: PPPoE+ and DHCP option82 Static and dynamic MAC address binding Anti-MAC and Anti-IP spoofing, source MAC Address & IP Address filtering Anti-DOS attack & firewall
2.1.6	Maintenance & Management: SNMPv1/v2/v3, Telnet & SSHv2 Remote & batch pre-deployment Remote upgrade and monitoring
2.1.7	Network Side Port: 2 x EPON, 2 x GPON
2.1.8	User Side Port: 4 x GE/FE (Electrical) + 4 x E1 ports
2.1.9	Operating Temperature: –40℃ to 45℃; startup at –25℃
2.1.10	Humidity: 5% to 95% (non-condensing)
2.1.11	Lighting protection capability: 6KV
2.1.12	Power Supply: AC: 220V/110V, DC:-48V
3.1.1	**EMS Server Configuration**
3.1.1.1	EMS server shall have the capability to manage at least 25K ONTs
3.1.1.2	EMS server shall support at least two clients

This section contains GPON line cards specs:

1. The GPON interface shall comply with ITU-T G.984.1/2/3/4/5/6 standards.
2. The GPON line card shall be hot-swappable and hot-inserted.
3. SFP module is preferred for GPON interface and the SFP shall be plug-in.
4. The proposed equipment shall support 1:128 splitter ratios in future with class C+ SFP.

5. The optical performance shall be complying with Class B+ standard with 28dB budget link loss. The Class C+ with 32dB is required.

6. The GPON line card shall have the function of DBA optimization, which can pre-evaluate the bandwidth of the GPON uplink.
7. The proposed equipment shall support ONU/ONT alarm report, port status inquiry, activation and deactivation, reset.
8. The proposed equipment shall support renew the AES key. The period shall be adjustable in minute level.
9. The proposed equipment shall be able to inspect the rogue (continuous lighting) ONT which radiates long time and have the capability to measure the optical power.
10. The GPON line card shall support shaping function based on ONU.
11. The proposed equipment shall support GPON type B and type C protection.

The proposed equipment solutions offered shall comply, but not limited to the following International Standards:

1) ITU-T G.652: Characteristics of a single-mode optical fiber and cable.
2) ITU-T G.703: Physical/electrical characteristics of hierarchical digital interface.
3) ITU-T G.983.4: A broadband optical access system with increased service capability using dynamic bandwidth assignment.
4) ITU-T G.984.1: GPON General Characteristics.
5) ITU-T G.984.2: GPON Physical Media Dependent (PMD) layer specification.
6) ITU-T G.984.3: GPON Transmission convergence layer spécifications.
7) ITU-T G.984.4: GPON ONT management and control interface specification.
8) IEEE 802.1ad Provider Bridges.
9) IEEE 802.1ag Ethernet OAM.
10) IEEE 802.1D Spanning Tree Protocol.
11) IEEE 802.1p VLAN prioritization.
12) IEEE 802.1Q VLAN tagging.
13) IEEE 802.1w Rapid Spanning Tree Protocol of at least 8 ports, based on port-based, address-based, and round robin.
14) IEEE 802.3 10 Mbps Ethernet.
15) IEEE 802.3u 100 Mbps Fast Ethernet.
16) IEEE 802.3ad Ethernet Link Aggregation.
17) IEEE 802.3ae 10 Gigabit Ethernet.
18) IEEE 802.3z Gigabit Ethernet.
19) IEEE 802.3x Flow Control.
20) IETF RFC 2131: DHCP.
21) IETF RFC 2132: DHCP Options and BOOTP
22) IETF RFC 2236: Internet Group Management Protocol, Version 2.
23) IETF RFC 2933: Internet Group Management Protocol Management Information Base.
24) IETF RFC 3046: DHCP Relay Agent Info Option (Option 82).
25) IETF RFC 3376: Internet Group Management Protocol, Version 3.

B. PASSIVE PART

Document - Technical Specifications for Unshielded Twisted Pair CAT6 Cabling System
Applicable Documents

The cabling system described in this specification is derived in part from the recommendations made in industry standard documents.The list of documents below (or the latest revisions) has bearing on the desired cabling infrastructure are incorporated into this specification by reference.

2. This Technical Specification and associated drawings
3. ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard – March 2001
4. ANSI/EIA/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces - February, 1998
5. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings - February, 1993
6. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications - August, 1994
7. ANSI/TIA-568-C.2 for Category 6 channel (Mandatory)

UNSHIELDED TWISTED PAIR CAT6 Cable	
Characteristic	**Min. Required Specification**
	Category 6 Unshielded Twisted Pair 4 pair 100Ω cable shall be compliant with ANSI/TIA-568-C.2 Additional Transmission Performance Specifications for 4-pair100Ω Category 6 Cabling.
	Category 6 UTP cables shall extend between the work area location and its associated telecommunications closet and consist of 4 pair, 23 AWG, UTP Non Plenum cable jacket.
	The 4 pair Unshielded Twisted Pair cable shall be ETL Verified to ANSI/TIA-568-C.2 Category 6.
Features	All Category 6 cables shall meet or exceed the following characteristics:
	Construction: 4 twisted pairs separated by internal X shaped, 4 channel, polymer spine /full separator. Half shall not be accepted.
	Conductor: Solid Copper
	Conductor Diameter: 1.045 ± 0.02mm
	Primary Insulation: Solid Polyethylene
	Jacket: LS0H (Low Smoke Zero Halogen)
Mechanical Characteristics	**Outer Diameter:** 6.1mm
	Max. Temperature: 75°C
	Tested Frequency: 250MHz as per Category 6 standard.
	Propagation Delay: 537.6@100MHz
	Delay Skew: 45ns Max
	Shipping Weight : 305m reel in a box 24kg
	Fire Propagation Test: UL 1581 VW1, IEC 60332.1

FACE PLATE	
Characteristic	**Min. Required Specification**
Features	Single / Dual Gang square plate, 86mmx86mm
	Write on labels in transparent plastic window – supplied with plate
	Screw hole covers – to be supplied with plate
	Plug in Icons – Icon tree – to be supplied with plate
	Should be able to support variety of jacks – UTP, STP, Fiber, Coax etc.

CAT6 DATA GATE RJ45 JACK	
Characteristic	**Min. Required Specification**
Features	Category 6, TIA/EIA 568C.2 – 250MHz
	All information outlets for 100 Ω, 22-24 AWG copper cable shall use insulationdisplacement connectors (IDC)
	Allow for a minimum of 200 re-terminations without signal degradation below standards compliance limits.
	Be constructed of high impact, flame-retardant thermoplastic with color and icon options for better visual identification.
	Shall have built in spring loaded shutter.
	Shall have Terminator cap
	IDC posts should be pointed
	Information outlet (RJ45 jack) should be covered under ETL Verification program for compliance with TIA/EIA 568B.C-2, ETL certificate to be submitted with offer. UL Listed
	568A/B configuration
Mechanical Characteristic:	**Plastic Housing:** Polycarbonate, UL94V-0 rated or equivalent
	Operating Life: Minimum 750 insertion cycles
	Contact Material: Copper alloy
	Contact Plating: 50 µ" gold over 100µ" nickel
	Plastic Housing: Polycarbonate, UL94V-0 rated or equivalent
	Operating Life: Minimum 200 Re-terminations
	IDC Contact Plating: Tin Plate (tin/lead)

24 PORT UNLOADED JACK PANEL	
Characteristic	**Min. Required Specification**
Features	Be made of cold rolled steel, in 24 port configurations. Each jack for the jack panel should have spring loaded shutter inside the jack for 100% dust free environment.

	Have port identification numbers on the front of the panel.
	Should have self-adhesive, clear label holders (transparent plastic window type) and white designation labels with the panel, with optional color labels / icons.
	Each port / jack on the panel should be individually removable on field from the panel.
	Should be certified by third Party like UL. Certificates to be submitted with bid.

CAT6 MOUNTING CORDS LSZH (1 Mtr and 2Mtr)	
Characteristic	**Min. Required Specification**
Features	Category 6 Equipment cords (Length – 1mtr & 2mtr.)
	The work area equipment cords shall, at a minimum comply with proposedANSI/TIA/EIA-568-C-2 Commercial Building Cabling Standards Transmission Performance Specifications for 4 pair 100Ω Category 6 Cabling.
	Category 6 modular equipment cords: Shall be round, and consist of eight insulated 24AWG, stranded copper conductors, arranged in four colour-coded twisted-pairs within a flame-retardant jacket.
	Equipped with modular 8-position modular plugs on both ends, wired straight through with standards compliant wiring.
	Should have 50 micro inches of gold plating over nickel contacts.
	Modular cords should include a moulded strain relief boot.
	Should be covered by ETL verification program for compliance with TIA 568B.C-2.Certificate to be submitted with bid.
	Approvals: ETL & UL
Mechanical Characteristic: Cable	**Conductor size:** 24 AWG stranded bare copper
	Max O.D.: 5.6mm (.22”)
	Jacket: LS0H Type
	Temperature range: -20 ˚C to +70 ˚C
Mechanical Characteristic: Plug	**Operating life:** Minimum 750 insertion cycles
	Contact Material: Copper alloy
	Contact plating: 50µ “Gold/100µ” Nickel
	Plug dimensions & tolerances compliant with FCC Part 68 and IEC 60603-7
Electrical Characteristics:- Plug	**Max voltage:** 150 VAC (max)
	Max current: 1.5A @ 25 ˚C
	Operating Temperature range: -20 ˚C to +70 ˚C

Single Mode Fibre Optic Cable	
Cable type	6 core, single mode, loose tube, CST armour, gel filled
Fibre type	9/ 125, Telcordia's GR-20 and ITU-T 652.D Compliance
Cable construction	BELLCORE GR 20 / IEC 794-1
Attenuation @ 1310 nm	< = 0.35 dB/Km
Attenuation @ 1550 nm	< = 0.20 dB/Km
Coating / Cladding non-circularity	<= 12 microns
Zero Dispersion Slope	<= 0.086 ps / sqnm-km
Max (chromatic) dispersion	<5.3 ps/nm-km @1270-1340 nm <3.5 ps/nm-km @1285-1330 nm <185 ps/nm-km @1550 nm
Tensile rating	1000N
Maximum Crush resistance	3000N
Operating Temperature	-40 Degree C to +70 Degree C
Armour	Corrugated steel tape armour
Colour	Black
Inner jacket	High density polyethylene
Outer jacket	High density polyethylene, anti - termite, anti - rodent suitable for direct burial application.
Secondary Buffer Material	Gel filled Loose Tube.
Min Bend	20 X Outer Diameter
Test (Must pass)	IEC794-1-E1 , IEC794-1-E2 , IEC794-1-E3 , IEC794-1-E4 , EIA-455-104 , IEC794-1-E7 , IEC794-1-E10 , IEC794-1-F1 , IEC794-1-F3 and IEC794-1-F5
Marking	Identification marking at regular intervals of 1 meter
Fibre Core	Fibre Core should be Silica Glass or equivalent.
Length of cable drum	standard factory length and can be supplied is max 4 Km
Approval	UL listed

Fibre Optic Patch Cord (LC/SC)	
Make and Type	SC to SC/LC Duplex Fibre Optic Patch Cord, 9/125 micron
Cable Sheath	LSZH
Cable Diameter	1.8 mm mini twin zip
Ferrule	Ceramic
Return Loss	> 45 db
Insertion Loss	.1 db Typical Max .3 db
Length	3/5/10/20/30 meters
ROHS	ROHS Compliant

Fibre Optic Pigtail (SC)	
Make and Type	SC Simplex Fibre Optic Pigtails, 9/125 micron
Cable Sheath	LSZH
Cable Diameter	1.8 mm simplex
Ferrule	Ceramic
Return Loss	> 45 db
Insertion Loss	.1 db Typical Max .3 db
Length	1/1.5 meters
ROHS	ROHS Compliant

Wall Mount Fibre Termination Box	
General Characteristics	The wall mount box must provide environmental and mechanical protection for fibre and interconnect components. This system must assist in the function of splicing and patching with neat fibreorganisation and reduce the risk of fibre disturbance during installation or re-entry.
Ease of Use	Easy detachable door for splicing and maintenance
Safety	Lock and key ensuring safety, avoiding unauthorised tempering
Identification	Color coded buffer tubes for easy identification
Cable Entry Protection	Rubber grommets at cable entry point for sealing. Grommets must be constructed of FR grade Nylon.
Housing	Complete Aluminium housing, fully powder coated.
Splice Tray	Fully cushioned splice holder containing grooves for fixing splice protection sleeves. Splice tray must be constructed of ABS.

Fibre LIU / Splicing Shelf		
Characteristic	**Min. Required Specification**	**Compliance**
FMS Fibre Management Shelf	19” rack mountable	
	The FMS fibre management shelf shall be suitable for high density front patching applications.	
	The FMS fibre management shelf shall be 1U, 19” rack mountable	
	The FMS fiber management shelf shall accommodate 24/48/96 Fiber terminations in 1U/2U rack space	
	The FMS fiber management shelf shall be supplied loaded with secondary coated LC pigtails	
	The FMS fiber management shelf shall have mounting brackets that can be placed in different positions	
	The FMS fiber management shelf shall provide easy access to splicing tray	
	The FMS fiber management shelf shall provide easy access to backside of connector	
	The FMS fiber management shelf shall provide labeling strip for adhesive labels and better cable management	
	The FMS fiber management shelf shall provide fiber guides, radius controls and secure tie downs	

Passive Optical Splitter		
Characteristic	**Min. Required Specification**	**Compliance**
Passive Optical Splitters	The passive optical splitters are branching components with more than 2 fiber ports. Splitters distribute the optical power among fibers in a predetermined way. The optical fiber splitters are used in central offices, customer premises or in outside plant applications. They will divide or combine the optical signals in the optical networks. This specification applies to single-mode, dual window and wavelength independent fiber optic splitters, manufactured by the planar waveguide technology (integrated optics).	
Fiber type	Single Mode	
	Low macro bend loss (ITU-T G.657A)	
	Zero water peak	
Mode field diameter at 1310	8.2 pm to 9.3 pm	
Mode field diameter at 1550	9.3 pm to 10.5 pm	
Cladding diameter **Cladding non-circularity**	125.0 µm ± 0.5 µm ≤0.7%	
Mode field eccentricity error	≤ 0.5 µm @ 1310 nm	
Cabled fiber cut off wavelength	≤ 1260 nm	
1625 nm bending loss performance	≤ 0.05 dB for 100 turns on 60 mm mandrel diameter ≤ 1.0 dB for 10 turns on 30 mm mandrel diameter	
PMD (fiber)	≤ 0.2 ps/√km	

Chromatic dispersion	≤ 3.5 ps/(nm.km) for 1290 nm up to 1330 nm	
	≤ 18 ps/(nm.km) at 1550 nm	
	≤ 22 ps/(nm.km) at 1625 nm	
Proof strain level	1%	
Attenuation at 1310 nm	≤0.35 dB/km @1310 nm	
Attenuation at 1383 nm	≤0.35 dB/km @1550 nm	
Splitter Mounting Unit	This shall be a 1U shelf or Wall mount metal frame which can hold at least 2 or 3 nos. of 2x4 and 2x8 splitter. It shall be protected inside a lockable door or drawer type unit moving on a railing which would assist in easy adds move / changes.	
2x4 Splitter	The splitters shall be enclosed in a rugged plastic housing and the leads shall be 2mm / 3mm. It shall be supplied with SCUPC connector on input and SCAPC connectors on outputs. It shall have an insertion loss within 4dB. The splitters shall be PLC type.	
2x8 / 2x16 / 2x32 Splitter	It shall be supplied in cassettes with 2mm / 3mm leads. It shall be compatible with the splitter cabinets. The splitter shall be PLC type and shall be terminated with SCAPC connectors.	
2x4 Splitter, Optical Specifications	▪ IL (dB) - 7.5 ▪ Uniformity (dB) - 1.3 ▪ Operating Wavelength (nm) - 1260-1360nm/1480-1580 nm ▪ PDL (dB) @ 1310 / 1550 - 0.3	
2x8 Splitter, Optical Specifications	▪ IL (dB) - 11 ▪ Uniformity (dB) - 1.6 ▪ Operating Wavelength (nm) - 1260-1360nm/1480-1580 nm ▪ PDL (dB) @ 1310 / 1550 - 0.3	

2x16 Splitter, Optical Specifications	▪ IL (dB) - 14.3 ▪ Uniformity (dB) - 1.6 ▪ Operating Wavelength (nm) - 1260-1360nm/1480-1580 nm ▪ PDL (dB) @ 1310 / 1550 - 0.4	
2x32 Splitter, Optical Specifications	▪ IL (dB) - 17.5 ▪ Uniformity (dB) - 2.3 ▪ Operating Wavelength (nm) - 1260-1360nm/1480-1580 nm ▪ PDL (dB) @ 1310 / 1550 - 0.4	

SECTION-XV : AVIATION LIGHT

'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.

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.

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 toughned clear borosilicate hard glass. LED's shall be able to withstand extreme temperature & humidity conditions and construction of dome shall be UV protected. Unit shall also be complete with a solid state flasher unit with adjustable flash rate.

The AOL shall be as per civil Aviation Ministry's guide lines for the site / area under consideration.

SPECIAL CONDITIONS FOR ELECTRICAL INSTALLATIONS

1. 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 by any ambiguity or inconsistency, the contractor should report the same to the CGEWHO/Architect/ Project Manager/ CGEWHO and obtain clarification before submitting the tender. Contractor to collect General Conditions of Contract and Schedule of Fiscal Aspects from the CGEWHO/ Architect/CGEWHO.

2. SCOPE OF WORK:

The work to be carried out under this contract comprises of internal 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. Mains and sub-mains between various distribution boards, cables, submain wiring, cable trays.

f. Distribution Boards, Panels& final DB's.

g. Earthing system.

h. Lighting Fixtures and Fans.

i. LV Works including Fire alarm system & Security systems.

j. UPS Works

k. Training of CGEWHO's staff/representative.

l. Preparation of "As Built Drawings & Documents".

3. STANDARD OF WORK:

The work shall be carried out to the satisfaction of the Architect/CGEWHO/Project Manager /CGEWHO 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.

4. 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

CGEWHO 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)

5. 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/ CGEWHO/ Project Manager/ CGEWHO, certificates of final inspection and approval by the Local Chief Electrical Inspectorate. All receipted amount shall however, be payable by the CGEWHO on production of proof of payment.

6. 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.

7. 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 CGEWHOs. 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.

8. 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 CGEWHO'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 earthingscheme 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/ CGEWHO / CGEWHO 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.

9. SHOP DRAWINGS & FINAL WORKING DRAWINGS:

The Contractor after studying the CGEWHO'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/ CGEWHO/ CGEWHO 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 CGEWHO's requirement. The contractor shall finally be responsible and accountable to CGEWHO 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/CGEWHO / CGEWHO.

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.

b) 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.

c) EARTHING LAYOUT

EarthingLayout of thecomplete 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.

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 to be Co-ordinating its drawings with other MEP Services & Site Plans before submitting to CGEWHOs/CGEWHO.

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.

10. PRODUCT SAMPLES

Samples of the materials like conduits, accessories, switches, Sockets, wires & cables, light fixtures etc. shall be submitted to the CGEWHOs/ CGEWHO prior to procurement. These will be submitted in two sets for approval and retention by CGEWHOs and shall be kept in their site office for reference and verification till the completion of the project.

11. 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.

12. TEST CERTIFICATES & TECHNICAL SUBMITTALS

Contractor shall submit to CGEWHOs/Project manager, test certificates & technical data sheets of all the items covered in the scope of work before supply of the item.

13. 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.

14. 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 CGEWHO/Architect/CGEWHO within 15 days of he 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 / CGEWHO/ CGEWHO.

15. 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 CGEWHO.

16. SAFETY OF MATERIALS:

The contractor shall provide proper and adequate storage facilities to protect all the materials and equipment, including those issued by the CGEWHO against damage from any cause whatsoever.

17. 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.

18. 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 CGEWHO/Architect/CGEWHO 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.

19. GUARANTEE:

At the close of the work and before issue of final certificate of virtual completion, the contractor shall furnish written guarantee indemnifying the CGEWHOs against defective materials and workmanship for a period of five year after testing & commissioning of the installation. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to CGEWHO 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.

20. 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 CGEWHO'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.

21. CONTACTOR'S CGEWHO& 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 CGEWHO / CGEWHO 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 CGEWHO/ CGEWHO.

22. CONTRACTOR'S LICENCE:

Contractor shall be in possession of a valid Electrical contractor's license (to be issued by state's chief electrical inspectorate) for carrying out electrical works of the nature specified in the scope of work and scope of works.

Contactor must furnish / submit a copy of the license to CGEWHO / CGEWHO before start of the work.

23. TESTS & TEST REPORTS

On completion of complete installation, contractor shall submit to CGEWHO 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. Contractor shall be responsible for the adequacy of the earthing system and shall consider the changes in the BOQ as may be required but with the approval of the CGEWHOs / CGEWHO / site in-charge before execution.

c. Checking all the terminations at panels, DB's and at lighting fixtures and socket outlets for tightness.

d. 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.

e. Contractor and its staff must follow good engineering practices.

g. A complete log of all the tests shall be maintained for review of CGEWHO / CGEWHO.

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.

m. Contractor shall assume full responsibility of safety of installation and shall be liable to CGEWHOs 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 CGEWHO for any deficiency and shortcomings in the system design/ product design.

24. 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.

25.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, sprinklers,smote/heat detectors etc 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 CGEWHO.

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 harmer effects and test pressure upto 15kg/ cm^2 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./cm^2 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 CGEWHO 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 CGEWHO. 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 CGEWHO.

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 width 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 Ipm 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 to be tested to 20kg/ cm^2 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 CGEWHO.

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/ CGEWHO/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 m^2 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 CGEWHO.

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**

21.10 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.

21.11 **SELECTION OF ORIFICE SIZE**
In moderate hazard application, sprinkler of orifice size 15 mm. shall be used.

21.12 **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.

21.13 **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^{o} 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 CGEWHO/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. /cm^2 at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 12 Kg. /cm^2 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 staring).

(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 CGEWHO 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/cm^2 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.

(d) 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 CGEWHO.

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. CGEWHO 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 CGEWHO.

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	:

Material of Construction

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	:

Material of Construction

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	:

Description of Engine

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	:

Size of Foundation

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	:

Material of Construction

Pump Casing	:
Impeller	:
Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
Mechanical Seal	:
Make of Mechanical Seal	:

Description of Motor

	Make	:
	Model No.	:
	Type	:
	Frame size	:
	Speed (RPM)	:
	Rated Capacity (Power)	:
	Full load current	:
	Enclosure	:
	Coupling / Pulley	:
	Size of Foundation 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 ofLocal 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 CGEWHO/Architect. Work will be executed only as per approved shop drawings.

1.5 Items in the tender document are approximate worked out on the tender drawing.Any change in items as per NBC 2016 shall be deemed to be included in the tender.

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.

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CONNAUGHT PLACE
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GAGAN GARG
CA-No.-98/26499

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 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.

1.11 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.

1.12 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.

1.13 CO-ORDINATION WITH OTHER AGENCIES

The contactor 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.

1.14 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 confirm 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.

1.15 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.

1.16 INSPECTION AND TESTING

1.16.1 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-Change 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.

1.17 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.

1.18 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.

1.19 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 there of 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.

1.20 **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 drawing .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 treys etc .

(h) Any other drawing relevant to the work.

2. Water Storage & Pump House

2.1 A static underground RCC water storage tank in 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 the tanks by the civil contractor.

2.1.1 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.

2.1.2 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 CGEWHO.

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 CGEWHO.

7. SHOP DRAWINGS

7.1 The Contractor shall submit two copies of Shop Drawings as an advance copy to the CGEWHO 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 CGEWHO.

7.2 The Contractor shall submit four copies catalogues, manufacturer's drawings, equipment characteristic data or performance charts as required by the CGEWHO.

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 CGEWHO. 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, gst, labourcess and 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 CGEWHO. 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 CGEWHO.

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 CGEWHO 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 CGEWHO.

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 CGEWHO.

15.3 Unless otherwise specified and expressly approved in writing by the CGEWHO, 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 CGEWHO 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 CGEWHO may, at his discretion get the damaged work repaired by other agencies and debit the cost of such repairs to the Contractor.

SECTION – E VENTILATION WORKS

TECHNICAL SPECIFICATIONS FOR VENTILATION WORKS

SECTION – 1 SYSTEM DESIGN DATA AND GENERAL REQUIREMENTS

1. GENERAL

The system design, basis of design, estimated requirements and other relevant data are outlined in this section. The detailed specifications and specific requirements are outlined in the subsequent sections. The envisaged system / system components shall be compatible to and integrated with building management system to be provided by other agencies.

2. LOCATION

2.1 The Proposed Project is located at Plot No.28, Sector 4, Vaishali, Ghaziabad, UP.

3. SCOPE OF WORK FOR THIS CONTRACT

3.1 The supply at site of all main equipment and items associated with ventilation system detailed under these technical specifications.

3.2 To execute all incidental work at site including all material supply at site required in the technical specifications. Nature of such works will be sheet metal duct/grille work. All electrical work connected with Ventilation works such as cables, electric panels etc., and erection at site for all manufactured items at works and also items fabricated at site.

3.3 Routine testing, pressure testing of fabricated components, commissioning of complete plant at site.

3.4 Performance testing at works of various equipment manufactured at works.

3.5 Performance testing at the site of complete Ventilation work as per various technical requirements.

4. SYSTEM DESCRIPTION:

It is proposed to provide Ventilation system for Basements, Corridor smoke extraction & Pressurization works etc.

4.1 VENTILATION SYSTEM-

DESIGN PARAMETERS:

Basement Ventilation-

1. Normal Case Supply/Exhaust – 06 Air Changes / Hour
2. Fire Case Supply / Exhaust – 12 Air Changes / Hour

Pressurization & Smoke Extraction-

1. Stairwell & Lift well– 50 Pascal (pa.)
2. Lift Lobby – 30 Pascal (pa.)

5.0 ITEMS TO BE PROVIDED BY OTHER AGENCIES

The following items of works shall also be provided the contractor.

5.1 Provision of main 3 Ph. 50 Hz, 415 VOLTS, 4 wire main electric supply cables along with main earthling conductor of required size up to the main panel.

5.2 False ceiling to cover the ducts and drop ceiling if required.

5.3 RCC Foundation for equipment (wherever required) directly resting on finished RCC floor/slab over neoprene rubber pads.

5.4 Ventilation Louvers & associated civil works for basements, coming at ground floor & Walls.

SECTION – 2– VENTILATION FANS

1. General

The ventilation fans, blowers shall be complete in all respects and shall generally comply with the specifications given below:

Fans performance rating data shall be tested accordance with AMCA Standards.

2. Axial flow fans

2.1 The Axial Fan Blades shall be of Cast Aluminum of aero foil design for high efficiency and high static pressure. The blades shall be joined together on cast aluminum hub. The fan shall be provided with guided vanes.

2.2 The mounting ring shall be of sheet steel with steel brackets to connect the frame, with the Fan/Motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.

2.3 Fan shall be complete with motor, motor mount direct driven and vibration isolation type, suspension arrangement.

2.4 Rotor: hub and blades shall be cast aluminum or cast steel construction. Blades shall be die-formed aero foil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blades mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow values, as specified and quoted.

2.5 Motor shall be energy efficiency squirrel-cage, totally-enclosed, fan cooled standard round frame, constant speed, continuous duty, single winding, suitable for 415+ 10% volts, 50 cycles, 3 phase AC power supply, provided with class 'F' / 'H' class insulation (as specified in BOQ). Motor shall be specially designed for quiet operation with 4/6 poles. For lowest sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor conduit box shall be mounted on exterior of fan casing and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.

2.6 Drive to fan shall be provided through direct drive with adjustable motor sheave and standard sheet steel belt guard with vented from for heat dissipation. Belts shall be of oil-resistant type.

2.7 Vibration isolation: The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of rubber-in-sheet type.

2.8 Limitation

2.8.1 The air velocity limits shall be as per Schedule of Equipment and/or BOQ but in no case exceed.

2.8.2 Outlet velocity shall not exceed 10.16 M/s (2000 FPM), however for the pressurization fan it may be increase (if required).

2.8.3 Inlet Velocity shall be limited to 5.08 M/S (1000 FPM), however for the pressurization fan it may be increase (if required).

2.9 Accessories

All necessary accessories shall be provided for proper operation and shall also include **(As part of Unit Price).**

- Vibration isolators.
- Double canvass connections at the outlet 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 at the Inlet/ Outlet (wherever required).

SECTION – 3– RECTANGULAR DUCT WORK (FACTORY FABRICATED)

1. General

1.1 The work under this part shall consist of furnishing labor materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.

1.1.1 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.

1.1.2 Ductwork shall mean all ducts, joints, stiffeners and hangers.

1.2. Governing Standards

1.2.1 Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the I.S-655 standard.

1.3. Duct Material

Ducting

1.3.1 The ducts shall be fabricated from galvanized steel sheets I.S-655 standard.

1.3.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in I.S-655 standard.

Rectangular ducts less than 750 mm: 24G
Rectangular ducts 751mm to 1500mm: 22G
Rectangular ducts 1501mm to 2200mm: 20G
Rectangular ducts greater than 2200mm: 18G

1.3.3 All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates.

1.3.4 Galvanizing shall be of 120gms/sq. m.

1.3.5 In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

1.3.6 The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.

Duct Connectors and Accessories

All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized).

1.4. Fabrication Standards

1.4.1 All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory-fabricated. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply.

1.4.2 Coil lines to ensure location of longitudinal seams at comes/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.

1.4.3 All ducts, transformation pieces and fittings to be made on CNC profile cutlers for required accuracy of dimensions, location and dimensions of notches at the folding lines.

1.4.4 All edges to be machine treated using lock formers, flanges and roller for fuming up edges.

1.5. Selection of G.I. Gauge and Transverse Connectors

1.5.1 All transverse connectors shall be the 4-bolt system with built-in sealant if any to avoid any leakage additional sealant to be used.

1.5.2 The specific class of transverse connector and duct gauge for a given duct dimensions will be 1" (250 Pa) pressure class.

1.5.3 Non-toxic, AC-applications grade P.E. or PVC gasket is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

1.6 Duct Construction

1.6.1 The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

1.6.2 Dimensional Tolerances: All fabricated dimensions will be within ± 1.0 mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be ± 1.0 mm per meter.

1.6.3 Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch to ensure air tightness.

1.6.4 Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

1.6.5 Plenums shall be shop/factory fabricated panel type and assembled at site.

1.7. Installations

1.7.1 During the construction, the contractor 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.

1.7.2 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 or vibration.

1.7.3 The duct 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 contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.

1.7.4 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.

1.7.5 Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed center top rivets or spot welding. Self-tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.

1.7.6 Fire retarding flexible joints are to be fitted to the delivery of all fans. The material is to be normally double heavy canvass.

1.7.7 The flexible joints are to be not less than 75 mm and not more than 200 mm between faces.

1.7.8 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

1.7.9 Duct passing through brick or masonry, wooden frame 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.

1.8. Documentation to Measurements

1.8.1 For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.

1.8.2 Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

1.8.3 All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

1.9. Testing

1.9.1 After completion, all duct system shall be tested for air leakage.

1.9.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas.

1.10. GRILLES (PARKING VENTILATION)

1.10.1 The supply and exhaust air grilles shall be made up of powder coated MS. The supply air grilles shall have double louver. The front horizontal louver shall be of extruded section fixed type. The rear vertical louver shall be MS and adjustable type. The exhaust air grille shall have single horizontal extended section fixed louvers.

1.10.2 The MS grilles shall have opposed blade dampers of black anodized extruded aluminum sections, which shall be key operated from the grille face wherever required.

1.10.3 The adjustable grill louvers shall be fabricated from extruded MS sections. The damper blades shall be of black anodized extruded MS sections and shaped to form air tight joints. . Grills longer than 450mm shall have intermediate supports for the horizontal louvers.

1.11. VENTILATION AIR INTAKE LOUVERS

Ventilation air intake louvers 50 mm deep wherever required as per shop drawing will be made of GI construction. The blades are inclined at 45 ° on a 40 mm blade pitch to minimize water ingress. The lowest blade of the assembly shall extend out slightly to facilitate disposal of rain water without falling in door/wall on which it is mounted.

1.12 STORM PROOF EXHAUST AIR LOUVERS

Ventilation Exhaust air louvers 80mm deep wherever required as per shop drawing will be made of GI construction. The blades are inclined at 45 degree on 75 mm blade pitch to minimize water ingress. The lowest blade of the assembly shall extend out slightly to facilitate disposal of rain water without falling in door / wall on which it is mounted.

1.13. FIRE CUM SMOKE DAMPER

1.13.1 The fire dampers shall be made from heavy gauge galvanized steel in multi plate construction. The damper shall be provided with Jam seal (compression type) on sites to prevent spread of smoke and fire. The motorized damper shall activate on a signal or either an electronic thermal sensor UL stamped mounted in the air stream or from the smoke detector system. The fire dampers and smoke detectors are to be installed in supply air duct & return air duct.

1.13.2 The dampers shall be equipped with a well designed control panel, using high components which consume less power. It shall operate at 24 volts obtained through a step down transformer. The panel is protected against surge currents or short circuits through a Fuse connected on the PCB. The panel shall have an optional power supply of 24 V AC. The control panel shall be well protected against wrong switching. All fire cum smoke damper must be qualified under UL standard 555-1995 of approved 90 min. fire rating. Fusible links for non motorized.

1.14. ACCESS PANEL

1.14.1 A hinged and gasket access panel shall be provided on duct work before each control device that may be located inside the duct work.

1.15. MISCELLANEOUS

1.15.1 All ducts above 450mm are to be cross broken to provide rigidity to the ducts.

1.15.2 All duct work joints are to be true right angle or approaching with all sharp edges removed.

1.15.3 Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grills through the shoot.

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1.15.4 Inspection doors measuring at least 450mm x 450mm are to be provided in each system at an appropriate location, as directed by Engineer.

1.15.5 Diverting vanes must be provided at the bends exceeding 600mm and at branches connected into the main duct without a neck.

1.15.6 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.

1.15.7 The ducts should be routed directly with a minimum of directional change.

1.15.8 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the Engineer, at no extra cost.

1.15.9 All duct supports, flanges, hangers and damper boxes etc. shall be given 2 coats of red oxide paint before installation and one coat of aluminum paint after the erection, at no extra cost.

1.15.10 All angle iron flanges to be welded electrically and holes to be drilled.

1.15.11 All the angle iron flanges to be connected to the G.S.S. ducts by rivets at 100mm centers.

1.15.12 All the flanged joints, to have a 4mm thick felt packing stack to the flanges. The holes in the felt packing are to be burnt through.

SECTION – 4 -MOTORS AND SWITCHGEARS

1. GENERAL

The motors and switch gears required for various items shall generally be as per specifications given below. All electric motors shall be suitable for 3 phase, 50 cycles 415 ±10% volts A.C. supply. The starters shall ensure the starting current of motor including compressor motor to 1.5 times full load currents.

2. SQUIRREL CAGE MOTORS

2.1 The squirrel cage motors shall be either screen protected or totally enclosed fan cooled, depending on the application and as stated in "schedule of equipment". All motors shall conform to IS 325/1978.

2.2 The body shall be of rugged cast iron construction. The rotor shall be of die cast aluminum. The rotor and cooling fan (if any) shall both be jointly balanced statically and dynamically at the factory of the manufacturer.

2.3 The winding shall be with class `B' insulation for motors.

2.4 The starting torque shall be sufficient to match the requirement of driven machine.

2.5 The shaft and bearings shall be of generous size and be easy to lubricate.

NOTE: All motors exposed to atmosphere shall be I.P 55.

3. STARTERS

3.1 The starters to be provided for the different type and rating of the motors shall be as follows: -

3.1.1 Squirrel cage motors - Upto 7.5 H.P - Direct on line

3.1.2 Squirrel cage motors - Above 10 H.P - Automatic star delta Starter.

3.1.3 All starters shall have auxiliary contacts for interlocking different machines, connecting indicating lights, controls, alarms, etc.

3.1.4 Starters for all the motors shall be provided with ammeters of suitable range of 96mm X 96mm size.

3.1.5 All starters shall be provided with separate single phasing preventers and adjustable over load relays.

3.4 **DIRECT-ON-LINE STARTERS**

3.4.1 These starters shall have a heavy duty air break contactors of suitable ratings.

3.4.2 Each starter shall be complete with adjustable overload relays on all three phases, single phase preventing device and under voltage release. The starters should be "hand reset" type.

3.4.3 The "no volt coil" of the starters shall be 220 volts whenever any controls or safety devices are connected in the starter circuits. Otherwise standard 415 volt coils may be used. There shall be on-off push buttons for each starter along with provision for remote operation of the starter.

4. SWITCH PANEL BOARD

4.1 The panel board shall be of compartmentalized cubical panel type, having in it all switches, starters and accessories and completely factory prewired. It shall be suitable for voltage systems upto 500 volts, 3 phase, 50 HZ, 4 wire supply capable of functioning satisfactorily in temperatures upto 45 deg C and rupturing capacity, not below 50 KA.

4.2 The boards shall be fabricated from not less than 2.0mm thick, cold rolled M.S. sheets. Suitable stiffeners shall be used in fabricating the housing. Panel should be fabricated with 7 tank process for powder coating of approved shade. The switch board shall be free floor standing types.

4.3 All outgoing feeders shall be protected with the moulded case circuit breakers having a rupturing capacity of not less than 50 KA.

4.4 No switching starter or accessories shall be provided in the bottom 450mm of the panel.

4.5 The bus bars shall be of high conductivity aluminum strips of specified ratings with heat shrinkable insulated sleeves of appropriate colour. There shall be adequate clearance between phase to phase and phase to neutral strips.

4.6 Items such as ammeters, switches etc. shall be located close to the corresponding switch gear, and otherwise all items shall be arranged in a neat symmetrical pattern.

4.7 Every starter/ammeter etc., shall be controlled by a MCCB of adequate rating as listed above.

4.8 Each MCCB/MCB, ammeter etc., shall be provided with a name plate to indicate controlled items.

SECTION –5-ELECTRICAL INSTALLATIONS

1. GENERAL

1.1 Work shall be carried out in accordance with the general specifications for Electrical Works, local rules, Indian Electricity act 1910 as amended up to date.

2. SCOPE

2.1 The scope of work covered under this section shall be inclusive but not limited to followings, and everything necessary to complete the work shall be provided by the contractor within the rates quoted by him for the electrical package on turnkey basis.

2.1.1 Electrical panels and other subsidiary panels, local electrical panel boards (EPB) and distribution boards whether indicated in the drawings or not / as required for proper functioning of the system.

2.1.2 Supplying and laying all aluminum conductor armoured power distribution cables for interconnecting the above panels and equipment including earthing the same.

2.1.3 All copper conductor armoured control cables from the final outlets upto the main control console.

2.1.4 A centralized control console to indicate the condition of various drives/equipment and also to control various feeders / drives / equipment.

3. WIRING SYSTEM

3.1 All power wiring shall be carried out with 650/1100 volts grade PVC insulated, armoured, overall, PVC sheathed aluminum conductor cables. Cables shall be sized for starting current and by applying proper de-rating factor. All control wiring shall be carried out by using 650/1100 volts FRLS insulated copper conductor wires in wire trays or in conduit. Minimum size of control wiring shall be 2.5 sq.mm. FRLS insulated copper conductor wires.

4. MAIN PANEL

4.1 The Non-draw out type L.T. Panel shall be with Aluminium bus bars, indoor type, free standing, floor mounting type, extendable on either side.

4.2 SITE CONDITIONS

Max. Peak room temperature in shade: 40°C.

4.3 STANDARDS

The design, manufacture & testing of the various items are covered by the following standards:

IS 8623 – 1977	:	Factory built assemblies.
IS 4237 – 1967	:	General requirement for Switchgear and Control gear for voltages not exceeding 1000V.
IS 2147 - 1962	:	Degree of protection provided by enclosure for low Voltage switchgear and Control gear.
IS 3619 - 1966)	:	Phosphate treatment. IS 6005 - 1970)
IS 5 - 1978	:	Colour for ready mixed paints & enamels.
IS 5082 - 1969	:	Wrought aluminum for electrical purpose.
BS - 162	:	Clearance & creepage for bus systems.
IS 375 - 1963	:	Marking arrangement for bus bar/cable.
IS 4237 - 1967	:	Clearances & Creepages for Part I & I devices.
IS 6875 Part II - 1973.	:	Push buttons & related control switches including control contactors.
IS 9224 Part I & II - 1979.	:	HRC Fuses.
IS 2516 Part I &	:	Alternating current circuit breakers (ACB).
II Sec. I - 1977.	:	Voltage not exceeding 1000V AC or 1200V DC.
IS 3231 - 1965	:	Protective relays.
IS 3156 - 1965	:	Voltage transformers.
IS 2705 - 1981	:	Current transformers.
IS 1248 - 1968	:	Elect. indicating instruments.

4.4 SPECIFICATIONS

Rated System	:	415V. 50Hz. TPN.
Rated insulation level	:	660V rms.
HV withstand level	:	2.5 KV rms for power circuit. (for 1 min).
	:	1.5KV rms for control circuit

Horizontal busbar	:	As indicated in S.O.Q. rating./ Drawings.
Rated short time	:	Upto 50kA rms for 1 sec. 110kA rating of H.Bus &peak (36MVA). V.Bus.
Protection of enclosure.	:	IP43.

4.5 CONSTRUCTION

4.5.1 The panel board shall be of compartmentalized cubical panel type, having in it all switches, starters and accessories and completely factory prewired. It shall be suitable for voltage systems upto 500 volts, 3 phase, 50 HZ, 4 wire supply capable of functioning satisfactorily in temperatures upto 45 deg C and rupturing capacity, not below 50 KA.

4.5.2 The boards shall be fabricated from not less than 2.0mm thick, cold rolled M.S. sheets. Suitable stiffeners shall be used in fabricating the housing. Panel should be fabricated with 7 tank process for powder coating of approved shade. The switch board shall be free floor standing types. Suitable M.S. removable, gland plates of minimum 3 mm thick shall be provided.

4.6 MOULDED CASE CIRCUIT BREAKERS (MCCB)

The normal Moulded case circuit breakers shall have all live parts totally enclosed in a moulded insulated housing. It shall have a quick make and quick break mechanism. The mechanism shall be trip free so that the contacts can not be held closed against a fault. The bi-metallic mechanism shall be provided for inverse time current trip characteristic, to prevent interruption on normal inrush currents or temporary overloads. The instantaneous release shall be provided to protect equipment against very high current or short circuits. There shall be a common trip bar so that in case of fault on any of the phases, all the three phases trip together.

The arcing shall be totally contained within the housing so that the possibility of any damage to any adjacent equipment or personnel due to accidental mishandling is avoided. Individual arc chutes shall be provided on each phase to draw the arc away from the contact tips, thus, quenching it rapidly.

The minimum breaking capacity of Moulded Case Circuit Breakers (Ics = Icu) at 415 V AC and 0.8 PF shall be 35 KA.

4.7 BUSBAR SYSTEM

4.7.1 BUSBAR

The busbar shall be located at the top/ bottom/ center busbar compartment. The busbar shall be of electrical grade, high conductivity, aluminium sections of required ratings with heat shrinkable PVC sleeve.

4.7.2 **EARTH BUS**

Cu earth bus of appropriate capacity shall be provided in the bottom most compartment along the entire length of the board for connection to project earth at either end.

4.7.3 **BUS BAR SUPPORTS**

Both horizontal and vertical busbars shall be supported at uniform intervals with

DMC / SMC busbar supports.

4.8 **CONTROL WIRING**

All control wiring shall be done as a standard, using 1.5 sq.mm. multi-strand FR insulated copper wires. The C.T. connections shall be done using 2.5 sq.mm. multi-strand PVC insulated copper wires of red colour.

4.9 **CURRENT TRANSFORMERS**

Current transformer meant for metering & protection shall be mounted on the bus links either on the incoming side or outgoing side as the case may be. They shall be wired and terminated suitably for external connection.

4.10 **FUSES**

All fuses shall be of the HRC cartridge type, conforming to IS:2208 mounted on plug-in type of fuse bases having a prospective current rating of not less than 46 KA. Fuses shall be provided with visible operation indicators to show that they have operated. Insulated fuse pulling handle shall be supplied with each control panel.

4.11 **INDICATING INSTRUMENTS & METERS**

Electrical indicating instruments shall be flush mounted digital type having min. 96 mm square to read voltage Amp. etc. Wherever possible, amp. meters measuring upto 10 amps. shall be directly connected, while those measuring above 10 amps. shall be connected through suitable CTs.

4.12 **CONTROL AND SELECTOR SWITCHES**

Control and instrument switches shall be of the rotary type and shall be provided with properly designated plate. Control switches shall have momentary contacts spring return to center with pistol grip handle. Instrument and selector switches shall have stay put contacts. The number of contacts and operation of each switch shall be as per the requirements of the connected circuit enclosed data sheet/enclosed drawing.

4.13 **PUSH BUTTONS**

All push buttons shall be of push to actuate type have 2 `NO' and 2 `NC' self reset contacts. They shall be provided with designation plates, engraved with their functions. push

button contacts shall be rated for 10 amps at 415V A.C. and 0.6 Amp. inductive breaking at 220V D.C.

4.14 INDICATING LAMPS

Indicating lamps shall be of the filament type having double contact bayonet caps and low watt consumption. Lamps shall preferably be provided with series resistors to prevent short circuiting of control supply of filament fusing. Colour of lens shall be as per enclosed drawing/data sheet. Lamp grip shall be supplied along with the panel so that replacement of the bulb can easily be done from the front of the panel.

4.15 DRAWINGS

The contractor shall provide the following drawings for approval to the department before commencement of supply/ fabrication.

i) General layout-Plan, section, elevations, SLD and Schematic diagram.

ii) Foundation

iii) Wiring-Power & Control

5. ROTARY SWITCHES

Switches upto 60amps shall be rotary type with compact and robust construction, build up from one or more stacks with contacts and a positioning mechanism with stop as required. The terminals shall be shrouded with insulation to prevent accidental contact with live parts. Rotary switches shall be backed up with moulded type HRC fuse fittings of appropriate rating.

6. SELECTOR SWITCH

When called for, selector switches of rated capacity shall be provided in control panel, to give the choice of operating equipment in selective mode.

7. STARTERS

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with IS: 1822-1967.

Direct on line starters shall be provided for motors upto 10 HP. Star Delta type starters shall be provided for motors of 12.5 HP and above HP capacity.

Starter's contactors shall have 3 main and 3 auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.38. `For design consideration of contactors, the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters, and 3 times the full load current of the motor in case of star delta/Reduced Voltage Starters.

Main and auxiliary contacts shall be silver or silver alloy. The insulation for contactor coils shall be of class "B". Operating coils of contactors shall be suitable for 220/415 + 10% volts AC, 50 cycles supply system. The contactors shall drop out when voltage drops to 80% of the rated voltage. The housing of the contactors shall be heat resistant and having high impact strength. Each starter shall have thermal overload protection on all three phases and also single phasing preventing relay.

8. OVER LOAD RELAYS

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand reset type thermal over load relay with adjustable setting. Hand-reset button shall be flush with the front door for resetting with starter compartment door closed, Relays shall be directly connected for motors upto 150 HP capacity. C.T. operated relays shall be provided for motors above 150 HP capacity. Heater circuit contactors shall also be provided with overload relays.

9. SINGLE PHASE PREVENTERS

Single phase preventers shall be provided on all the three phase motor starters and shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

10. TIME DELAY RELAYS

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

11. TOGGLE SWITCH

Toggle switches, where called for, shall be in conformity with IS 3854-1969 and shall be of 5 amps rating.

12. PUSH BUTTON STATIONS

Push button stations shall be provided for manual starting and stopping of motors/equipment as called for, `RED' and `GREEN' colour push buttons shall be provided for `starting' and `stopping' operations. `Start' or stop indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, dock lever shall be provided for `Stop' push button. One set of normally open and one set of normally closed contacts shall be provided in push button stations. The push buttons contacts shall be suitable for 15 amps current capacity.

13. CABLES

13.1 M.V. cables shall be PVC insulated aluminum conductor and armoured cables conforming to IS: 7098 (part-II) as amended upto date. M.V. cables shall be armoured and suitable for laying in trenches, duct and on cable trays as required. Control cables, and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables. Digging

and back filling of trenches, sand & bricks, saddles clamps etc. shall be included in the package and nothing extra shall be paid to the contractor on this account.

13.2 **WIRES**

650/1100 volts grade FRLSH PVC insulated copper conductor wires.

13.3 **Cable Laying**

Cable shall be laid as per relevant CPWD specification in general. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable.

14. All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. Circuit wiring diagram of control panel shall be fixed to the cover of control panel for verification. The following capacity contactors and overload relays shall be provided for different capacity motors:

Motor rating	Type of Starter	Contactor current rating	Overload relay range
a. 5.0 HP motors	D O L	16 amps	6-12 amps
b. 7.5 HP motors	D O L	16 amps	6-12 amps
c. 10 HP motors	Star Delta	16 amps	6-12 amps
d. 12.5 HP motors	Star Delta	32 amps	6-12 amps

15. DRAWINGS

Shop drawings for control panels and wiring of equipment showing the route of conduit/cable shall be submitted by the contractor for approval of purchasers before starting the fabrication of panel and starting the work. On completion, four sets of completion/"As-installed" drawings incorporating all details like, conduit routes, number of wires in conduit, location of panels, switches, junction/pull and cable route etc. shall be furnished by the Contractor.

16. PAINTING

All sheet steel work shall undergo a process of degressing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be backed in an oven. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

17. TESTING

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with code of Practice IS: 732-1963 (Revised) and test report furnished by a qualified and authorized person.

All tests shall be carried out in the presence of Engineer-in-Charge.

18. MISCELLANEOUS

18.1 The final connections to the equipment shall be through flexible connections in case of conduit wiring and also where the equipment is likely to be moved back and forth, such as on slide rails.

18.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 meters away from the main panel.

18.3 Two separate and distinct earthing conductors shall be connected from the equipment upto the main switch board panel.

SECTION – 6-TESTS AT SITE & FACTORY

1. GENERAL

The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the purchasers/ Engineer in accordance with the provisions of the applicable ASHRAE/NBC / I.S-655 / ARI standards.

2. FOR ASSOCIATES WORKS AT SITE

2.1 All electrical items will be subjected to inspection at any stage during manufacturing activity. Routine electrical test as per relevant codes. Inspection of manufacturer's test certification.

2.2 Inspection of raw materials to be used for fabrication and assembly and inspection of manufacturer's certificates.

2.5 Checking of electrical circuits (power & controls) and checking functioning of controls and other circuits of ventilation system.

2.6 Checking of assemblies for electrical control panel, instruments panels, local panels (dimensional and functional) annunciator panels etc.

2.7 Inspection of complete electrical installation at site.

2.8 Performance testing of complete Ventilation system as per specifications.

3. The above inspection procedure is given for general guidance and information of vendors and inspection of purchaser is strictly not limited to these and inspection engineer of purchaser will have full right to have detailed inspection at any stage right from placement of order to completion of project as desired by inspection engineer, co-ordination of inspection agency of purchaser with his factory/sub-contractor's factory/ erection site will be the sole responsibility of successful contractor after placement of order for complete air conditioning plant covered under these technical specifications.

4. DUCT WORK

4.1 All branches and outlets shall be tested for air quantity, and the total of the air quantities shall be within plus five percent (5%) of fan capacity.

4.2 Fire dampers, volume dampers and splitter dampers shall be tested for proper operation.

5. BALANCING AND ADJUSTMENT

All air handling ventilation equipment, duct work and outlets shall be adjusted and balanced to deliver the specified air quantities indicated, at each inlet and outlet, on the drawings. If these air quantities can not be delivered without exceeding the speed range available horse power, the department shall be notified before proceeding with the balancing of air distribution system.

6. ELECTRICAL EQUIPMENT

6.1 All electrical equipment shall be cleaned and adjusted on site before application of power.

6.2 The following tests shall be carried out :

6.2.1 Wire and cable continuity tests.

6.3 Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 volt meggar. The meggar reading shall be not less than one meg. ohm.

6.4 Earth resistance between conduit system and earth must not exceed half (1/2) Ohm.

6.5 Phasing out and phase rotation tests.

6.6 Operating tests on all protective relays to prove their correct operation before engineering the main equipment.

6.7 Operating tests on all starters, circuit breakers, etc.

7. PERFORMANCE TESTS

7.1 The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the purchasers.

7.1.1 Air volume passing through each unit, duct, grilles and apertures.

8.1.2 Differential pressure readings across each fan.

8.1.3 Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.

8.1.4 Continuous recording over a specified period, of ambient wet and dry bulb temperatures under varying degrees of internal heat loads and use and occupation, in each zone of each part of the building.

8.1.5 Daily records should be maintained of hourly readings, taken under varying degrees of internal heat load and use and occupation, of wet and dry bulb temperaturesl. The current and voltage drawn by each machine.

8.1.6 Any other readings shall be taken which may subsequently be specified by the client.

9. MISCELLANEOUS

9.1 The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provisions of conditions of contract and specification.

9.2 The date of commencement of all tests listed above shall be subject to the approval of the purchaser, and in accordance with the requirements of this specification.

9.3 The contractor shall supply the skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system if the purchaser requests such a test for determining specified or guaranteed data as given in the specification or on the drawings.

9.4 Any damage resulting from the tests shall be repaired and/or damaged material replaced, to the entire satisfaction of the department.

9.5 In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed.

9.6 The contractor must inform the department when such tests are to be made, giving sufficient notice, in order that the purchaser or his nominated representative may be present.

9.7 Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the department.

9.8 The contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the purchaser, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

9.9 In case of equipment's being supplied by the contractor from a place outside India for which department may or may not be able to send its representative, the manufacturers test certificates (for all acceptance test) for inspection of material and witnessing the various tests at the factory as carried out by the manufacturer have to be submitted along with the supply of equipment's. This must be witnessed by a representative of the contractor.

NOTES:

A. TEST INSTRUMENTS

1. All instruments for testing shall be provided by the Ventilation system contractor.

2. Thermometer shall have graduations of 0.1^{O}C and shall be got calibrated from N.P.L. or any recognized test house beforehand.
3. Thermometers used in the psychrometers shall have graduations of 0.2° C and shall be calibrated as at (2) above.
4. Pressure gauges shall also be got calibrated beforehand from a recognized test houses.
5. Air flow rates shall measure in the supply duct using pitot tube.

SECTION – F

ELEVATOR

SUPPLY, INSTALLATION AND COMMISSIONING OF PASSENGER LIFTS (CAPACITY OF 10 to 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.**

2.0 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 CGEWHO responsibility.

2.2 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.

2.3 INSPECTION AND TESTING

CGEWHO Project Manager and his staff, CGEWHO 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.

2.4 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.

2.5 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 & CGEWHO, if they desire. If required by the Engineer, the Contractor shall permit the CGEWHO authorised representative to be present during any of the tests. After notification to the CGEWHO 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.

2.6 MAKE OF MATERIALS

No specification or make of material described in the tender document/Contract Agreement shall be changed without prior approval of CEO CGEWHO through Project Manager.

2.7GODOWN/WORKER ACCOMMODATION

No storage space shall be given by CGEWHO 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.

2.8 FIRE OFFICER'S APPROVAL

It shall be the responsibility of the contractor to meet all mandatory requirements of Vaishali 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.

2.9 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.

2.10 PARTICULAR SPECIFICATION

As enclosed.

2.11 DRAWINGS

As enclosed

2.12 The children of labourers shall stay in crèche otherwise penalty shall be initiated against the contractor.

2.13 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 **GDA/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.

2.14 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 CGEWHO shall have no liability whatsoever on this account.

2.15 RULES FOR SAFETY AND LABOUR WELFARE

2.15.1 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.

2.15.2 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 CGEWHO 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.

2.15.3 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.

2.15.4 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).

2.15.5 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.

2.15.6 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.

2.15.7 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.

2.15.8 HOISTING MACHINES

Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

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.

iii) 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.

iv) 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.

v) 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 /CGEWHO whenever he brings it to Site of work and get it verified by the Project Manager/CGEWHO.

2.15.9 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/sheet fencing of sufficient height erected as per the design approved by the CGEWHO, 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 CGEWHO, 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 CGEWHO 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 CGEWHO

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 CGEWHO. Neither CGEWHO nor CGEWHO 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 CGEWHO 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 CGEWHO and/or CGEWHO 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 CGEWHO or CGEWHO may desire verification. Such statement of expenditure may form the basis of any action that the CGEWHO &CGEWHO 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 CGEWHO and CGEWHOs 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 CGEWHO or the CGEWHO requiring him to remove the same, and on his default to comply with such notice, the CGEWHO 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 CGEWHO 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 CGEWHO.

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 CGEWHO through their CGEWHO 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 CGEWHO 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 CGEWHO and CGEWHO informed of hiscompliance 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 CGEWHO, Architect, CGEWHO and or their representatives, the consulting Engineers, to inspect check measure the work, and theContractor 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 CGEWHO, Architect, CGEWHO and/or their representatives with whatever facilities, measurements, documents, samples, tests etc., that they may require.

3.10 CONSTRUCTION DRAWINGS

3.10.1 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.

3.10.2 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 CGEWHO through the CGEWHO, 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 CGEWHO.

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/CGEWHO 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 all authorities namely, The CGEWHO/his representative, the Architect/his representative, the Project Manager, the Contractor/his representative, and CGEWHO 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/overhead in MRL lift, 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/overhead. 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 chequred plate, locking arrangement etc., duly painted for trap door opening in each machine room/overhead.

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/overhead 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/overhead shall have trap door to permit passage for heavy parts to be replaced for repairs, if required by lift vendor.

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 CGEWHO'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 CGEWHO 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 CGEWHO 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 CGEWHOs responsibility.

9. Warranty

The bidder shall provide for Five 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 CGEWHO. 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 CGEWHO through CGEWHO/Consultant.

a) Motor sizing calculation.
b) Brake selection calculation.
c) Single line/Schematic diagram of electronic control panel.
d) Layout of lift machine room/over head 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 in Over Head below 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 factory 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 Stainless 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.

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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 CGEWHO 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 enrooted. 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 confirming to European rules and specification for electrical works. All cables shall be flame retardant of PVC insulated or 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 CGEWHO's inspectors.
c) CGEWHO's existing property subject to damage by Contractor's operations.

Contractor's employees and those of its sub-contractors shall become acquainted with CGEWHO'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 or 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 personor 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 with 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 under cutting 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 CGEWHO 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 CGEWHO. As regards Contractor's machines, the Contractor shall notify the safe working load of the machine to the CGEWHO/ CGEWHO 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 CGEWHO 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 manners 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 CGEWHO from time to time within his quoted rates.

SECTION – G EXTERNAL DEVELOPMENT WORK

ROAD, CAR PARKING, PATHWAYS, KERBS AND EARTH FILLING

1. SCOPE OF WORK

The road work in this contract comprises of previous of road with sub base course 150 mm thick consolidated, basecourse, 150 mm thick for fire tender path and base course 100 mm thick consolidated PCC in road & car parking areas, 100mm thick Cement concrete vaccume dewatered in road, 80 mm thick the Interlocking paver & grass paver,kerb stones, stone cobbles etc and earth filling as described in schedule items and as specified in succeeding paragraph.

MATERIAL

2. SUB 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 80 mm 63 mm 40 mm	100 65-85 25-60 0-15	one test per 100 cum
2.	63 mm to 40 mm	80 mm 63 mm 50 mm 40 mm 20 mm	100 97-100 35-70 0-15 0-5	- do –

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	12.5 2	12.5 mm 10.0 mm	100 90-100	0.63
Base Course	10.00mm	10.00 mm 4.75 mm 150 micron	100 85-100 10-30	0.40cum

(ii) The screening shall be clean, durable, free from disintegrated pieces and other objectionable material.

(b) STONE CHIPPING PROPERTIES

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 Agg. Impact value	IS:2386 (Part IV) IS:2386 (Part IV) IS:5640***	60% Max. *50% Max.	one test per 200 cum aggregates.
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.

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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. CONSOLIDATIONOF 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 150 mm. Loose quantity of the aggregate shall be 2.02 cum per 100mm/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 ½ 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 shallbe 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. RECTIFICAITON 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 150 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 looseaggregate required for base course should not less than 1.78 cum per 10 sqm of road surface for 100 mm consolidated thickness of base course.

a) **Spreading of Stone Aggregate**
This shall be as specified above for sub base course relavent para and the base course shall be constructed with a consolidated thickness of 100 mm thick.

b) **Rolling**
This shall be as per relavent para of the sub base course

c) **Sprinkling and Grouting**
This shall be as per relavent para of the sub base course

d) **Application of Screening**
This shall be as per relavent para of the sub base course

e) **Application of Binding Material**
This shall be as per relavent para of the sub base course

f) **Setting and Drying**
This shall be as per relavent para 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 1:4:8 (1 cement: 4 Coarse Sand: 8 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 or with the surface vibrator.The top surface shall be finished leveled and smooth for laying polythene sheet.

(c) **Separation Layer**
The surface of middle layer shall be swept clean and a separation layer of 120 micron polythene sheet over middle layer shall be laid flat without creases. Overlaps of minimum 300mm shall be provided wherever required and the sheet shall be nailed appropriate locations and distances to avoid slippage while laying the top layer.

(c) **Top layer**
Minimum100 mm thick vacuum dewatered concrete of design mix M:30 with Polypropylene PlastFibre @ 900 gms per cum (Tashi India Ltd)shall be laid in pattern as shown on the drawings as directed. Panel size shall not be more than 5m 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 pattern and as directed by the CGEWHO/ CGEWHO. The grooves shall be 10 mm wide clear gap between panels and these gaps shall be filled with joint sealin compound 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 1:4:8 (1 Cement: 4 Coarse Sand: 8 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

a) These shall be precast cement concrete (M-25) made in Factory under hydraulic pressure finished smooth with a homogenous layer of cement plaster of approved manufacturers. The sizes of kerb stones shall be as shown in the drawings.

b) **Laying of Kerb Stone**

i) The surface area should be leveled & consolidated.

ii) Prepare the sub base by laying PCC 1:4:8 (1 cement :4 coarse sand : 8 stone aggregate)

iii) Setting in position, line & level with cement mortar 1:2 (1 cement : 2 coarse sand)

iv) The joints shall be filled up with cement mortar 1:2 (1 cement : 2 coarse sand) finished properly and cured well.

c) The kerb stones shall be alternatively painted white/blue or as approved by the Architect & Project Manager with three coats of synthetic enamel paint as required.

d) Parking numbers (each of 4 letters/numbers) shall be painted with synthetic enamel paint on kerb stones at locations as directed by Architect/Project Manager. Each letter shall be 75 mm high & 20 mm wide.

21. EARTH FILLING OVER AREA

If required,Earth filling over areas shall be by bringing earth from outside CGEWHO 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 CGEWHO/ Architect.

Computing the gross filling volume shall be by prismoidal 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.

22. GRASSPAVERS /INTERLOCKING PAVERS

a) 80mm thick interlocking pavers/80mm thick Grass paver shall be precast cement concrete (M-30) made in factory finished smooth with a homogenous layer of different colours of approved manufacturers.

b) **Laying of interlocking pavers :-**

The sub-base shall be laid as specified in Clause 16.57 of CPWD Specifications 2009, Volume-2. At junctions of paved areas with flooring of some other finish, the pavers shall be cut (if needed), laid in place and the gap grouted with cement mortar 1:6 (1 cement : 6 coarse sand) to give a straight edge at the junction. Sand shall be spread over the entire paved area to fill in any gaps at joints between pavers. The Sweet earth shall be filled in cavities of grass pavers.

23. GRANITE COBBLES

100x100x100mm thick black granite cobbles of similar colour shall be fixed over a layer of PCC (1:4:8) with min 20mm th cement mortar 1:3 (1 cement : 3coarse sand) in line and levels as per drg. The joints shall be grouted with cement mortar 1:3 (1 cement : 3coarse sand) complete.

24. ROAD MARKING & ROAD SIGNAGES

Road marking & road signages would be done as per drawing and as directed by Architect/Project Manager.

BOUNDARY WALL

1. 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.

2. 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/ CGEWHO after getting the layout of the plot approved from the local authorities.

3. 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 detailed specifications for earth filling, plinth filling, RCC, brick work, DPC, steel and iron work;plaster, cement base paint, painting and other finishing shall be as specified herein before.

4. M.S. RAILING OVER BOUNDARY WALL

M.S. railing on boundary wall shall be fabricated out of M.S. angle,M.S. square bars. M.S. flat iron and MS hollow pipe with spikes fabricated out 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.

5. MAIN GATE

Steel gate shall be of ornamental pattern and shall be fabricated and wedded out of M.S. flat M.S. sq. bars, flower leaves cut and fabricated out of M.S. sheets, M.S. tubes, M.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 coasts 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 and provision of gate lights is included in the scope of the item.

6. WELDING

This shall be done by electric are process as specified herein before.

7. 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/ CGEWHO shall be provided in the boundary wall to serve as weep holes.

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 CGEWHO. It will 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.

DOOB GRASS

Grass shall be fresh DOOB Grass from weed, rank vegetation but having 'Rhizomes' with sufficient nodes and shall be approved by the Architect/ CGEWHO.

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. SPREDING 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.

SECTION – H WATER TREATMENT PLANT (WTP)

TEMPORARY WATER TREATMENT PLANT FOR CONSTRUCTION PURPOSE

It is mandatory that the vendor will install a water treatment plant to generate potable water matching all quality parameters good for construction as mentioned below: -

PH (HYDROGEN ION CONCENTRATION)		6.5 – 8.5
TURBIDITY (SCALE)		2.50 - 10
TOTAL DISSOLVE SOLID	mg/lit	500 - 1500
TOTAL HARDNESS AS CaCo3	mg/lit	200 – 600
CHLORIDES AS chlorides	mg/lit	200 – 400
SULPHATES AS So4	mg/lit	200 – 400
NITRATES AS No3	mg/lit	45 – 50
CALCIUM AS Cal	mg/lit	75 – 200
MAGNASIUM AS Mg	mg/lit	30 - 150